EFFECTS OF GAME AND POEM-ENHANCED INSTRUCTIONAL STRATEGIES ON PUPILS' LEARNING OUTCOMES IN MATHEMATICS IN BAYELSA STATE, NIGERIA

BY

Toinpere Mercy FREDERICK-JONAH
B.Ed.(Hons) Mathematics (Port-Harcourt), M.Ed. Mathematics Education (Ibadan)
Matric No: 124195

A Thesis in the Department of Teacher Education,
Submitted to the Faculty of Education
In partial fulfillment of the requirements for the Degree of

DOCTOR OF PHILOSOPHY
of the

UNIVERSITY OF IBADAN

SEPTEMBER, 2014

ABSTRACT

Mathematics is a core and compulsory school subject from primary through the senior secondary school level. Reports from examination bodies have shown that the mean score of Bayelsa State pupils' achievement in mathematics is below average. This has been attributed to the lecture instructional strategy being adopted by the teachers of the subject. Therefore, game- and poem-enhanced instructional strategies have been recommended to improve mathematics instruction at the primary school level but few studies have been carried out to determine the effectiveness of these strategies. Therefore, this study, determined the effects of game- and poem-enhanced instructional strategies on pupils' achievement, knowledge of mathematics concepts and interest in mathematics. The moderating effects of verbal ability and gender were also determined.

A pretest-posttest, control group, quasi-experimental design with 3x3x2 factorial matrix was adopted. Three hundred and forty-four primary six pupils from twelve purposively selected public schools in Yenagoa and Ogbia Local Government Areas of Bayelsa State were randomly assigned to two treatments and control groups. The study lasted for twelve weeks. The instruments used were two teachers' assessment sheets, instructional guides on Poem-Enhanced Instructional Strategy (PEIS) and Game-Enhanced Instructional Strategy (GEIS) for the experimental groups and Modified Lecture Instructional Strategy (MLIS) for control groups, Pupils' Mathematics Achievement Test (r=0.72), Pupils' Mathematics Concepts Test (r=0.81), Pupils' Interest in Mathematics Inventory (r=0.73) and Pupils' Verbal Ability Test (r=0.85). Seven null hypotheses were tested at 0.05 level of significance. Data were analysed using Analysis of Covariance (ANCOVA) and Scheffe Post-hoc analysis.

Treatment had significant main effect on pupils' achievement in mathematics ($F_{(2,325)}$= 142.473; η^2=0.467), knowledge of mathematics concepts ($F_{(2,325)}$=81.115; η^2=0.333) and interest in mathematics ($F_{(2,325)}$=163.003; η^2=0.501). GEIS group performed better on achievement in mathematics ($\bar{x}$=17.42) than PEIS group ($\bar{x}$=16.40) and MLIS groups ($\bar{x}$=12.91). The PEIS had higher posttest mean score on pupils' knowledge of mathematics concepts ($\bar{x}$=14.43) than GEIS ($\bar{x}$= 13.44) and MLIS group ($\bar{x}$=10.57). Also, PEIS had higher posttest mean score on interest in mathematics ($\bar{x}$=15.36) than

GEIS group ($\bar{x}$=14.41) and MLIS ($\bar{x}$=10.77) groups. Verbal ability had significant main effect on pupils' achievement in mathematics ($F_{(2,325)}$=35.939; η^2=0.181), knowledge of mathematics concepts $F_{(2,325)}$=5.777; η^2=0.034) and interest in mathemat ics ($F_{(2, 325)}$=19.320; η^2=0.106). The posttest mean scores on pupils' achievement in mathematics by verbal ability were high ($\bar{x}$=16.80), medium ($\bar{x}$=15.99) and low ($\bar{x}$=13.95). Similarly, the posttest mean scores on pupils' knowledge of mathematics concepts by verbal ability were high ($\bar{x}$=13.58), medium ($\bar{x}$=12.80) and low ($\bar{x}$=12.06). Also, the posttest mean scores on pupils' interest in mathematics by verbal ability were high ($\bar{x}$=14.26), medium ($\bar{x}$=13.76) and low ($\bar{x}$=12.52). There was significant interaction effect of treatment and verbal ability on pupils' knowledge of mathematics concepts ($F_{(4, 325)}$=2.731; η^2=0.033).

Game-enhanced instructional strategy is most effective in improving pupils' achievement in mathematics, while poem-enhanced instructional strategy is most effective in improving pupils' knowledge of mathematics concepts and interest in mathematics. Primary school teachers and curriculum developers should adopt these strategies to improve pupils' learning outcomes in mathematics.

Keywords: Game-enhanced instructional strategy, Poem-enhanced instructional strategy, mathematics learning outcomes

Word count: 489

ACKNOWLEDGEMENTS

I give you thanks, Jehovah, the Almighty God, the giver of life, wisdom and opportunity, the one who brought to pass what I thought, I could not attain in life. May you, Jehovah, receive the praise, the honour and the glory, for you have done it.

My heartfelt gratitude goes to my supervisor, Prof. M.K Akinsola, for his fatherly disposition to me. His particular interest in my progress was demonstrated by painstakingly going through my work promptly. His words of encouragement and outlook provided the much needed impetus to forge ahead. He is a man; God has used to prepare my table for me that I may eat for the remaining part of my life on earth. May the true God Jehovah, the Almighty, abundantly bless you and your household in everything. May God give you long life to enjoy all the blessings bestowed upon you (Amen).

I cannot forget the immense contribution of Dr. Ayotola Aremu, who selflessly contributed her professional knowledge to this work as it were a co-supervisor. Such a kind gesture is difficult to find in these last days. You are truly a friend in time of need and a role model to me. May the God of heaven who has the ability to see the heart desires of every man, abundantly bless you and your household (Amen).

My profound appreciation also goes to my external examiner, Prof. M. F. Salman and the internal-external examiner, Dr. D. O. A. Ajayi. Their inputs in this work, which were given promptly, sped up this work to success. May God give you added blessings.

This piece of work would not have been completed without the constant interest of various lecturers who were like fathers, mothers and friends in the department who would always ask, “How is your work?”, and read it to make their various professional inputs. Worthy of note is the Head of Department, Prof. S.A. Adesoji; the sub-dean, Dr K. O. Kester; Prof. A. Olagunju; Prof. A. Abimbade; Prof. J.O. Ajiboye; Prof. S.O.Salami; Dr. D.O. Fakeye; Dr. P.A. Amosun; Dr. F.O. Ezeokoli; Dr. B. Lawal; Dr. Olusegun Akinbote; Dr. A. Tella; Dr T. Ige and Dr. A. Salami. I also extend my appreciation to the following lecturers in the other departments; Dr M.A. Odeniyi; Dr M.N. Odinko; Dr. P. Abu; Dr. B.A. Adegoke; Dr. S.A. Odebumi; Dr. Yara; Dr. A.B. Sunday of the University of Ibadan. My dear colleagues, Dr. D. Okodoko; Dr. T. Victor; Dr. Alade, Dr. A.O. Ogundiwin; Mr. O. Israel; Mr. F. Areelu. Mr. E . O. Odeyemi; Mr. T. Ajani; Mr. W. Samson, Mrs. J. N.

Chukwunenye and Abraham Josephine are appreciated. May the good God bless your efforts.

I also appreciate the past and present vice-chancellors, registrars, deans of faculty, heads of department, colleagues and the entire staff of the Niger Delta University for their support during my absence from the University. I say big thank you to everyone.

Who will I send and who will go for me? They were Messrs Tamaraulayefa. A. Singabele and Jeremiah Patrick Zidougha who designed and produced the mathematical games and photocopies of the instruments at an affordable price. They also went round with me to the various schools to take the photographs of the experiments. They were always available to be used. God should give you a fruitful life.

I am also grateful to the head teachers, research assistants, pupils of various schools involved in the study. Their assistance made this research a success. I appreciate everyone. May God bless you all.

I am also indebted to my parents, Mr. Reuben Frederick and Mrs. Change Frederick, for their encouragement and prayers. May you live long to enjoy the fruit of your labour. Also my brothers, sisters and wards especially Miss Taribimini Solomon, who cared for my children, though a child, yet like a mother in my absence. No wonder, my last child of less than four years of age called her “mother of mothers.” May Jehovah, your God, abundantly bless you. Let other people serve you more than the way you have served me (Amen).

Finally, my deepest gratitude goes to my dear husband, Mr. C.N. Jonah, who married me as a young girl in the secondary school and continued to be beside me, coping with my absence in the family for months without being distracted. Your encouragement, prayers, emotional and financial support to ensure that I attain this academic height has made me to further trust you and confirm the true love you have for me. A man like you, who did not turn me to a full house wife in my tender age of marriage, is very rare. I cannot pay you back, but may Jehovah our God help me to humbly give you deep respect, cherish and unify my heart to always love you.

I will not forget to appreciate my children, Epretari, Miepredei, Ebimoweni, Nimiyefagha and, especially, Edubamodei Jonah, who forfeited his motherly care and love in his early months on this earth. Despite all these, he has always expressed the

love he has for me as he learns to speak, "mummy, I very so much love you. I will buy you a jeep." I dearly love you all. May Jehovah our God, abundantly bless us.

Also, I express my appreciation to all those who contributed to the success of this work in one way or the other that are not mentioned. The true God will bless you all.

Toinpere Mercy Frederick-Jonah

September, 2014

CERTIFICATION

I certify that this work was carried out by Mrs. T. M. Frederick-Jonah in the Department of Teacher Education, University of Ibadan, Nigeria.

……………………………………………………

Supervisor

PROF. M.K. AKINSOLA,

NCE (Abeokuta), B.Sc (Ed) (Hons) Lagos, M.Ed., Ph.D. (Ibadan)

(Mathematics Education),

Department of Teacher Education,

Faculty of Education,

University of Ibadan, Nigeria

DEDICATION

This research work is dedicated to **Jehovah, the Almighty God.**

TABLE OF CONTENTS

CHAPTER FIVE

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Primary education is the foundation of Nigeria educational system. Primary school education is the education given in institutions for children aged 6 - 12 years (Federal Republic of Nigeria, 2013). It is the foundation of every educational programme. In describing the importance of this level of education, Etukudo (2000) and Iji (2010) stated that primary school education forms the stepping stone for other levels of education and human activities. Maduagwu (2002) described it as a springboard for other levels of education. Koligili, Tumba and Zira (2007) and Kurumeh and Imoko (2008) view it as the foundation and bedrock of the Nigerian education system as well as the first step of Universal Basic Education (UBE). A firm foundation at the primary school level is pivotal to a robust educational system (Osinubi, 2004). This is because the primary education level is the key to the success and failure of the whole educational edifice; for the rest of the educational levels are built upon it (Adesina, 2011).

It is because of this great importance of primary education that the present democratic government in Nigeria has revisited the issue of free basic education, so that every child can have access to education by the year 2015 in accordance with the goal for Education For All (EFA). To Okpala (2006), this is aimed at equipping learners with skills of literacy, numeracy, problem-solving as well as functional knowledge, attitude and generative skills as determined by the environment, that is the educational opportunities designed by each member country.

The first two objectives of primary education are clearly stated in the National Policy on Education (Federal Republic of Nigeria, 2013) as: inculcating permanent literacy and numeracy, and the ability to communicate effectively; and laying a sound basis for scientific and reflective thinking. The inculcation of permanent numeracy stresses the need for every child to be mathematically literate at the primary school level (Iji, 2008). The National Policy on Education (Federal

Republic of Nigeria, 2013) states that the mathematical development of the child cannot be ignored at the primary school level. In line with this recognition, Nurudeen (2007) avers that, if Mathematics is properly taught at the primary school level, there will be improved achievement in the subject at other levels of education. Kankia (2008) gives a clearer reason to this position by stating that Mathematics curricula content are sequential and spiral in nature. This implies that adequate understanding of Mathematics concepts at the primary school level would improve achievement at other levels of education.

Adesina (2011) claims, that primary education has significant impact on Nigeria's social, economic and political development. Primary education is perceived as having significant impact on the attainment of the Nigeria's vision 20:2020. The lingering problems of under-achievement in secondary and tertiary institutions in Nigeria are traceable to the poor and shaky foundation laid at the primary school level. Salman (2009) avers that, the primary education needs to be given adequate attention. Mathematics and other science-related subjects need urgent attention for a country like Nigeria that is aspiring for scientific and technological advancement. Thus, improving the teaching and learning of Mathematics at the primary school level is imperative.

Mathematics has been applied by various researchers, engineers and mathematicians according to their needs. The different ways many people see Mathematics at different times indicate how important or indispensable Mathematics is in today's modern world. Some try to show its elegance, precision, beauty and brevity; others show its structure and the training it provides (Ibrahim, 2004). Obodo (2000) conceptualised Mathematics as a system of sounds, words and patterns for communicating mathematical ideas. In the same vein, Harbor-Peters (2000) sees Mathematics as a culture and as well as an art. As a culture, Mathematics affords man the opportunity to know and access things and objects within his immediate and remote environment. As an art, the beauty of Mathematics is exhibited in the process where chaos of isolated facts is transformed into logical order.

Mathematics plays a vital role in the achievement of the primary school objectives, particularly science and technology and science-related disciplines, for it is the language used in expressing them. Ukeje in Aguele and Usman (2007) asserts that, without Mathematics, there is no science, without science, there is no modern technology, and without modern technology, there is no modern society. This implies that Mathematics is the precursor and the queen of science and technology and the indispensible single element in modern societal development. Also, Mathematics is a core and compulsory school subject in the curricula from primary to junior secondary and to the senior secondary school levels of the Nigeria educational system (Abubakar and Bawa, 2006; Aguele and Usman 2007; Kurumeh and Imoko, 2008). Mathematics is also applied in agriculture, sports, business, medicine, transportation, public utility, communication and others (Kolawole and Oluwatayo, 2006; Iji, 2008). Further, Mathematics is important for the development of critical thinking (Agwagah, 2005).

Mathematics is an important school subject; it is also important in every activity of man. It is expected that students' achievement at all levels would be good. However, Olayinka (2006) describes the state of mathematics education in Nigeria as depressing; implying that students' achievements in Mathematics at the primary, junior and senior secondary and tertiary levels are poor. Also, Bassey, Joshua and Asim (2009) note that academic achievement of students in mathematics education is still low, both in certificate and non-certificate examinations. For example, Azuka (2008) reports poor achievement of pupils in Mathematics in both internal and external examinations; Kurumeh and Imoko (2008) also express dismay in marking the pupils' scripts during Common Entrance Examination and Primary School Mathematics Olympaid because of the poor achievement of pupils' in Mathematics in these examinations.

Recent research findings in Nigeria have shown that the performance of pupils in primary Mathematics is below average and also that the problem-solving skills of the pupils are poor. In the report of Education Sector Analysis (ESA, 2004) carried out in Nigeria, the national mean percentage scores of primary four and primary six pupils in numeracy were 33.7 and 35.7, respectively. Table 1.1 presents the detailed information about the performance of the pupils across the nation in 2004.

Table 1.1. Percentage performance in numeracy test by State (including Abuja) and class

S/N	STATE	PRY IV % pass	PRY VI % pass	S/N	STATE	PRY IV % pass	PRY VI % pass
1	ABIA	27.63	-	20	KANO	36.51	35.71
2	ABUJA	28.33	37.67	21	KATSINA	29.85	27.64
3	ADAMAWA	22.93	27.32	22	KEBBI	41.43	45.54
4	AKIWABOM	28.29	27.7	23	KOGI	32.2	36.55
5	ANAMBRA	31.04	39.24	24	KWARA	32.59	-
6	BAUCHI	45.5	35.33	25	LAGOS	32.54	37.76
7	BAYELSA	22.61	43.12	26	NASARAWA	25.4	25.39
8	BENUE	40.78	54.82	27	NIGER	32.65	31.57
9	BORNO	19.32	20.85	28	OGUN	49.27	46.51
10	C/RIVERS	34.4	31.42	29	ONDO	35.03	33.09
11	DELTA	30.46	22.48	30	OSUN	32.4	28.96
12	EBONYI	20.21	22.48	31	OYO	36.41	41.65
13	EDO	33.64	28.64	32	PLATEAU	29.11	29.24
14	EKITI	35.63	39.67	33	RIVERS	-	27.78
15	ENUGU	48.8	38.72	34	SOKOTO	27.77	30.91
16	GOMBE	36.71	34.68	35	TARABA	45.15	44.73
17	IMO	26.32	30.58	36	YOBE	39.28	40.67
18	JIGAWA	46.35	45.07	37	ZAMFARA	33.17	34.35
19	KADUNA	47.75	48.31				

SOURCE: Education Sector Analysis (ESA, 2004), Nigeria

Table 1.1 shows that primary 4 pupils in Ogun State had the highest mean percent score of 49.27, while pupils in Borno State had the lowest mean percent score of 19.32. Primary 6 pupils in Benue State had the highest mean percent score of 54.82, while primary 6 pupils in Delta and Ebonyi States had the lowest mean percent score of 22.48. Similarly, the final report by the National Assessment of Universal Basic Education Programme (NAUBEP, 2009) shows that the national mean score for primary six pupils in Mathematics was 42.87(see appendix 8).

In Bayelsa State, primary 4 and primary 6 pupils had 22.61 and 43.12 mean percent scores, respectively. This clearly shows that neither the state mean score nor the national mean score was up to credit level in primary mathematics. Primary six pupils from other zones of Nigeria (for example, South West and South East) need a minimum of 75% pass in Mathematics and in English Language in Common Entrance Examinations into Federal Government Colleges. Most states in the Niger Delta region, for example Bayelsa State, need as low as 55% (National Examination Examiner's Report, 2008). It is obvious that achievement of primary school pupils in Mathematics is poor.

Kurumeh and Imoko (2008) further report that the teachers who mark Junior Secondary School WAEC also complain of the poor achievement of the students in all state examinations in Mathematics. This Mathematics foundation which is very weak at the primary school level is carried to the junior secondary school and then to the senior secondary school level. This is in agreement with what Ebisine (2010) expresses: there has been a loud outcry against the frustrating achievement of secondary school students in Mathematics. Countless research works affirm the state of poor achievement in Mathematics at all levels of education (for instance, Agwagah, 1996; Ukeje, 1997; STAN, 2000; Apex, 2002; Obiniyi, 2005; Maduabum and Odili, 2006; Aburime, 2007). This reveals that poor achievement in Mathematics by students has existed for long.

The problem of students' poor achievement in Mathematics in both internal and external examinations has been reported by mathematics educators, mathematicians and examination bodies. For instance, Kurumeh (2006) observes that students have great difficulty in understanding, comprehending, and assimilating Mathematics taught to them in the classroom. So they resort to learning by rote, resulting in consistent mass failure of students. Uwadia (2009), cited in Dahiru (2010), views inadequate coverage of syllabus, inadequate facilities for teaching, students' poor attitude to study, and heavy workload on teachers as causes of poor achievement in Mathematics. In his comments on the results of 2006 Common Entrance Examination in Amao (2010), the Chief Examiner noted that the majority of public primary school pupils did not do well because they could not simply make out anything of what teachers taught because of their inability to understand the language of instruction. The Chief Examiner's Report of WAEC (2009) notes that poor achievement of students in Mathematics is caused by poor language skills and expression, insufficient preparation, misinterpretation of questions, inadequate technical competence and poor hand writing.

Other factors responsible for the poor achievement of students in Mathematics include poor background laid at the primary school level of education (Amazigo, 2002; Etukudo, 2006; Kurumeh and Imoko, 2008); lack of interest, lack of conducive learning environment, phobia and dislike of Mathematics (Olayinka, 2006; Kurumeh, 2007; Onwuka, Iweka and Moseri, 2010), poor reasoning ability and problem-solving (National Council of Teachers of Mathematics NCTM, 2000; Olkun and Toluk, 2005); teacher factor (Darling-Hammond, 2000; Ojo, 2008). Alio (1997), quoted in Nurudeen (2007), views teachers' strategy of presenting problem-solving as contributing factor to high failure rate in Mathematics.

Many studies have identified mainly the teachers' strategy of teaching as the major factor contributing to poor achievement of students in Mathematics. For instance, Salman (2009) attributes the perennial low achievement of Nigerian pupils in Mathematics to inadequate knowledge of the subject matter content by teachers and poor instructional techniques and calls for imparting adequate knowledge of mathematics to pupils through the use of effective instructional techniques. Anaduaka (2011) states that the errors students make are largely as a result of deficits in the teachers' teaching strategies. Also, the WAEC Chief Examiner's Report (2001), Harbor-Peters (2001), Badmus (2002), Okoli (2006), Eze (2008), and Iji (2010) have all found teaching strategy as the major cause of poor achievement of students in Mathematics at all levels of education. The strategies adopted by the teachers do not sustain the development of students' interest in Mathematics. This is also one of the major causes of poor achievement in Mathematics (Agwagah, 2005).

The lecture instructional strategy for example is a strategy in which the teacher presents a verbal discourse on a particular subject, theme or concept to the learners while the learners are passive listeners. The teachers deliver preplanned lessons to the students with little or no instructional aids (Okoli, 2006). The lecture instructional strategy pays more attention to teachers. The teacher begins the class by reviewing, then teaches the new lesson, and finally gives a take-home assignment. It is boring for students and diminishes students' interest in Mathematics because the students' only job in the classroom is to passively sit and watch the teacher solve mathematics exercises or problems on the chalk board and then copy what the teacher did (Peng, 2002). Also, Adesoji (2004) lists some reasons why teachers refuse to change from the lecture instructional strategy. Such reasons include lack of infrastructural facilities, overloaded curriculum and lack of training programmes/workshops for teachers. The lecture instructional strategy used in teaching Mathematics can thus be described as an authoritarian form of teaching by the teacher (Agwagah, 2005). It is also described as one that does not sustain the development of pupils' interest in Mathematics (Agwagah, 2004) and poorly develops learners' cognitive, psychomotor and affective structures (Kankia, 2008).

A study of 59 public schools purposively sampled and four schools randomly selected for the study on lecture instructional strategy in a Mathematics class in Kenya revealed that teacher-pupil classroom interaction activities in the lower classes were not exploited to the full because the teachers did not involve all the pupils during classroom interaction. For instance, teachers rushed over lessons, interacting only with bright pupils ignoring weaker and slow learners; did all the work on the chalkboard; avoided group work which promotes pupil-pupil interaction; and did not demonstrate any skill (Majanga, Nasongo and Sylvia, 2011). Hence, there is the urgent need to enhance the lecture instructional strategy with some activities that provide for the pupils' active participation in the classroom.

The effective activities recommended for the primary school level include the use of games to enhance greater understanding of concepts (Aremu, 1998; Agwagah, 2001), creating a creative corner for less capable pupils in Mathematics who may be good at arts or writing, which involves activities, such as poetry or stories about mathematical situations and geometric drawings (Ojo, 2008; Albool, 2012). Iji (2007) also recommends exhibition of poems to teachers at the primary school level. Ohuche (1990) suggests providing adequate opportunities for manipulation of materials accompanied by verbalization of materials as well as conceptualisation by means of discovery. Therefore, this study examined the effects of poem- and game-enhanced instructional strategies on pupils' learning outcomes in Mathematics.

Poetry has vital roles to play in children learning. Owen (2010) states that memorizing poetry increases child's cognitive ability, for poems present language in more ordered and rhythmical ways than prose. These techniques increase a child's ability to reason, imagine, think, argue and experience the world in sensory and aesthetic ways. Through memorization of poetry, a child's mental capacity is exercised and thus increases in flexibility and strength.

Poetry offer Mathematics students, new means to explore the recondite realm of abstract mathematical concepts, improving cognitive understanding and confidence (Bahls, 2009). Mathematics is not just all about calculations; it is beyond calculation (Agwagah, 2008). 'There is a great and growing body of linguistic and visual metaphors that constitute a healthy understanding of mathematics in which things called fields, rings, bundles and flows play dominant roles; mastery of these concepts often involves creativity more readily expected of a poet than of a scientist' (Bahls, 2009: 76). Students' cognitive understanding of mathematical terminology and symbolism, and confidence in carrying out computation and other mathematical tasks are key coordinates of success in learning Mathematics (Bahls, 2009).

Both poetry and Mathematics deals with images, ideas and metaphors. Metaphors are the currency with which poetic trade takes place, and Mathematics has the same metaphors both metaphors, alive such as spheres, balls, sinks, lattices, chains, sheaves, itineraries and distances; and dead metaphors, such as calculate, to do algebra, and to factorize. By using poetical metaphors, students become more aware of these and other mathematical metaphors and thereby gain deeper understanding of mathematical concepts that those metaphors describe. This new form of mathematical cognition is made possible through poetry (Bahls, 2009).

The other activity that can be used to enhance mathematics instruction is the use of games. A game is a type of play that follows a set of rules, aims at a definite goal or outcome and involves competition against other players or against barriers imposed by nature of the game (Agwagah, 2001). A mathematical game is a game with the course of the game having mathematical structure or consideration (Onwuka, Iweka, and Moseri, 2010).

Dalton (2007: p3), quoting Bright et al. (1985: p5) lists seven elements of games

1. A game is freely engaged in.
2. A game is a challenge against a task or an opponent.
3. A game is governed by a definite set of rules. The rules describe all the procedures for playing the game, including goals sought; in particular, the rules are structured so that once a player's turn comes to an end, that player

is not permitted to retract or to exchange for another move made during that turn.

4. Psychologically, a game is an arbitrary situation clearly delimited in time and space from real-life activity.
5. Socially, the events of the game situation are considered in and of themselves to be of minimal importance.
6. A game has a finite state-space. The exact states reached during play of the game are not known prior to the beginning of play.
7. A game ends after a finite number of moves within the state-space.

Games play vital roles in mathematics instruction. The use of games in teaching Mathematics makes students to be actively involved in the daily lessons since they are interested in learning mathematics as game (Abubakar and Bawa, 2006). Games relax tension, clear boredom and foster an environment where teaching and learning are pleasant, interesting, exciting, stimulating, motivating and academically rewarding (Kankia, 2008). Games provide unique opportunity for integrating the cognitive, affective, and social aspects of learning (Azuka, 2002).

Many studies have been carried out on mathematical games, with positive results. Ugwuangi (2002) used game and simulation to generate students' interest on Sequence and Series. Dotun (2005) used ladder and tunnel game to teach algebraic expression. Okigbo (2008) employed card games to teach Percentages, Fractions and Decimals in secondary schools; Aremu (1998) used card and geoboard-based games as instructional strategies on primary school pupils' achievement in practical geometry. The achievement of students in all the experimental groups was better than that of the control groups.

Many types of games have been developed and used by researchers and mathematics educators to enhance learning mathematics in the primary, junior and senior secondary schools. Onwuka et al. (2010) enumerate some games for teaching Number and Numeration, Algebra, Geometry, Mensuration, Trigonometry and Statistics, which are particularly useful for both primary and junior secondary schools. They are

(a) Coordinate points game used, for identifying and locating coordinate points
(b) Geoboard games, for identifying and calculating angles, to identify and represent geometric shapes and also calculate areas of geometrical shapes.
(c) Card games, for solving linear equations and for geometrical shapes.

(d) Ludo game, for probability concepts.

(e) Identificator game.

(f) Factor card game.

(g) Phythagorean triple game.

Agwagah (2001) also developed different types of games for the primary school, like matchob, number race, odd-even card game, secret factor, and equation card game. She mostly developed these games for the lower basic classes. The National Mathematical Centre (NMC, 2002) Abuja developed different games on different topics in Mathematics for the secondary school level, for example, fraction grid, equation whot, mathematics circle race, geometry and statistics vocabulary, mathematics palace game and plane figure card game.

The knowledge of mathematics concepts is the main outcome of any mathematics instruction process. Mathematics concepts are the mathematics words, principles, symbols, formulae and expressions understood in the context of Mathematics. In other words, they mean the language of Mathematics. Language is a way of expressing ideas and feelings using symbols, sounds, movement or rules (Olokun, 2005). The language of Mathematics thus refers to the set of mathematics words, symbols and expressions which are understood in the context of mathematics (Binda, 2006).

The knowledge of mathematics concepts is prerequisite to any meaningful mathematics instruction. The ability of students to use mathematical operations to simplify or solve problems depends on a good grasp of the language of Mathematics (Obioma, 2005; Gershon, Guwal and Awuya, 2008). A student who does not know what the term factorize means will have no business with the instruction to factorize the expression $Cd^2 + C^2d + Cd^2$. A good knowledge of concepts is then the key to learning Mathematics, especially topics like word problems which cut across all topics in Mathematics (Nnaji, 2005).

The failure of many children to understand basic mathematics concepts at a very early stage makes them to fare poorly in Mathematics (Kwok, 2009). The main objective of Mathematics learning at the primary school level is to develop in the pupils the power of reason, power to solve problems and to find responses that are novel to their experiences (Hogan, 2005). This is dependent on pupils' knowledge and understanding of mathematics concepts and their meanings. Olokun (2005) observes that symbolic language is another area students have to master in

Mathematics. They must learn symbols for operations, relational symbols (> and <); and the meanings of parentheses and brackets. This will enhance problem-solving which is the highest level of learning that will be achieved. Therefore, in this research, knowledge of mathematics concepts was taken as a dependent variable.

In order to achieve good performance in Mathematics, the interest and attitudes of students towards Mathematics need to be developed and properly harnessed right from the primary school level; this is where the solid foundation for the subject is laid (Ekine, 2010). When students generate interest in mathematics lesson and excitement about it, half of the students' problems in Mathematics are solved (Kankia, 2008). Interest is a condition for learning Mathematics and there can be no real mathematics education without interest in Mathematics (Udegbe, 2009). Several studies show a positive relationship between interest and achievement in Mathematics (Eccles, Denissen and Zarret, 2007).

Obodo (1997) and Azuka (2002) observe that students in Nigeria have poor interest in Mathematics and Mathematics related-disciplines at all levels of education. The resultant effect of all the problems of mathematics teaching and learning is that a large pool of students express lack of interest in Mathematics at all levels of the educational system and mathematics educators are of the opinion that the development of students' interest in Mathematics should be a goal for mathematics teaching and learning (Anaduaka, 2011). Sotinu (2007), cited in Ekine (2010), observes that pupils' interest in science declines as they progress from the primary schools to their secondary school years as their performance in science subjects seems to take a decline as they progress in class. Also, Udegbe (2009) affirms that the students' poor interest in Mathematics is responsible for their poor achievement in both external and internal Mathematics examinations which increase students' hatred and phobia for Mathematics and mathematics-related courses.

The low interest of students in Mathematics emanates from anxiety and fear, and this is expressed from their faces in Mathematics classes (Okigbo and Okeke, 2011). Another cause of poor interest in Mathematics is the teacher's strategy of teaching Mathematics, which does not sustain the development of interest in Mathematics among others (Agwagah, 2005). The WAEC Chief Examiner's Report (2009) suggests that teachers should help students improve their achievement and develop interest in Mathematics by reducing the abstractness of Mathematics and removing their apathy and fears of the subject.

There are other factors, such as verbal ability and gender, which may have effect on the teaching and learning process, especially in Mathematics. Whetton (1994), cited in Komolafe (2010), defines verbal ability as a group intelligence tests which are largely verbal, designed to provide overall measure of scholastic ability used in an educational context. Researchers have documented the fact that students' verbal ability significantly influences their performance on standardized achievement tests (Maduabuchi, 2002; Fakeye, 2006). Awofala, Balogun and Olagunju (2011) state that exploring the influence of verbal ability and cognitive style on Mathematics achievement only began in recent years. Poetry is highly loaded with connotations and figurative language, which requires a reasonable level of verbal ability for students' competence. This study found the moderating effects of pupils of varying levels of verbal ability on learning outcomes in Mathematics.

The effect of gender on learning outcomes of Mathematics and science-related subjects are still a major controversy among educators. This may be as result of conflicting results from such gender-related studies. Some studies found significant differences in favour of boys, a few in favour of girls, while others are neutral. Alio and Harbor-Peters (2001), Juhun and Momoh (2002), Onasanya (2008), and Shafi and Areelu (2010) found significant differences in favour of boys. Eniayeju (2010) found that girls achieved significantly better in all tests in the cooperative groups. Salau (2001), Etukudo (2002), Galadima and Yusha (2007), Bawa and Abubakar (2008), and Ebisine (2010) found no significant difference in the achievement of male and female students in their various studies. This inconsistency in the test achievement of boys and girls need to be further investigated in the use of poems and games to enhance mathematics instruction at the primary school level.

The choice of gender as a variable was also necessitated by the current world trend and research emphasis on gender issues following the millennium declaration of September, 2000 (United Nations, 2000) which has as its goal, the promotion of gender equity, the empowerment of women and elimination of gender inequality in basic and secondary education by 2005 and at all levels by 2015 (Bassey et al., 2009). The need to ensure the achievement of this goal in school Mathematics at the primary school level and in Nigeria, in order to provide pertinent information on the level of achievement of both boys and girls and needed action to be taken also justify the inclusion of this variable in this study.

1.2 Statement of the problem

Mathematics plays a significant role in virtually all activities of man, especially in this modern age of science and technology. Its demand is, therefore, at a premium position. Yet students' achievement in Mathematics at all levels of education is poor. The available literature shows that pupils' poor achievement in Mathematics is due to a number of factors, especially those related to the strategies used for teaching mathematics. The lecture instructional strategy, which is predominantly used by teachers, might have contributed to under-achievement in Mathematics at various levels of education. Some other factors that might have contributed to under-achievement in Mathematics include lack of interest in Mathematics, low understanding of mathematics concepts, and so on. Game and poem are recommended to solve the problems of teaching Mathematics at the primary school level. However, most studies on game in teaching Mathematics were carried out at the secondary school level. Also, game was used with other strategies, such as game and simulation; game and analogy; or two distinct games, like ladder and tunnel games, card and geoboard-based games, to determine the most effective strategy. Therefore, this study determined the effects of game and poem-enhanced instructional strategies on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics. The study also determined the moderating effects of verbal ability and gender on the dependent variables.

1.3 Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

$H0_1$ There is no significant main effect of treatment on pupils'

(i) achievement in Mathematics

(ii) knowledge of mathematics concepts

(iii) interest in Mathematics.

$H0_2$ There is no significant main effect of verbal ability on pupils'

(i) achievement in Mathematics

(ii) knowledge of mathematics concepts

(iii) interest in Mathematics.

$H0_3$ There is no significant main effect of gender on pupils'

(i) achievement in Mathematics

(ii) knowledge of mathematics concepts

(iii) interest in Mathematics.

$H0_4$ There is no significant interaction effect of treatment and verbal ability on pupils'

(i) achievement in Mathematics

(ii) knowledge of mathematics concepts

(iii) interest in Mathematics.

$H0_5$ There is no significant interaction effect of treatment and gender on pupils'

(i) achievement in Mathematics

(ii) knowledge of mathematics concepts

(iii) interest in Mathematics.

$H0_6$ There is no significant interaction effect of verbal ability and gender on pupils'

(i) achievement in Mathematics

(ii) knowledge of mathematics concepts

(iii) interest in Mathematics.

$H0_7$ There is no significant interaction effect of treatment, verbal ability and gender on pupils'

(i) achievement in Mathematics

(ii) knowledge of mathematics concepts

(iii) interest in Mathematics.

1.4 Scope of the study

The study covered primary six pupils in twelve public primary schools in Ogbia and Yenagoa Local Government Areas of Bayelsa State, Nigeria. The study examined the effects of poem and game-enhanced instructional strategies on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics. It also determined the moderating effects of verbal ability and gender on the dependent variables. The content scope included fraction and decimal (addition, subtraction, multiplication and division), volume, capacity, weight, 2 and 3-dimensional figures. These are topics in the primary Mathematics curriculum listed for primary six pupils.

1.5 Significance of the study

The findings of this study would provide empirical evidence on the effectiveness of using poem and game-enhanced instructional strategies in teaching the listed topics in Mathematics in Nigeria among teachers at the primary school level. It would also give insight to teachers in the choice of the most appropriate strategies and activities to enhance the lecture instructional strategy usually applied in the classroom to make it enjoyable, active, and free from the passivity and boredom usually used to describe the lecture instructional strategy. This would aid engaging both science and arts-oriented pupils actively in a mathematics classroom.

The study would also provide evidence that would give direction to authors of Mathematics text-books. Thus, they can write books on mathematical poems and mathematical games thereby giving aesthetic appeal and meaningfulness to the text, reducing abstractness of text, widening the range of mathematical books and attracting more sales.

The study would also provide useful information to mathematics educators, curriculum developers in Mathematics and government agencies in the area of recommending enrichment activities while teaching science and arts-oriented students in Mathematics. The larger society would also benefit from the advancement of science and technology through the improved achievement of students in Mathematics.

1.6 Operational definitions of terms

Achievement in Mathematics: This is the score obtained by pupils from the Pupils' Mathematics Achievement Test (PMAT) based on the content covered in the Mathematics curriculum taught using game and poem-enhanced instructional strategies and modified lecture instructional strategy.

Games: These are card games in which the structure of the games is purely mathematical, with definite rules and procedures which pupils play as competitive enjoyable enrichment activities to enhance mathematics instruction which focus on the concepts covered in this study.

Gender: This refers to the male or female pupils in the primary schools.

Interest in Mathematics: This is the likeness or dislike shown by pupils in mathematics class, mathematics-related issues, and in Mathematics as a subject.

Knowledge of Mathematics Concepts: This is the score obtained by pupils from the Pupils' Mathematics Concepts Test (PMCT). The concepts are the mathematical language or terminologies in a topic such as words, symbols, expressions, objects, formulae, equations, principles and so on, associated with fraction and decimal, 2 and 3- dimensional figures, volume, capacity and weight.

Learning Outcomes: These refer to the knowledge and attributes attained as a result of pupils' involvement in a particular set of educational experiences. These were measured using PMAT, PMCT, PIMI and PVAT.

Modified Lecture Instructional Strategy: The strategy of teaching mathematics in which the teacher communicates orally with the use of occasional questions, demonstrations and diagrams on the chalkboard without game and poem enrichment activities and instructional materials.

Poems: These are words arranged in regular patterns of rhymed and accented lines which focus on the mathematics concepts covered in this study used as enrichment activities to enhance mathematics instruction.

Verbal Ability: This refers to the scholastic proficiency of a learner in the use of language without specific curriculum content. This is at three levels (high, medium and low) which the pupils express in a given test.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The literature relevant to this study is reviewed in the following order:

2.1 Theoretical framework

2.1.1 Ausubel's Subsumption Theory of Verbal Meaningful Learning (1963)

2.1.2 Skinner's Operant Conditioning Theory (1938)

2.2 Nature and importance of mathematics

2.3 Primary mathematics education

2.4 Mathematical games as an instructional strategy

2.5 Characteristics of a mathematical game

2.6 Mathematical games and learning outcomes in mathematics

2.7 Mathematical poems as an instructional strategy

2.8 Poems and learning outcomes in mathematics

2.9 Knowledge of mathematics concepts and learning outcomes

2.10 Interest in mathematics and learning outcomes

2.11 Verbal ability and learning outcomes in mathematics

2.12 Gender and learning outcomes in mathematics

2.13 Appraisal of the literature reviewed

2.1 Theoretical framework

This work is anchored on the following theoretical framework. Ausubel's Subsumption Theory of Verbal Meaningful Learning (1963) and Skinner's Operant Conditioning Theory (1938).

2.1.1 Ausubel's Subsumption Theory of Verbal Meaningful Learning (1963)

Ausubel's subsumption theory of verbal meaningful learning applies only to reception (expository) learning in which individuals learn large amounts of meaningful materials from verbal/textual presentations in school settings. He claims that a primary process in learning is subsumption in which new material is related to relevant ideas in the existing cognitive structure on a substantive basis. Ausubel (1963) observes that meaningful verbal learning occurs when what is to be learned can be related to existing concepts (subsumers).

Ausubel distinguishes reception learning from rote and discovery learning. Rote learning does not involve subsumption (that is meaningful materials) and discovery learning involves the learner in discovering information through problem-solving (Ausubel, 1978). Cooper (2009) asserts that meaning is created through some form of representational equivalence between language (symbols) and mental context. The expository (verbal) learning strategies include speech, reading, and writing, which encourage rapid learning and retention. Conversely, discovery learning facilitates transfer to other context. Also, Ausubel supports the theory that pupils form and organize knowledge themselves. Pupils gradually learn to match new knowledge with existing knowledge in their mental structures. Ausubel considers the verbal learning to be very effective for pupils of age 11 or 12 above (Slideshare, 2011).

The subsumption theory involves effective linking between new knowledge and existing cognitive structure. Three linkages that are important in the learning processes in Science and Mathematics, as identified in Odili (2006), are

(a) Internal linkage in the cognitive structure, which is concerned with how effectively or loosely the learner's knowledge is integrated.

(b) Activation of a particular part of the cognitive structure for learning, which relates to the accuracy with which a particular part of cognitive structure is retrieved for use in learning a particular piece of new knowledge.

(c) External linkage between an existing cognitive structure and the new learning content which is concerned with subsumption of concepts that enable the linking of the existing cognitive structure to new concepts or knowledge to be learned.

Ausubel recommends the use of advance organizers where subsummers do not exist (Odili, 2006). This is the major instructional mechanism proposed by Ausubel in classroom application. The advance organizer is a tool or mental learning aid to help students integrate new information with their existing knowledge, leading to meaningful learning as opposed to memorization. It is a means of preparing the learners' cognitive structures for the new learning experience. It is a device to activate the relevant schema or conceptual patterns so that new information can be more readily subsumed into the learners' existing cognitive structures.

Odili (2006) summarizes the implication of Ausubel's work as thus;

(a) The most general ideas of a subject should be presented first and then progressively differentiated in terms of detail and specificity.

(b) Instructional materials should attempt to integrate new materials with previously presented information through comparisons and cross referencing of new and old ideas.

Ausubel's subsumption verbal meaningful learning theory is relevant to this study in the areas of using poems to enhance mathematics instruction. The use of poems involves the construction of images for appreciating Mathematics. The Califonia Infant/Toddler Learning and Development Foundation (2010) stated that social-emotional contexts unfold cognitive development. Also, Sternberg and Grigorenko (2004) assert that the cultural context is important to young children's cognitive development. Aspects of intelligence that have to do with social competence appear to be seen as more important than speed in some non-Western cultural contexts. The poems used in this study approach mathematics learning in the cultural context focusing on the activities of the child's immediate environment.

The poems are verbal presentation of the mathematics concepts to be learned. Also, the mental images created from the child's immediate social environment reflecting the concepts serve as advance organizers or subsummers to the prior or existing knowledge of the child's cognitive structure to enable him learn the new concept. Furthermore, verbal meaningful learning strategies include speech, reading and writing (Cooper, 2009). The use of poetry in teaching involves these key aspects of learning.

2.1.2 Skinner's Operant Conditioning Theory (1938)

B.F Skinner is an American psychologist who developed the operant conditioning theory of learning in 1938 in order to examine what effect consequences had on behaviour. Operant conditioning theory examines the stimulus, the response to the stimulus (a behaviour) and the behaviour's consequence (Skinner, 1938). This theory states that the organism is in the process of operating on the environment. During this operating, the organism encounters a special kind of stimulus called a reinforcer. This special stimulus has the effect of increasing the operant, the behaviour occurring just before the reinforcer. The behaviour is followed by a consequence, and the nature of the consequence modifies the organism's tendency to repeat the behaviour in the future (Boeree, 2006).

To illustrate this, Skinner constructed a box called the Skinner box. This box contains a bar that releases a pellet of food into a tray and at the same time automatically registers the responses at a time chart. Each time the hungry rat presses the bar and light shows, a pellet of food falls into the dish. The rat eats and presses the bar again. The food reinforces the pressing of the bar. The pressing response is responsible for producing the food (reinforcer) which then acts as a stimulus for response (bar pressing); this makes the rat to keep pressing the bar even when there is no food reward.

Skinner's operant conditioning theory is relevant to the study in that the games were developed with this understanding. The games played are guided by rules. Whenever a pupil plays the game correctly, that child is immediately rewarded, depending on the rule of the game either by moving up a ladder or acquiring more marks. A child who plays the game wrongly will also be punished immediately by remaining at the same position, losing marks or getting out of the game (Aremu, 1998). These reinforcers will lead to behaviour change, such as pupils actively participating in the lesson, developing the spirit of competitiveness, enhancing achievement, and developing positive interest and attitude towards Mathematics. According to Obodo (1997), a positive reinforcer (reward) is an event that increases the rate of responding, such as a teacher nodding his head, smiles, assigning high grades, a pleasant statement and others. By doing this in a study, it was observed that students attitude were changed positively, interest strengthened, class attendance increased, highly motivated and were more eager to study Mathematics.

The games were also constructed based on some learning principles that guide the use of games. Aremu (1998) presents these principles:

(a) There is need for students' participation and plenty of practice since learning is activity. Games by nature are activities, thus students actively participate in learning and are involved in a lot of practice.

(b) Motivation is important to the learner. It is the teacher's task to infuse necessary motivational forces which heighten the students' desire, need and interest in learning. Games enhance motivation.

(c). Repetition reinforces information and makes information more enduring. A good way to repeat information is through the use of games and poems.

(d) Immediate Knowledge of Results (IKOR) must be given promptly. IKOR reinforces success and gives quick correction. The use of games incorporates this principle, in that when a student has his turn in the game, right there, he knows through his mates whether he is right or wrong. This reinforces success.

(e) Finally, nothing absolutely new is ever learned effectively with one exposure. Games and poems used in this study give room for repeating the presentation of the various concepts (stimuli) to be learnt.

2.2 Nature and importance of mathematics

Amoo and Rahman (2004) view Mathematics as a language, a particular kind of logical structure, a body of knowledge about numbers and space, and merely as an amusing intellectual activity. Akinsola (2005) regards Mathematics as a special language that is used to identify, describe and investigate the patterns and challenges of every living entity. It is a language that helps in understanding past events, and to predict and prepare for future events so that one can fully understand the world and more successfully live in it.

The American Association for the Advancement of Science (AAAS, 1990) notes that Mathematics is a theoretical discipline which explores possible relationship among abstractions without concern for whether those abstractions have counterparts in real world. The abstractions can be anything from strings of numbers to geometric figures to sets of equations. Also, Pappas (1999) describes Mathematics as a fiction which also connotes the abstract nature of Mathematics.

The value of mathematics has been identified by many researchers and mathematics educators in various aspects. Kurumeh (2006) considers Mathematics as the language in which scientific ideas are expressed. It is the means by which other sciences, including Physics, Chemistry, Biology and disciplines like Engineering and Geology, are understood. Thus, Eraikhuemen and Oteze (2008) view Mathematics as the bedrock of scientific and technological development. Many other researchers and educators emphasize the vital role Mathematics plays in the scientific and technological development of a nation (STAN, 2000; Eze, 2008; Iji, 2008; Koko, 2008).

Everybody needs mathematics; an engineer, a grocer, a house wife, a sportsman, an employee, and so on. Agwagah (2008) avers that a common man get on sometimes very well without learning how to read and write, but he can never pull on without learning how to count and calculate. Even insane persons know the quantity of food that can get into their mouth at a time. Mathematics is inborn with man and we cannot afford to do without it.

Another important area in which the value of Mathematics is emphasized is on the development of critical thinking. Pollak (1986) posits that Mathematics is the best way to teach youngsters how to think. Mathematics is taught for its impartation of reasoning power. The Foundation of Critical Thinking (FCT, 2004) stated that lack of developing critical thinking in humans makes most of one's great capacity dormant and most under-developed.

2.3 Primary mathematics education

Primary education is the foundation of every serious educational programme. The primary education is the success or failure and foundation of the whole education system (Agwagah, 2006; Kurumeh and Imoko, 2008).

The objectives of primary education are to:

(a) Inculcate permanent literacy and numeracy, and ability to communicate effectively.

(b) Lay a sound basis for scientific and reflective thinking.

(c) Promote patriotism, fairness, understanding and national unity.

(d) Instill social, moral norms and values in the child.

(e) Develop in the child the ability to adapt to the child's changing environment.

(f) Provide opportunities for the child to develop life manipulative skills that will enable the child to function effectively in society within the limits of the child's capacity (FRN, 2013: 21).

Odili (2006) also states the objectives of primary education in relation to mathematics education as

(a) To lay a solid foundation for the concept of numeric and scientific thinking.

(b) To develop in the child the ability to adapt to his changing environment.

(c) To give the child opportunities for developing manipulative skills that will enable him to function effectively in society within the limits of his capacity.

The activities that will guide the child to achieve these noble objectives are very vital issues in the educational system. The Federal Ministry of Education (FME, 2004) notes that the key to the success or failure of the whole educational objectives of the child hinges on the level of adequacy of the primary school subjects, such as Mathematics, English Language as well as Social Studies. Also, Iji (2007) posits that the inclusion of permanent numeracy as first among the objectives for primary education stresses the need for every child to be mathematically literate.

Despite the relevance of Mathematics education at the primary school level, it is faced with many problems. Conceptual development is limited at the primary school level (Agwagah, 2001). Children dislike Mathematics at this level (Nurudeen, 2007; and Ojo, 2008). In order to solve these problems, Ojo (2008) recommends using concrete materials throughout primary school years and creating a creative corner for pupils who are less capable in Mathematics. Such pupils may be good at art or writing. They may display their creative works in the creative corner of bulletin board. Such activities include poetry or stories about mathematical situations and geometric drawings. Iji (2010) admonishes teachers to make earnest efforts geared towards making the child mathematically competent early enough. Kurumeh and Imoko (2008) assert that ideas, attitudes and beliefs acquired at this stage are usually difficult to change at adulthood. Ohuche (1990) opines that in teaching elementary Mathematics, all teaching should spring from activities, experiences and real situations or equipment. Both discovery and explanatory techniques need to be used; and provide adequate opportunities for manipulation of materials accompanied by verbalization of materials as well as for conceptualization by means of discovery. Teachers need to communicate mathematical ideas in an original fashion through demonstration and proofs; exhibits poems, research projects and further opportunities for originality (Iji, 2007). Agwagah (2001) recommends the use of games. To ensure a sound background at the primary school level in Mathematics, Etukudo (2006) emphasizes teaching Mathematics beyond counting, subtraction, multiplication and division to include ability to apply mathematical ideas in generating, developing and solving simple problems in industry, teaching and business.

2.4. Mathematical games as an instructional strategy

Mathematical games take the form of puzzles, magic tricks, fallacies, paradoxes or any type of mathematics which provides amusement or curiosity. Such games provide enjoyment and recreation (Dotun, 2005). Onwuka et al. (2010) observe that game makes the teaching and learning of Mathematics easy and enjoyable. Also, the skills acquired from the game, to a considerable extent, help to arouse and sustain students' interest in some difficult concepts in Mathematics. Games develop pleasure, satisfaction and sense of competiveness; promote creativity skills, problem-solving ability; and bring about effective and retentive learning (Kankia, 2008). Mathematics educators could improve and promote the teaching and learning of Mathematics through games, particularly at the early stage of education; that children are natural lovers of games (Akpan, 1988).

Games are used in many countries of the world to teach mathematics and science because of its importance in the educational process. In terms of general thinking skills, games offer opportunity for concentrating, thinking ahead, searching for pattern, noticing, using visual imagery, showing perseverance, reflecting, being methodical and logical (Azuka, 2002).

Agwagah (2001) outlines the advantages of mathematical games to the teacher:

(a) With games, the feedback to the teacher can be direct, and assessment is made more simple and relevant.

(b) Games provide inexpensive instructional materials for teachers.

(c) Games give the teacher added insight into the quality and level of pupils' work and in understanding of Mathematics.

(d) Games can help to bridge the gap caused by lack of understanding on the part of the pupils and lack of communication on the teacher's part.

(e) Games pose a quite different role for the teacher as coordinator, referee, facilitator, and observer, rather than expositor.

Agwagah (2001) also lists the disadvantages of mathematical games. They include;

(a) They take too long to design.

(b) They tend to take longer time to use than traditional techniques.

(c) Games create noise in the classroom.

(d) Games may be misused, for instance by judging game success by the amount of enjoyment, instead of the amount of learning done. They may also be overused.

2.5 Characteristics of a mathematical game

A mathematical game possesses some characteristics that qualify it as a mathematical game. Onwuka et al. (2010) identify the following characteristics of a mathematical game:

(a) It must have a mathematical structure.

(b) It must involve at least two participants.

(c) There are usually rules governing each mathematical game.

(d) There must be a winner and a looser, based on a systematic scoring pattern.

(e) It must be activity-based or activity-oriented and should stimulate creative thinking or mental processes.

These features are fundamental to the development of any mathematical games either for educational or commercial purposes. They are the guide to any game developer especially such games that are used for educational purposes. If any of these features are missing such a game is no longer called a mathematical game. These features were properly considered and incorporated in the games developed for the study.

Agwagah (2001) classify mathematical games on the basis of five criteria:

(i) Development and reinforcement games. Development games are used for introducing new concepts, while reinforcement games are used for consolidation or revision of factual information.

(ii) Chance or strategy games. A game of chance is one in which, a player wins or loses because of chance or luck. It does not involve any skill. Strategy games involve a player devising a plan to achieve a specified goal. Thus, they involve skills such as speed, accuracy, superior memory, or quickness of thought to achieve the particular objectives.

(iii) Individual or group mathematical game could either be played on individual or group bases.

(iv) Mathematical games could be card, seed, board, computer, puzzles. This depends on whether the game materials are cards or seeds or game is played on a board, or a computer or they are puzzles.

(v) Attribute or non-attribute games: Attribute game focuses on attributes of colour, size, shape, thickness and so on. Non-attribute games can focus on things other than the attributes listed above. Generally some games combine two or more of these classifications, but usually one mode dominates.

Mathematical games served different purposes which range from whether they are to be used for the development of mathematics concepts and skills. Also, how and the materials with which the games are designed are vital issues to game developers. The games developed and used in this study are aimed at learning mathematics at the primary school level of which appropriate criteria were considered for the total development of the child.

The National Mathematical Centre (NMC, 2002) Abuja identifies the component features of a mathematical game to include:

(a) Title: This is the name by which a game is identified.

(b) Class level: This refers to the class that will benefit from the game.

(c) Topic: This indicates the mathematics topic(s) that the game purports to teach.

(d) Players: This specifies the number of individuals to play the game.

(e) Purpose of a game: This indicates the aim of the game in covering the mathematics topic(s). It indicates whether the game is used for initial instruction in developing the mathematics concept or for remediation, or enrichment.

(f) Objectives of a game: This refers to the object of the game. It indicates what it means to win or terminate the game. For instance, the object may be to reach a particular position on the game board, or to collect the most cards, or to accumulate most points, and so on.

(g) Materials: These represent the materials necessary for playing the game, such as game board, buttons, beans, seeds, cards and decision devices, like dice, coins, spinners, and so on.

(h) Procedures: This specifies the processes or steps involved in playing the game.

(i) Rules: The rules of a game are the clear, concise instructions that players must obey in playing the game.

(j) Follow-up activities: These may be mathematical tasks, problems or exercises.

2.6 Mathematical games and learning outcomes in mathematics

Abubakar and Bawa (2006) examined the effect of number base game in the study of number bases at the senior secondary school level and found a significant difference in the mean achievement scores of students taught number bases using number base game. It was equally discovered that there was no significant difference in the achievement of male and female students. Based on the findings, it was recommended, among others, that mathematics teachers as curriculum implementers should be trained by teacher educators on how to prepare different games on different concepts in Mathematics so as to build positive attitude, interest and problem-solving skills in them, that are broader in application than knowledge for its own sake. Also, Kankia (2008) found that students taught through games achieved significantly better than the students taught without games.

Okigbo (2008) used card games to teach percentages, fractions and decimals and found that playing the game before and after a mathematics exercise on fraction reinforced the understanding of number values and sustained students' interest. Also, Aremu (1998) found that the card and geoboard game-based strategies showed significant effects on variations in pupils' achievement in geometry. The card-based strategy recorded the highest posttest mean scores. The geoboard-based strategy also had improved scores over the lecture strategy. No significant gender differences were observed in the pupils' achievement scores in game-based strategies.

2.7 Mathematical poems as an instructional strategy

Literature is concerned with the literary aspect of communication using language for artistic and creative purposes with a view to creating beauty which is intellectual (Ayebola, 2006). Some literary aspects used in expressing mathematical ideas are stories, essays, poems, books, and other forms of literature that convey life experiences, real or imagined. One way of connecting school mathematics to everyday life is to draw attention to the mathematics inherent in human thinking and communication about life experiences (Haury, 2001). Studies cited in Haury (2001), gave various reasons to link mathematics instruction to children's literature. For instance, Usnick and McCarthy (1998) note that the literature connection motivates students, Welchman-Tischler (1992) claims that, it provokes interest, Murphy (2000) claims that it helps students connect mathematical ideas to their personal experiences, it accommodates children with different learning styles, promotes critical thinking. Melser and Leitze (1999) argue that it provides a context for using mathematics to solve problems.

The aspect of literature considered in this study, poetry, has much to do in children learning. St.Cyr (2008) stated that children are natural lovers of poetry. Kids love words, rhyme, and beat. As long as the sounds have rhyme and rhythm, it will stick to the child's mind. When kids learn how to talk, they play with sounds, they sing, listen and they repeat. The repetitive nature of poems helps children's memory to learn and expand in understanding and knowledge. The world is made up of poetry and we need to help the kids appreciate the beauty of words. Children have a natural affinity for poetry which begins with their first exposure to nursery rhymes and stories of repetitive lines (Mazzucco, 1994). Children learn better and faster when rhyme is used from an early age. Rhymes are pleasing to the ear and they build listening skills which are helpful for later reading comprehension. Learning to manipulate words through rhyming and word games is an important reading skill. Rhymes also delight children and they are an introduction to music and fun of language (LeFebvre, 2004).

Bahls (2009) identifies two important purposes poetry serve in Mathematics course. First, poetry offers a new sort of cognition, new lens, and one based in linguistic metaphor, through which students can examine and re-examine mathematical ideas. Second, writing poetry emboldens students and gives them confidence by allowing them familiar with idioms in which they can express themselves mathematically.

Writing is an integral part of teaching poetry. The National Council of Teachers of Mathematics (NCTM, 2000) recommends that writing about mathematics be nurtured across grades. The National Institute for Literacy (2007) researches established that, like reading, improving students' writing skills improve their capacity to learn. In Alvermann (2002), an expert in adolescence literacy, studied students' self-efficacy and engagement and urged that all teachers, despite their content area expertise, to encourage students to read and write in many different ways, for writing raises the cognitive bar, challenges students to problem-solving and think critically.

Urquhart (2009) states that mathematics classes previously relied on skill building and conceptual understanding activities, but today writing in Mathematics lesson is more than just a way to document information, but a way to deepen students' learning and a tool for helping students gain new perspective. Students whose strengths are language-based use writing as a key to understanding other disciplines, especially Mathematics. Urquhart (2009:1) avers that writing in Mathematics gives me a window into my students' thoughts that I don't normally get when they just compute problems. It shows me their roadblocks, and it also gives me, as a teacher, a road map.

Also, Burns (2004:30) states, "I can no longer imagine teaching mathematics without making writing an integral aspect of students' learning." Also, a teacher, as quoted in Urquhart (2009:8) explained that writing enhances the metacognitive aspect of leaning mathematics, "if there is no writing in Mathematics class, all they are doing is the evaluation-execution portion of learning. Orientation and organization come before execution, and that's what writing gets at. That is the most valuable piece of writing in mathematics class." Writing in mathematics class enhances active learning, problem-solving, invention; increases reading; improves content; and is a way to participating in interdisciplinary collaboration (Urquhart, 2009). Therefore, writing should be as much at home in Mathematics class as in English Language class.

Urquhart (2009) recognizes three kinds of writing prompts that reflect three aspects of learning mathematics – (1) content, (2) process and (3) affective. Content prompts deals with mathematical concepts and relationships; process prompts focus on algorithms and problem-solving; and affective prompts centre on students' attitudes and feelings. These areas are incorporated in the writing of the poems, especially the content and process. The affective aspect will be incorporated effectively in the pupils' activities and assignments together with the other prompts.

2.8 Poems and learning outcomes in mathematics

Very few research works are reported in the use of poetry and writing in Mathematics. Pugalee (2004) conducted a study with 9th-grade algebra students to determine if journal writing can be an effective instructional tool in mathematics education and found a positive effect in problem-solving because the writer organize and describe internal thoughts. Also, Pugalee (2005) studied the relationship between language and mathematics learning and found that writing supports mathematical reasoning and problem-solving and helps students internalize the characteristics of effective communication.

Bahls (2009) found that, in writing poetry, many students seemed able to make their own mathematical ideas, yet hidden to them. Some of the students who performed poorly or at least more reluctantly than their peers on traditional mathematical exercise, such as computation, heavy home-work problems and in-class examination relished the chance to work with a new medium. Also, Samuels (1987) cited in Bahls (2009), found that performing poetry in a sociology classroom emboldened weaker students.

Poetry, which may require the pupils to explain the poems, might result to storytelling, which is a strategy of teaching that is effective for motivating students' desire to learning (Diaw, 2009). Stories create a favourable environment for learning, reduce students' tension and improve students' memory for what they learn (Balakrishnan, 2008; Shirley, 2008). Also, storytelling in teaching mathematics can assist in understanding complex thoughts and ideas, because it encourages students to focus and think harder (Zazkis and Lijedahi, 2009). Albool (2012) found that using the storytelling strategy of teaching mathematics increased the students' ability to understand fraction concepts, and increased their ability to solve mathematics problems, thus increased their achievement in Mathematics.

2.9 Knowledge of mathematics concepts and learning outcomes

Knowledge of mathematics concepts has to do with the language used in Mathematics (Binda, 2006). Language is a way of expressing ideas and feelings using symbols, sounds, movement or rules (Olokun, 2005). By this definition, Mathematics can be considered as a kind of language, as it deals with symbols and rules. Binda (2006) defines the language of Mathematics as the English language used for the mathematical purposes. This language consists of words, and symbols that have meanings related to particular contexts and procedures for solving mathematics problems. The language of Mathematics refers to the set of mathematics words, symbols and expressions which are understood in the context of Mathematics.

From the above discussion, the language of Mathematics may be referred to as the concepts in Mathematics which students need to learn and understand to enable them perform well. For instance, in the concept of fraction, related key words, symbols or sub-concepts, like numerator, denominator, part of a whole, less than (<), greater than (>), equal to (=) and many others that the students need to learn and understand for a better performance in fraction. Backhouse, Haggarty, Pirie, and Stratton (1992) claim that learners' mathematical concepts are intimately associated with words, through which the concepts are learned and with any mathematical symbols used in connection with these concepts.

Nnaji (2005) defines a mathematical concept as a mental construct, whereby like properties of a set of experiences are grouped together. The elements of this set may involve objects (set objects), actions (operational concepts), processes (rational concepts) or organizational concepts. For instance, the elements are described as:

(a) Set concepts: A square is a quadrilateral having all sides equal.

(b) Operational concepts: The addition of any two odd numbers results in an even number.

(c) Relational concepts: Closure is the common property of a mathematical group, that is, if you add integers you will always get an integer.

Learning what an object is: a fraction, a polygon, an equation, a quotient, is learning the concept of that object.

The importance of students having knowledge of mathematics concepts or the language of mathematics cannot be ignored. Before a student solves a mathematics task, he/she must comprehend and translate the problem statement correctly. This is influenced by the extent to which he/she understands the meanings of words or concepts taught them before they can figure out what is being said or sought for, which is a function of language (Binda, 2006). Understanding mathematical symbols and terms will help the learner in his/her mental translation of mathematical information in the learning process (Osafehinti, 1993).

The understanding of the language of Mathematics is a prerequisite for high mathematics achievement (Binda, 2006). The learning of this language is not without difficulties, which include:

(a) Non-availability of dictionary of Mathematics.

(b) The inability of the students to retain and recall contextual meanings of mathematics words and symbols.

(c) The abstractness of most mathematics words and symbols. For instance, the meaning of the words, "solve" or "simplify" can hardly be explained using concrete materials.

(d) English equivalent forms for most mathematics words and symbols are difficult to find. Such words and symbols are given in other languages such as Greek and Latin, thereby rendering their learning extremely difficult.

(e) Phobia and general negative attitude towards Mathematics (Binda, 2006).

Also, students find it difficult to conceptualise the topics being taught not to talk of the application. Students just copy notes and struggle to memorize the mathematics topics. With these, students cannot appreciate the application of Mathematics to daily activities; they find it difficult to accept that words should be found in Mathematics (Eze, 2007). Gershon, Guwal and Awuya (2008) found that word problems are often found in Mathematics and students of colleges often complain that they least expected that there is a mathematical course that hardly uses figures. They cannot imagine how courses as Number Theory, Real Analysis and Abstract Algebra are full of worded problems.

Understanding mathematics specific language, prepositions, and lexical items is another problem in Mathematics learning. Olokun (2005) notes that prepositions in general and the relationships they indicate are critical lexical items in the mathematics register that can cause a great deal of confusion. Word order, such as saying the same expression in different ways, requires a lot of reasoning. For instance, 30 divided by 6 and 6 divided by 30 mean different things. Mathematics-specific language, such as hypotenuse, minus, and exponent, must be understood. Some common words like table, product, rational, odd, and factor, have meanings in Mathematics that are different from daily language. Right means direction or correctness. However, right is used in Geometry to refer to an angle with special characteristics and has nothing to do with direction or correctness. Prepositions are conceptually challenging; they carry important but confusing functions in Mathematics. For instance, one-third of twelve oranges and reduce by 5cm. Prepositions can also signify different actions as 3 multiplied by 10 or 3 increased by 10.

In an attempt to solve the above mentioned problems, Binda (2006) recommends general strategies, oral strategies, kinesthetic strategies and word origins. A brief description of each is given.

a. **General strategies:** These strategies include building concepts first before attaching vocabularies to establish ideas. This should be followed with students recording the new term and its meaning with a diagram in a personal glossary.

b. **Oral strategies:** These strategies involve encouraging students to work orally in groups to solve problems. While doing this, students should talk mathematics. In other words, the teacher should create opportunities for students to discuss procedures for solving mathematics problems while the teacher listens (silent teacher technique) and correct the students where necessary.

c. **Writing strategies:** The teacher should encourage mathematical writing among the students, such as journal writing, in which the teacher provides the stem and requires the students to fill.

d. **Visual strategies:** These strategies involve the use of structured overview, picture, dictionaries, mathematical graffiti, and mathematical cartons among others.

e. **Kinesthetic strategies:** These involve the use of manipulative, such as algebraic tiles, making models, building three-dimensional figures, and others. Such strategies also involve group or individual projects, usually accompanied with public representations, such as drama and rehearsals.

f. **Word origins:** It is a fact that mathematics words have their histories and roots. Teachers should teach the histories of mathematics words. This is because the knowledge of where these words came from will help students to make connections between mathematics words and the everyday English language. For example, the word perpendicular came from the root word *pend* which means to hang. Also, asymptote, which is related to the word symptom, is from the root *sym.*

Some studies have been carried out by researchers and mathematics educators to ascertain students' level of achievement in concept development. Reys (1989) used calculators to help primary school pupils to develop conceptual understanding in finding the mean in Statistics. It was found that this enabled the pupils to concentrate on the concept rather than the tedious computation and this enhanced a better achievement. Binda (2006) carried out a study to find the relationship between understanding the language of mathematics and achievement at the secondary school level and found a weak but positive relationship between the variables studied. This suggests that mathematics teachers need to teach the language of Mathematics in order to enhance classroom communication during mathematics lessons thereby, improving achievement in the subject.

Galadima and Yusha (2007) found no significant gender difference in the learning of concepts, principles, terms and symbols among Senior Secondary School (SS2) students. The study found that both boys and girls achieved poorly in the test administered on mathematical concepts, principles, terms and symbols. More than 75% of the students scored low marks in mathematical areas of Algebra, Trigonometry and Statistics as a result of the lack of understanding the basic concepts, principles, terms and symbols. Also, Inekwe (1997) found, in his study, that boys and girls achieved poorly in Geometric reasoning ability test.

2.10 Interest in mathematics and learning outcomes

Interest is a significant factor that enhances the learning of Mathematics and thus improves the achievement of students in Mathematics (Udegbe, 2009). Harbor-Peters (2002) explains that interest leads the individual to make a variety of choices with respect to the activities in which he/she engages. The individual shows preference to some and aversion to others. It is the tendency to seek out and participate in certain activities or to prefer, or engage in a particular type of activities.

Most secondary school students in Nigeria were found to have poor interest in Mathematics. They absent themselves in mathematics lessons and those who stay in the lesson pay little attention to their teachers. When the option is available, most students will prefer not to have anything doing with the study of Mathematics because they lack interest in it (Udegbe, 2009).

Researchers and mathematics educators have investigated the factors responsible for the low interest of students in Mathematics. Nurudeen (2007) is of the view that the difficulty in understanding the technical language associated with Mathematics is one of the major factors responsible for students' lack of interest and even their poor achievement in Mathematics. Habor-Peters (2001) and

Abakporo (2005) identify teachers' strategies of teaching as one of the problems of learning Mathematics that have resulted in students' lack of interest in Mathematics. The inability of students to understand the basic mathematical principles, computations or logical facts involved and the underlying processes that gave rise to the mathematical facts as the cause of poor achievement and lack of interest in Mathematics (Soyemi, 2003). Ukpebor (2006) attributes persistent low interest and poor achievement of students in mathematics and science education to inadequate instructional resources/materials.

Various suggestions have been made by researchers and mathematics educators to solve the problem of students' lack of interest in Mathematics. For instance, Harbor-peters (2002) recommends to teachers to use tangible/visual representation, such as sketches/models, to concretize ideas. Such representations link up thought processes to reality. Such materials generate and sustain interest in mathematics teaching and learning. Another source of interest in Mathematics is for the teacher to vary his/her method of presenting similar ideas to take care of individual differences which, in turn, will dispel boredom and generate interest. Further suggestions are on various avenues through which teachers can explore enrichment activities. Adetula (2001) identifies sources of enrichment content such as:

a. Mathematical recreation
b. History of mathematics
c. Application of mathematics
d. Instructional resources

Still, Akinsola and Popoola (2004) posit that, for teachers to meaningfully enhance learning and improve interest in Mathematics, they should tap heavily from devices which have direct sensory appeal and exhibit mathematical concepts clearly. Ukeje and Obioma (2002) stated that amusement and pleasure should be combined with mathematics instruction to make their learning more interesting. Abubakar and Bawa (2006) aver that teachers should teach Mathematics in an application-oriented form using instructional materials, such as games whose materials are readily available in the child's environment. This is because learning by doing is a better way to develop and sustain students' interest in Mathematics.

Various studies quoted in Udegbe (2009) reported the effect of some strategies and activities on students' interest in Mathematics and other learning outcomes in Mathematics. For instance, Ezeamenyi (2002) investigated the effect of four games on junior secondary schools students' achievement, interest and retention in Mathematics. The study was carried out in four secondary schools in Enugu State, Nigeria. The result showed that students taught with games achieved more, generated more interest and retained more in Mathematics than those taught without games. Uchedu and Mbah (2007) investigated the effect of peer interaction in Problem-Based Learning (PBL) context on students' achievement and interest in Science. The result revealed that peer interaction learning strategy had positive interest in Science than traditional lecture-based learning strategy. Agwagah (2008) investigated the effect of using origami to get students interested and involved in Mathematics. She concluded that origami is one possible way to captivate and get students interested in Mathematics.

Okigbo and Okeke (2011) investigated the effect of games and analogies on students' interest in Mathematics using 246 JSS 2 students. They found that the game was more effective in improving students' interest in Mathematics than analogy. It was also found that a non-significant difference existed between the mean interest scores of male and female mathematics students taught with either game and also those taught with analogy. It was recommended that teachers should be encouraged to adopt game more than instructional analogy in teaching number and numeration and algebraic processes in Mathematics.

2.11 Verbal ability and learning outcomes in mathematics

Verbal ability refers to the scholastic ability of a learner, especially without any specific curriculum content. Buffery and Grey (1972) quoted in Komolafe (2010) state that learners' verbal abilities are linked to biological differences in the organization of the brain. Scientific research has revealed that the left cortex dominates and controls verbal functions and develops quickly in females, while the right cortex in boys is usually dominant for non-verbal functions, such as spatial relationships. To buttress this finding, Odebode (2001) reported that girls performed better in verbal tests and obtained higher grades than boys, while boys excelled in Mathematics and in all science related-subjects. Throughout the world, women are higher in verbal abilities than men, but are lower in Mathematics and spatial ability. Men are superior to women in problem-solving tasks and specific abilities related to problem-solving (Asoegwu, 2008).

Idogo (2011) investigated the effects of instructional strategies on basic reading and comprehension skills on 370 primary 5 and 6 pupils and found a significant positive effect of instructional strategies on verbal ability. The high ability group performed better than the average and low ability pupils. Awofala et al. (2011) found that verbal ability and cognitive style had significant main effect on students' achievement in mathematical word problems using 450 JSS students. High verbal ability students performed significantly better than low verbal ability students in mathematical word problems. Hall (2004), cited in Binda (2006) found a positive correlation between students' verbal ability and achievement in Mathematics; stressing that, when students are strong in verbal abilities, their understanding of Mathematics will be enhanced. Iti (2005) found no significant difference of verbal ability on pupils' interest and class participation in primary science; but found significant difference in the achievement of male and female pupils in primary science.

2.12 Gender and learning outcomes in mathematics

Gender differences are a reflection of cultural values and expected social roles for men and women. They are not as a result of biological differences or genetic deficits especially in learning Science and Mathematics (Ogunkunle, 2007). Gender refers to the social roles that are believed to belong to men and women within a particular social grouping. It is a learned perception, so anything associated with gender can be changed or reversed to achieve equality and equity for both men and women (Amoo and Onasanya, 2010).

Gender differences in mathematics achievement are caused by

(a) Social economic status and ethnicity.
(b) Teacher-student interactions.
(c) Teacher-student behaviours.
(d) Characteristics of the classroom.
(e) Personal beliefs in Mathematics.
(f) Learning of complex mathematics (Fennema, 1995).

Amoo and Onasanya (2010) point out specific school influences, such as: timetabling of subjects, assessment procedures, teacher expectations and behaviour vis-a-vis classroom practices and interpretation of mathematics curriculum, peer pressures, unequal funding, and stereotyped textbooks, as causes of gender inequality in science and mathematics teaching and learning.

Researchers have found that gender plays a significant role in the learning outcomes of students. Muthukrishna (2010) carried out a study in KwaZulu-Natal in South Africa, examining whether there was a significant gender gap in Mathematics achievement, the nature of the gap, and the factors associated with the differential performance of girls and boys in mathematics class. The quantitative data was drawn from grade-six Mathematics achievement test results conducted in 2008 and 2009. The findings in the study revealed a gender gap in Mathematics achievement in favour of girls. The key factors associated with the gender gap include the issue of boys and masculinities, the dynamics of classroom cultures, and the differential attitudes to learning in respect of boys and girls in the Mathematics class. However, a study by Wilmot (2001) in Ghana revealed a general poor performance of both sexes in each class but significant differences in achievement were observed in favour of boys in only primary six (6). Opolot-Okurot (2005) investigated the students' attitudes toward Mathematics in Uganda secondary schools and found that, for all the attitudinal variables (anxiety, confidence and motivation), males had higher scores than females.

Vale (2009) cited in Muthukrishna (2010), reported that many studies conducted between 2000 and 2004 in Australia showed no significant differences in achievement in Mathematics between males and females, although males were more likely to obtain higher mean scores. In New Zealand, studies favoured females at the primary school level, while studies conducted at the secondary school level favoured males. Also, a large scale study in the U.S.A by Hyde and Mertz (2009) revealed that, girls had now reached parity with boys in Mathematics performance, including at high school where a gap existed in earlier decades. Furthermore, girls were found to doing better than boys even for tasks that require complex problem-solving in the U.S.A.

The situation in Nigeria is not different, for studies have reported gender differences from primary school to the secondary school level. For instance, Eniayeju (2010) assessed the gender differences in Mathematics using a cooperative learning strategy. Three hundred and eighty-nine primary six pupils participated in the study. The experimental groups were assigned to either homogeneous (single sex) or the heterogeneous (mixed sex) groups. The results revealed that girls in heterogeneous groups had significantly higher mean scores than their counterparts in homogeneous groups. The results of boys and girls in the cooperative groups showed that girls achieved significantly better than boys in all tests.

Onasanya (2008) determined the effectiveness of team teaching using 297 J.S 2 students and found that male students achieved significantly better than female students in using team teaching in Mathematics class. Shafi and Areelu (2010) determined the effect of improvised instructional materials on 300 S.S.S 3 students' achievement in solid geometry and found a significant difference between the achievement of boys and girls in the experimental groups. Males achieved significantly better than females. Ebisine (2010) found no significant difference in the level of difficulty encountered by male and female students in understanding the non-technical words in multiple choice Mathematics tests. Also, Bawa and Abubakar (2008) found no significant difference in achievement of male and female students taught linear equations using weighing balance approach. Galadima and Yusha (2007) discovered no significant gender differences in Mathematics achievement of students in learning mathematical concepts, principles, terms and symbols among senior secondary school students. It is evident from the various works highlighted that gender differences still exist while learning Mathematics.

2.13 Appraisal of the literature reviewed

The reviewed literature showed that the primary school level of education is considered significant in Mathematics education. This is because it is the foundation on which the secondary and the tertiary levels are built. The Mathematics curriculum is sequential and spiral in nature, which implies that a good background at the primary school level will enhance good performance at the other levels of education. The reviewed literature also revealed that pupils' conceptual development, interest and achievement in Mathematics was poor, which accounted for the poor achievement of students at the higher levels.

As evidenced in previous researches, game and poem are recommended to solve the problems of teaching Mathematics. The use of game in teaching Mathematics makes students to be actively involved in the daily lessons. It also provides unique opportunity for integrating the cognitive, affective and social aspects of learning and is academically rewarding.

Most studies on game in teaching Mathematics were carried out at the secondary school level. Also, game was used with other strategies, such as game and simulation; game and analogy; and two distinct games, like ladder and tunnel games, card and geoboard-based games, to determine the most effective strategy. The results revealed that the game instructional strategy improved students' interest, attitude, and achievement in Mathematics better than the other strategies. However, there is relatively no study that determines the effects of games and poems on learning outcomes in Mathematics at any level of education.

Many scholars claim that poetry should be used in teaching Mathematics to help pupils who are good at arts or writing to enable them learn Mathematics. Children are natural lovers of poetry and memorizing poetry increases a child's cognitive ability to reason, imagine, think, argue and experience the world in sensory and aesthetic ways. There is a great and growing body of linguistic and visual metaphors that aids a healthy understanding of Mathematics. Mastery of these concepts often involves creativity more readily expected of a poet than of a scientist.

Few studies have been carried out in some aspects of poetry, such as reading and writing, and in storytelling in Mathematics. The use of poetry in teaching Mathematics has been investigated in college Mathematics. However, such studies in Mathematics have not been carried out in Nigeria at any level of education. Therefore, this study determined the effects of game and poem-enhanced instructional strategies on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics. Besides, studies on gender and achievement in Mathematics are inconclusive. Investigation of verbal ability on pupils' learning outcomes in Mathematics is a relatively new development. Therefore, the study determined gender together with verbal ability as moderating variables on pupils' learning outcomes in Mathematics.

CHAPTER THREE

METHODOLOGY

This chapter deals with the research design, variables in the study, population and sample selection, research instruments, reliability and validity of the instruments, general procedure for treatment, data collection and method of data analysis.

3.1 Research design

This study adopted a pretest-posttest, control group, quasi-experimental design. The design is schematically represented as:

E_1:	0_1	x_1	0_2
E_2:	0_3	x_2	0_4
C:	0_5	x_3	0_6

Where:

0_1, 0_3, 0_5 represents pretest observation for both experimental and control groups.

0_2, 0_4, 0_6 represents posttest observation for both experimental and control groups.

X_1 represents treatment 1; poem-enhanced instructional strategy

X_2 represents treatment 2; game-enhanced instructional strategy

X_3 represents the modified lecture instructional strategy

This design also employs the 3x3x2 factorial matrix, shown in table 3.1

Table 3.1. 3x3x2 Factorial matrix of the design

Treatment	Gender	Verbal Ability		
		Low	Medium	High
Poem-Enhanced Instructional Strategy (PEIS)	Male			
	Female			
Game-Enhanced Instructional Strategy (GEIS)	Male			
	Female			
Modified Lecture Instructional Strategy (MLIS)	Male			
	Female			

3.2 Variables in the study

The variables considered in this study are:

3.2.1 Independent variables: The independent variable (instructional strategy) manipulated at three levels.

i. Poem-enhanced instructional strategy.

ii. Game-enhanced instructional strategy.

iii. Modified lecture instructional strategy.

3.2.2 Moderator variables

The following moderator variables were examined in the study.

i. Verbal ability, at three levels (high, medium, low)

ii. Gender, at two levels (male, female)

3.2.3 Dependent variables

There were three dependent variables.

i. Knowledge of mathematics concepts

ii. Interest in Mathematics.

iii. Achievement in Mathematics.

3.3 Selection of participants

Two local government areas in Bayelsa State and six schools in each local government areas were purposively selected and randomly assigned to treatment and control group. The selection of the local government areas was based on the following criteria:

(i) The local government areas must have roadways because of the state's terrain (rivers)

(ii) The local government areas must have at least six (6) public primary schools that have roadways.

The selection of the schools were based on the following criteria: (i) the schools must be public schools; (ii) the schools must have experienced teachers who possess teaching qualification and have been teaching Mathematics for not less than five years; and (iii) the teachers must be willing to be involved in the experiment.

Six (6) schools were randomly selected from one local government area; that is, a total of twelve (12) schools from two local government areas were used for the study. One intact class of primary six (6) pupils was randomly selected from each of the twelve public primary schools in the two local government areas. Two (2) schools each were randomly assigned to treatment (i.e. groups 1 and 2) making a total of four schools to treatment and two (2) schools to control group in one local government area. Also, the same number of schools was assigned to treatment and control group in the second local government area. A total of 344 pupils (males=164, females=180) were used.

3.4 Research instruments

Nine instruments were used in the study; namely:

1. Instructional Guide on Poem-Enhanced Instructional Strategy (IGPEIS)
2. Instructional Guide on Game-Enhanced Instructional Strategy (IGGEIS)
3. Instructional Guide on Modified Lecture Instructional Strategy (IGMLIS)
4. Pupils' Mathematics Achievement Test (PMAT)
5. Pupils' Mathematics Concepts Test (PMCT)
6. Pupils' Interest in Mathematics Inventory (PIMI)
7. Pupils' Verbal Ability Test (PVAT)
8. Teacher's Assessment Sheet for Poems (TASP)
9. Teacher's Assessment Sheet for Games (TASG)

3.5. Teachers' instructional guides

These were teaching guides prepared by the researcher for the teachers on Poem-Enhanced Instructional Strategy, Game-Enhanced Instructional Strategy and Modified Lecture Instructional Strategy. These were used during the training period for the experimental and control groups respectively.

3.5.1 Instructional Guide on Poem-Enhanced Instructional Strategy (IGPEIS).

The main features of the guide were general information, which consisted of subject, topic, and class. It also had the procedure, general objectives, teacher activities, pupils' activities, materials (poems' manuals), pupils' evaluation guide and contents to be taught for eight weeks.

Validation of Instructional Guide on Poem-Enhanced Instructional Strategy (IGPEIS)

The instructional guide (IGPEIS) was given to experienced Mathematics teachers teaching primary six (6) classes, lecturers in Teacher Education, Science/Mathematics unit and English Language unit, University of Ibadan, to examine its content and face validity. The appropriateness of the language used and images created in the poems to the age of the children were also examined. The recommendations given were used to reconstruct the guide.

3.5.2. Instructional Guide on Game-Enhanced Instructional Strategy (IGGEIS)

The main features of the guide were general information which consisted of subject, topic, and class. It also contained the procedure, general objectives, teacher activities, pupils' activities, deck of playing cards, game boards and game tokens, pupils' evaluation guide and title, objectives of the game, procedure, rules, and follow-up activities.

Validation of Instructional Guide on Game-Enhanced Instructional Strategy (IGGEIS)

The instructional guide on IGGEIS was given to experienced Mathematics teachers in primary schools that were teaching primary six (6), two lecturers in Teacher Education, Science/ Mathematics unit, University of Ibadan, to examine its content and face validity. The validity of IGGEIS was further ensured according to Pulos and Sneider's (1994) in Aremu (1998) model for game development and validation in terms of suitability, appropriateness, clarity of ideas, class level, scope and relevance to the study by two experts in the area of Educational Technology, Faculties of Education, University of Ibadan and Niger Delta University, Nigeria for scrutiny and amendments. The games also passed through the supervisor of the researcher for necessary corrections. The ratings 4, 3, 2, 1, and 0 on table 3.2 represent very good, good, average, poor and very poor respectively.

Table 3.2. Guidelines for games model validation

Contents	**4**	**3**	**2**	**1**	**0**
Relevance to learner's needs and ability					
Relevance of the objectives of the game					
Appropriateness of materials used					
Relevance of the game for the task to be learnt					
Attractive and sturdy					
Clarity of game					
Image familiar with the learner					
Balance ease, enjoyable with challenge					
Appropriate for the age of learners					
Learner's skill development					
Total					

3.5.2.1 Game development

The conceptual framework model adopted for the development and evaluation of the nine games is Pulos and Sneider (1994) in Aremu, (1998). The framework is based largely upon research and developments in cognitive science and developmental theories. The framework is based upon the challenge facing any game developer or evaluator. The tasks that determine the game:

(i) should include the necessary components of the concepts to be taught, that is component analysis.

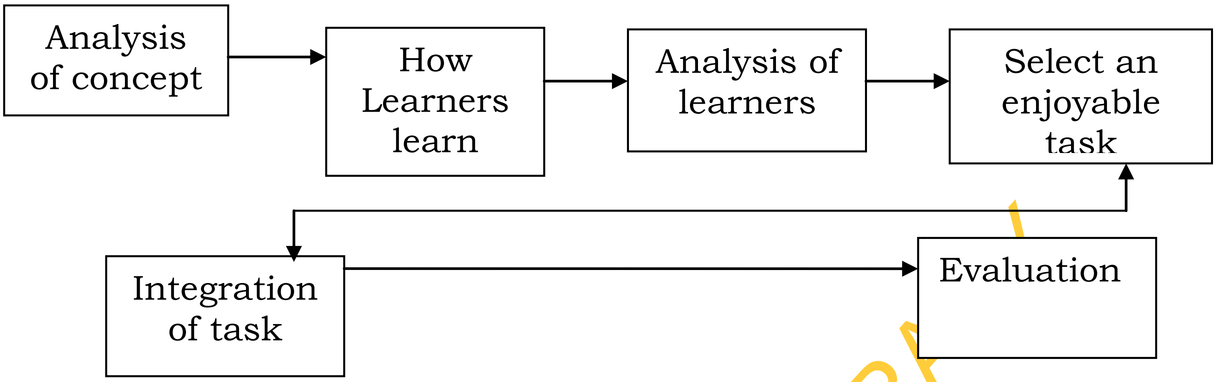
(ii) will help learners to learn the concepts

(iii) is likely to remove or reduce the difficulties students have in learning the concepts.

(iv) should be interactive and enjoyable

(v) should enhance learning.

Fig.1. Pulos and Sneider (1994) conceptual model for developing and evaluating games (adopted from Aremu, 1998)



Stage 1:

Analysis of concepts:

The concepts of this study were from the primary six mathematics curriculum. They are identified difficult topics by Salman (2009); (see appendix 7). The researcher also carried out a survey of difficult topics in the study area in the year 2010 and found similar result.

The topics were

1) Fraction and Decimal.
2) Volume.
3) Capacity.
4) Weight.
5) 2 and 3-Dimensional Figures

Stage 2:

How learners learn

The learning theory that supports the games discussed in this study is Operant Conditioning Theory proposed by B.F Skinner (1938). This has been thoroughly discussed in chapter two of this work.

Stage 3:

Analysis of learners

At this stage, each sub-concept was carefully considered to find out the similarities and differences that could confuse learners in learning the concepts. From the analysis and comments of teachers, the concepts that learners mixed up were identified.

All the identified misunderstood concepts were borne in mind in designing the games. The most misunderstood concepts were used more frequently in the games to ensure practice that leads to better understanding.

Stage 4

Selection of an enjoyable task

The games used in this study were popular and interesting card games adapted from the mathematical games developed by the National Mathematical Centre (NMC, 2002), Abuja. From the words of Professor Sam O. Ale, in the foreword, these games are useful and are recommended for use by teachers and pupils in the school system to improve the teaching and the learning process in Mathematics.

These games were

1. Expression Whot
2. Mathematics Palace Game
3. Capacity Board Game
4. Plane Figure Card Game
5. Circle Race Game, and
6. Mathematics Vocabulary Game

Stage 5

Integration

All the concepts that were analysed were integrated into the structure of the existing games and some were modified to suit the age and ability of the pupils and content to be taught in the classroom.

Stage 6:

Evaluation

These games were evaluated by the National Mathematical Centre (NMC), Abuja and were certified as good games for improving the teaching and learning of Mathematics by Professor Sam. O. Ale (NMC, 2002) as found in the foreword. They were further certified by other experts in educational technology.

3.5.3 Instructional Guide on Modified Lecture Instructional Strategy (IGMLIS)

This guide allowed some measure of interaction of pupils with teacher and materials without the poems and games. The main features of the guide were general information, which consisted of subject, topic, procedure, general objectives, teacher activities, and pupils' activities, contents for each week and pupils evaluation guide.

Validation of Instructional Guide on Modified Lecture Instructional Strategy (IGMLIS)

The instructional guide (IGMLIS) was given to experienced Mathematics teachers that were teaching primary six (6) for review and all their suggestions were considered in the guide.

3.6 Pupils' Mathematics Achievement Test (PMAT)

The PMAT was a twenty-five-item multiple choice test with four options A-D adapted from primary six pupils' Mathematics texts. This was to measure pupils' cognitive achievement in Mathematics. Section A contained the demographic data of the pupils, such as pupil number, school number, local government area, age, sex and class. Section B comprised twenty-five multiple choice items on fraction and decimal, volume, capacity, weight, 2 and 3- dimensional figures based on the curriculum and identified difficult topics (see appendix 7). The test items focused on the first three levels of cognitive domain: knowledge, comprehension, and application, as categorized by Okpala, Onocha and Oyedeji (1998) in Aremu (1998). The specification for the construction of PMAT is shown in table 3.3.

Table 3.3. Table of specification of Pupils' Mathematics Achievement Test (PMAT)

Topic	Knowledge	Comprehension	Application	Total
Fraction and Decimal (addition, subtraction, multiplication and division)	1 **(1)**	2, 3, 4 **(3)**	16, 17,18 **(3)**	**7**
Volume (cylinder, triangular prism and sphere)		10, 11, 20, 21 **(4)**	22 **(1)**	**5**
Capacity		5 **(1)**	9, 19 **(2)**	**3**
Weight	7 **(1)**	8 **(1)**	6 **(1)**	**3**
2 and 3-dimensional figures	12,13, 14, 23,24,25 **(6)**	15 **(1)**		**7**
Total	**8**	**10**	**7**	**25**

Validation and reliability of PMAT

To validate PMAT, fifty items were initially adopted from primary six pupils' Mathematics text and given to a test measurement expert; a lecturer who specialized in mathematics education as well as experienced primary six mathematics teachers with the table of specification to vet the structuring, adequacy, face and content validity as well as task level of the items. Based on the recommendation of these experts, eleven (11) items were expunged and others modified.

The modified test of thirty nine (39) items were administered to one hundred (100) primary six (6) pupils that were not involved in the real study to determine the discriminating indices for each item. The difficulty levels were computed manually by the researcher. The result of the analysis was used to pick twenty-five (25) items that were neither too difficult nor too easy and these were between 0.4 and 0.6. The twenty-five (25) items were then re-administered to fifty (50) pupils and a reliability coefficient of 0.72 was obtained using Kuder-Richardson formula 21 (KR-21)

3.7 Pupils' Mathematics Concepts Test (PMCT)

The PMCT was a twenty (20)-item multiple choice test with four options A-D constructed by the researcher to measure pupils' knowledge of mathematics concepts on the topics selected for the study. It was constructed based on what is involved in knowledge of mathematics concepts, given by Backhouse, Haggarty, Pirie and Stratton (1992); Nnaji (2005) and Binda (2006); that is, the words, symbols, principles, expressions, equations, formulae in Mathematics. Section A of PMCT contained the demographic data of pupils, such as pupil number, school number, local government area, age, sex and class. Section B consisted of twenty (20) items on the content areas.

Validation and reliability of PMCT

To validate PMCT, thirty six (36) items were initially developed and given to a test measurement expert; a lecturer who specialized in Mathematics Education as well as experienced primary six mathematics teachers to vet the structuring, adequacy, face and content validity as well as task level of the items. Based on the recommendation of these experts, some items were expunged and others modified.

The modified test, of thirty-two (32) items, were administered to one hundred (100) primary six (6) pupils that were not involved in the real study to determine the discriminating indices for each item and difficulty levels were computed manually by the researcher. The result of the analysis was used to pick twenty (20) items that were neither too difficult nor too easy and these were between 0.4 and 0.6. The twenty (20) items were then re-administered to fifty (50) pupils and a reliability coefficient of 0.81 was obtained using Kuder-Richardson formula 21 (KR-21).

3.8 Pupils' Interest in Mathematics Inventory (PIMI)

This instrument was adapted from Ekine (2010). It consisted of twenty items with which the pupils were to indicate their like and dislike for Science. Ekine (2010) noted that the instrument was structured as dichotomous (yes/no) inventory, because the primary school pupils could not respond clearly to a Likert scale used at first. Ekine (2010) citing Akinbote (1993) reported that the yes/no response mode have been found to be more appropriate and better understood by primary school pupils. The only change made on PIMI in this study was replacement of Science with Mathematics.

The instrument addressed three characteristics interest-oriented actions which include cognitive stabilization that shows a person's knowledge of the subject, emotional status and personal value of the person's interest. These three areas were considered in structuring the items in Mathematics. Ekine (2010) had a reliability coefficient of 0.79 using Cronbach Alpha.

Validation and reliability of PIMI

To validate PIMI, the twenty items were subjected to expert review to assess the content and face validity in respect of the suitability of language presentation, clarity and application to the investigation. The suggestions were incorporated into the items. The test items were then given to thirty (30) pupils that were not involved in the main study to determine the reliability of the scores using Kuder-Richardson 20 (KR-20), since the PIMI is structured dichotomous yes/no and had a reliability coefficient of 0.73.

3.9 Pupils' Verbal Ability Test (PVAT)

The PVAT was a thirty (30)-item test; an Intelligence Quotient (IQ) test for children called the Wechsler Intelligence Scale for Children Revised (WISC-R) test, adopted from Komolafe (2010). This revised edition was published in 1974, as WISC-R for children between the age ranges of 6-16 years (Wechsler, 1974). The only modification made by Komolafe was a careful selection taken into consideration, the cultural setting of the pupils, the school curriculum, among others, that are relevant to the level of the respondents. The instrument was to test pupils' ability to reason, discover differences and similarities between words, and also used to categorize pupils into high, medium and low verbal abilities. A correct answer attracted one (1) mark, while a wrong answer was scored zero (0). Pupils who score from 1-10 marks, 11-20 marks, and 21-30 marks were grouped as low, medium and high verbal abilities, respectively. The test was used as pre-test only. Komolafe (2010) had a reliability coefficient of 0.81 using KR-21.

Validation and reliability of PVAT

To validate PVAT, the test was given to lecturers in Language Education and two teachers teaching English Language in primary six classes to vet the structuring, clarity of language and appropriateness of the content in terms of its difficulty for primary six pupils. Then the test was administered to fifty (50) pupils that were not part of the main study to determine the reliability of the test using Kuder-Richardson 21 formula (KR-21), which yielded a reliability coefficient of 0.85.

3.10 Research procedure

The researcher obtained a letter of introduction from the Department of Teacher Education, University of Ibadan, to the head teachers of the selected schools to be allowed to use their schools, teachers and pupils for the study. This was necessary in order to seek the cooperation of the head teachers and primary six teachers that were involved in the study because the topics taught during the treatment period were not in order with the school scheme of work.

Preliminary activities

1. Training of teachers

The researcher personally visited the participating teachers in their respective local government areas and trained them on how to adhere strictly to the instructional and experimental procedures. Two teachers were trained as research assistants for each experimental group. They were asked to use the instructional guides IGPEIS and IGGEIS, while the teachers for control group were asked to adhere to the steps on the Instructional Guide on the Modified Lecture Instructional Strategy (IGMLIS). The first two weeks were used for training the participating primary six teachers in each of the local government areas by the researcher.

2. Pre-test

The third week was used for the administration of pre-test by the teachers and researcher in the order: PIMI, PMAT, PMCT and PVAT.

3. Procedure for treatment

The fourth to eleventh weeks (eight weeks) were used for the administration of the treatment to experimental groups (PEIS and GEIS) and control group (MLIS).

Experimental Group I: Steps in Instructional Guide on Poem-Enhanced Instructional Strategy (IGPEIS)

The pupils in this group were taught using the following steps:

Step1:

- The teacher briefly reviews the previous lesson/introduces the new topic.

Step 2:

- The teacher distributes the poems manuals to pupils.
- Pupils read the poems aloud (choral reading by the whole class, small groups in rows and individually at random).
- Pupils explain the images and dramatize or role-play the actions in the poems.
- Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.

Step 3:

- Teacher gives few problems to solve as class work.
- Teacher marks pupils' work and do corrections for them.
- Teacher concludes the lesson by giving home work to pupils.

2. **Experimental Group 2: Steps in Instructional Guide on Game-Enhanced Instructional Strategy (IGGEIS)**

Step1:

- The teacher briefly reviews the previous lesson/ introduces the new topic.

Step 2:

- Teacher teaches the new topic.
- Teacher rearranges the class/distributes game materials
- Teacher explains the game materials, rules and the objectives of the lesson.
- Pupils play the games with minimum teacher intervention

Step 3:

- Teacher's debriefing session, to further clarify the concept and problems.
- Follow-up activities by way of pupils coming to the board to solve problems/give assignment.
- Collection of materials and rearrange the class.

3. **Control Group: Steps in Instructional Guide on Modified Lecture Instructional Strategy (IGMLIS)**

Step1:

- Teacher reviews the previous lesson and introduces the new topic.

Step 2:

- Teacher teaches the new topic.
- Teacher draws models on the chalk board to represent the concept.

- Teacher allows some form of interaction with pupils (pupils ask questions and solve problems on the chalk board).
- Teacher allows pupils to copy the notes.

Step 3:

- Teacher gives pupils few problems to solve as class work.
- Teacher marks pupils' work and do corrections for them.
- Teacher concludes the lesson by giving home work to pupils.

4. Posttest

Week twelve was used for the administration of posttest by the teachers and researcher in the order: PIMI, PMAT and PMCT.

3.11 Method of Data Analysis

The data collected were analysed using Analysis of Covariance (ANCOVA). This was adopted to test the hypotheses using pre-test scores as covariates. Estimated Marginal Means (EMM) analysis was used to determine the magnitude of performance of the various groups. Scheffe's post-hoc test was also used when significant differences were observed to show the pairs of groups that were significantly different and to determine the direction of the difference.

CHAPTER FOUR

ANALYSIS AND RESULTS

This chapter presents the results and the interpretation of the analysis of data. Analysis of Covariance (ANCOVA) using pretest scores as covariates, Estimated Marginal Mean (EMM) analysis and Scheffe's multiple comparison test (post-hoc analysis) were used to test the null hypotheses at 0.05 level of significance. The results of the analysis of data are presented in Tables 4.1 to 4.18.

4.1 Testing of hypotheses

4.1.1 H0$_1$ (i): There is no significant main effect of treatment on pupils' achievement in Mathematics.

Table 4.1. 3x3x2 Analysis of Covariance (ANCOVA) of posttest scores of pupils' achievement in Mathematics with treatment, verbal ability and gender using pre-test scores as covariates

Source of variation	Type III Sum of Squares	Df	Mean Square	F-cal.	Sig.	Partial Eta squared
Corrected Model	5230.539	18	291.085	153.801	0.000	0.895
Intercept	398.600	1	398.600	210.608	0.000	0.393
Pretest scores	918.251	1	918.251	485.175	0.000	0.599
Treatment	529.293	2	269.647	142.473	0.000*	0.467
Verbal ability	136.037	2	68.019	35.939	0.000*	0.181
Gender	1.598	1	1.598	0.844	0.359	0.003
Treatment*Verbal ability	5.461	4	1.365	0.721	0.578	0.009
Treatment*Gender	1.663	2	0.831	0.439	0.645	0.003
Verbal ability*Gender	5.288	2	2.644	1.397	0.249	0.009
Treatment*Verbal ability*Gender	10.537	4	2.634	1.392	0.236	0.017
Error	615.101	325	1.893			
Total	89558.000	344				
Corrected Total	5854.640	343				

R. Squared = .895 (Adjusted R Squared = .889) * = Significant at $p < 0.05$ alpha level

Table 4.1 indicates that the main effect was significant on pupils' achievement in Mathematics ($F_{2, 325}$ = 142.473; $p < 0.05$; partial eta squared = 0.467), which gives an effect size of 46.7 percent. Thus, $H0_1$ (i) was not accepted.

Consequent upon the observed main effect, Table 4.2 is presented to determine the magnitude of the mean scores of the groups' performance.

Table 4.2. Estimated marginal mean analysis of the posttest scores of pupils' achievement in Mathematics by treatment

Grand Mean =15.575	Mean	Std Error	95% Confidence interval	
Treatment			Lower	Upper
GEIS	17.417	0.176	17.070	17.764
PEIS	16.400	0.203	16.001	16.799
MLIS	12.909	0.213	12.490	13.327

Table 4.2 shows that, the pupils exposed to GEIS had the highest adjusted posttest mean score of 17.417, followed by pupils exposed to PEIS, with a mean score of 16.400, while pupils exposed to MLIS had the lowest adjusted posttest mean score of 12.909. However, the grand mean was 15.575. The source of the significant difference obtained was determined using Scheffe's post-hoc test, as shown in Table 4.3

Table 4.3. Scheffe's post-hoc pairwise comparison analysis of treatment and pupils' achievement in Mathematics

Treatment	N	Mean	GEIS	PEIS	MLIS
GEIS	116	17.417		*	*
PEIS	128	16.400	*		*
MLIS	100	12.909	*	*	

*Pairs of group significantly different at $p < 0.05$.

Table 4.3 shows that pupils exposed to GEIS performed significantly better, with a mean score of 17.417, than pupils exposed to PEIS, with a mean score of 16.400. Also pupils exposed to PEIS were better than those exposed to MLIS, with a mean score of 12.909. This further indicates that the significant difference shown by the ANCOVA analysis was as a result of the difference between GEIS and PEIS, GEIS and MLIS as well as that of PEIS and MLIS.

4.1.2 $H0_1$ (ii): There is no significant main effect of treatment on pupils' knowledge of mathematics concepts.

Table 4.4. 3 x 3 x 2 Analysis of Covariance (ANCOVA) of posttest scores of pupils' knowledge of mathematics concepts with treatment, verbal ability and gender using pre-test scores as covariates

Source of variation	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta squared
Corrected Model	3829.104	18	212.728	94.824	0.000	0.840
Intercept	488.881	1	488.920	217.920	0.000	0.401
Pretest scores	933.110	1	933.110	415.937	0.000	0.561
Treatment	383.947	2	181.974	81.115	0.000*	0.333
Verbal ability	25.921	2	12.961	5.777	0.003*	0.034
Gender	0.980	1	0.980	0.437	0.509	0.001
Treatment*Verbal ability	24.505	4	6.126	2.731	0.029*	0.033
Treatment*Gender	11.271	2	5.636	2.512	0.083	0.015
Verbal ability*Gender	2.766	2	1.383	0.616	0.540	0.004
Treatment*Verbal ability*Gender	6.407	4	1.602	0.714	0.583	0.009
Error	729.102	325	2.243			
Total	61273.000	344				
Corrected Total	4558.206	343				

R. Squared = 0.840 (Adjusted R Squared = 0.831); * = Significant at $p < 0.05$ alpha level

Table 4.4 shows that the main effect was significant on pupils' knowledge of mathematics concepts ($F_{2, 325} = 81.115$; $p < 0.05$; partial eta squared = 0.333), which gives an effect size of 33.3 percent. Hence, the null hypothesis ($H0_1$ (ii)) was not accepted. To find the magnitude of the mean scores of performance of each group, Table 4.5 is presented.

Table 4.5. Estimated marginal mean analysis of the posttest scores of pupils' knowledge of mathematics concepts by treatment

Grand Mean = 12.812	Mean	Std Error	95% Confidence interval	
Treatment			Lower	Upper
GEIS	13.439	0.192	13.061	13.817
PEIS	14.429	0.221	13.994	14.863
MLIS	10.567	0.233	10.110	11.025

Table 4.5 shows that pupils exposed to PEIS had the highest adjusted posttest mean score of 14.429, followed by pupils exposed to GEIS, with mean score of 13.439, while pupils exposed to MLIS, had the lowest adjusted mean score of 10.567. However, the grand mean was 12.812. The source of the significant difference obtained was determined using Scheffe's post-hoc test, as shown in Table 4.6

Table 4.6. Scheffe's post-hoc pairwise comparison analysis of treatment and pupils' knowledge of mathematics concepts

Treatment	N	Mean	GEIS	PEIS	MLIS
GEIS	116	13.439		*	*
PEIS	128	14.429	*		*
MLIS	100	10.567	*	*	

*Pairs of group significantly different at $p < 0.05$.

Table 4.6 reveals that, pupils exposed to PEIS performed significantly better, with a mean score of 14.429 than pupils exposed to GEIS, with a mean score of 13.439. Also pupils exposed to GEIS, were better than those exposed to MLIS, with a mean score of 10.567. This further shows that the significant difference shown by the ANCOVA analysis was as a result of the difference between GEIS and PEIS, GEIS and MLIS as well as that of PEIS and MLIS. This means that the three groups differed in their mean scores on pupils' knowledge of mathematics concepts. This further implies that all the possible pairs contributed to the significant effect obtained on pupils' knowledge of mathematics concepts.

4.1.3. $H0_1$ (iii): There is no significant main effect of treatment on pupils' interest in Mathematics

Table 4.7. 3 x 3 x 2 Analysis of Covariance (ANCOVA) of posttest scores of pupils' interest in Mathematics with treatment, verbal ability and gender using pre-test scores as covariates

Source of variation	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta squared
Corrected Model	3696.065	18	205.337	124.682	0.000	0.874
Intercept	674.351	1	674.351	409.471	0.000	0.558
Pretest scores	765.782	1	765.782	464.988	0.000	0.589
Treatment	536.894	2	268.447	163.003	0.000*	0.501
Verbal ability	63.636	2	31.818	19.320	0.000*	0.106
Gender	0.639	1	0.639	0.388	0.534	0.001
Treatment*Verbal ability	15.573	4	3.893	2.364	0.053	0.028
Treatment*Gender	2.126	2	1.063	0.646	0.525	0.004
Verbal ability*Gender	5.040	2	2.520	1.530	0.218	0.009
Treatment*Verbal ability*Gender	14.089	4	3.522	2.139	0.076	0.026
Error	535.238	325	1.647			
Total	68228.000	344				
Corrected Total	4231.302	343				

R. Squared = .874 (Adjusted R Squared = .866) * = Significant at p < 0.05 alpha level

Table 4.7 indicates that the main effect was significant on pupils' interest in Mathematics ($F_{2, 325}$ = 163.003; p<0.05; partial eta squared = 0.501), which gives an effect size of 50.1 percent. Therefore, the null hypothesis $H0_1$ (iii) was not accepted. Consequent upon the observed main effect, estimated marginal mean analysis was used to determine the magnitude of the mean scores of the groups' performance, as shown in Table 4.8.

Table 4.8. Estimated marginal mean analysis of the posttest scores of pupils' interest in Mathematics by treatment

Grand Mean = 13.512	Mean	Std Error	95% Confidence interval	
Treatment			Lower	Upper
GEIS	14.411	0.167	14.083	14.739
PEIS	15.355	0.189	14.984	15.726
MLIS	10.772	0.197	10.385	11.158

Table 4.8, shows that the pupils exposed to PEIS had the highest adjusted posttest mean score of 15.355, followed by pupils exposed to GEIS, with a mean score of 14.411, while pupils exposed to MLIS, had the lowest adjusted posttest mean score of 10.772. However, the grand mean was 13.512. The source of the significant difference obtained was determined using Scheffe's post-hoc test, as shown in Table 4.9

Table 4.9. Scheffe's post-hoc pairwise comparison analysis of treatment and pupils' interest in Mathematics

Treatment	N	Mean	GEIS	PEIS	MLIS
GEIS	116	14.411		*	*
PEIS	128	15.355	*		*
MLIS	100	10.772	*	*	

*Pairs of group significantly different at p < 0.05.

Table 4.9 indicates that pupils exposed to PEIS performed significantly better, with a mean score of 15.355, than pupils exposed to GEIS, with a mean score of 14.411. Also pupils exposed to GEIS were better than those exposed to MLIS, with a mean score of 10.772. This further indicates that the significant difference shown by the ANCOVA analysis was as a result of the difference between GEIS and PEIS, GEIS and MLIS as well as that of PEIS and MLIS. This means that the three groups differed in their mean scores on pupils' interest in Mathematics. This further implies that all the possible pairs contributed to the significant effect obtained on pupils' interest in Mathematics.

4.2.1 $H0_2$ (i): There is no significant main effect of verbal ability on pupils' achievement in Mathematics.

Table 4.1 shows that the main effect was significant on pupils' achievement in Mathematics ($F_{2, 325}$=35.939; p<0.05; partial eta squared = 0.181), which gives an effect size of 18.1 percent. Hence, the null hypothesis ($H0_2$ (i)) was not accepted. Consequent upon the observed main effect, estimated marginal mean analysis was used to determine the magnitude of the mean scores of the groups' performance, as shown in Table 4.10.

Table 4.10. Estimated marginal mean analysis of the posttest scores of pupils' achievement in Mathematics by verbal ability

Grand Mean =15.575	Mean	Std Error	95% Confidence interval	
Verbal Ability			Lower	Upper
Low	13.945	0.188	13.574	14.315
Medium	15.986	0.109	15.771	16.200
High	16.796	0.342	16.124	17.468

Table 4.10 shows that, pupils with high verbal ability had the highest adjusted posttest mean score of 16.796, followed by pupils with medium verbal ability, with a mean score of 15.986, while pupils with low verbal ability had the lowest adjusted posttest mean score of 13.945. However, the grand mean was 15.575. The source of the significant difference obtained was determined, using Scheffe's post-hoc test, as shown in Table 4.11

Table 4.11. Scheffe's post-hoc pairwise comparison analysis of verbal ability and pupils' achievement in Mathematics

Verbal Ability	N	Mean	Low	Medium	High
Low	109	13.945		*	*
Medium	202	15.986	*		*
High	33	16.796	*	*	

*Pairs of group significantly different at $p < 0.05$.

Table 4.11 shows that, there was a significant difference on pupils' achievement in Mathematics. Pupils with low and medium verbal ability had a significant difference. Again, it was also revealed that a significant difference existed between pupils with low and high verbal ability. Similarly, a significant difference existed between pupils with medium and high verbal ability. This implies that the three groups differed in their mean scores on pupils' achievement in Mathematics. In other words, all the possible pairs contributed to the significant main effect obtained on pupils' achievement in Mathematics.

4.2.2 H0$_2$ (ii): There is no significant main effect of verbal ability on pupils' knowledge of mathematics concepts.

The result presented in Table 4.4 indicates that the main effect was significant on pupils' knowledge of mathematics concepts ($F_{2, 325} = 5.777$; $p<0.05$; partial eta squared = 0.034), which gives an effect size of 3.4 percent. Therefore, the null hypothesis $H0_2$ (ii) was not accepted. Consequent upon the observed main effect, estimated marginal mean analysis was used to determine the magnitude of the mean scores of the groups' performance, as shown in Table 4.12.

Table 4.12. Estimated marginal mean analysis of the posttest scores of pupils' Knowledge of mathematics concepts by verbal ability

Grand Mean =12.812	Mean	Std Error	95% Confidence interval	
Verbal Ability			Lower	Upper
Low	12.057	0.197	11.669	12.445
Medium	12.798	0.116	12.571	13.025
High	13.580	0.373	12.846	14.314

Table 4.12 indicates that, pupils with high verbal ability had the highest adjusted posttest mean score of 13.580, followed by pupils with medium verbal ability, had a mean score of 12.798, while pupils with low verbal ability, had the lowest adjusted posttest mean score of 12.057. However, the grand mean was 12.812. The source of the significant difference obtained was determined using Scheffe's post-hoc test, as shown in Table 4.13

Table 4.13. Scheffe's post-hoc pairwise comparison analysis of verbal ability and pupils' knowledge of mathematics concepts

Verbal Ability	N	Mean	Low	Medium	High
Low	109	12.057		*	*
Medium	202	12.798	*		*
High	33	13.580	*	*	

*Pairs of group significantly different at $p < 0.05$.

On pupils' knowledge of mathematics concepts, Table 4.13 shows that, pupils with low and medium verbal ability had a significant difference. A significant difference also existed between pupils with low and high verbal ability. Similarly, there was a significant difference between pupils with medium verbal ability and those with high verbal ability. This means that the three groups differed in their mean scores on pupils' knowledge of mathematics concepts. Thus, all the possible pairs therefore contributed to the significant main effect obtained on pupils' knowledge of mathematics concepts.

4.2.3 H0$_2$ (iii): There is no significant main effect of verbal ability on pupils' interest in Mathematics.

Table 4.7 reveals that the main effect was significant on pupils' interest in Mathematics ($F_{2, 325}$ = 19.320; p<0.05; partial eta squared = 0.106), which gives an effect size of 10.6 percent. Hence, the null hypothesis (H0$_2$ (iii) was not accepted. Estimated marginal mean analysis was used to determine the magnitude of the mean scores of the groups' performance, as shown in Table 4.14.

Table 4.14. Estimated marginal mean analysis of the posttest scores of pupils' interest in Mathematics by verbal ability

Grand Mean=13.512	Mean	Std Error	95% Confidence interval	
Verbal Ability			Lower	Upper
Low	12.524	0.159	12.211	12.837
Medium	13.759	0.097	13.568	13.950
High	14.255	0.312	13.640	14.870

Table 4.14 shows that pupils with high verbal ability had the highest adjusted posttest mean score of 14.255, followed by pupils with medium verbal ability, with a mean score of 13.759, while pupils with low verbal ability, had the lowest adjusted posttest mean score of 12.524. However, the grand mean was 13.512. The source of the significant difference obtained was determined using Scheffe's post-hoc test, as shown in Table 4.15

Table 4.15. Scheffe's post-hoc pairwise comparison analysis of verbal ability and pupils' interest in Mathematics

Verbal Ability	N	Mean	Low	Medium	High
Low	109	12.524		*	*
Medium	202	13.759	*		*
High	33	14.255	*	*	

*Pairs of group significantly different at p < 0.05.

Table 4.15 reveals that pupils with high verbal ability performed significantly better, with a mean score of 14.255 than pupils with medium verbal ability, with a mean score of 13.759. Also pupils with medium verbal ability were better, than those with low verbal ability, with a mean score of 12.524. This further shows that, the significant difference revealed by the ANCOVA analysis was as a result of the differences between high and medium verbal ability, high and low verbal ability, as well as that of medium and low verbal ability. This means that the three groups differed in their mean scores on pupils' interest in Mathematics. This further implies that all the possible pairs contributed to the significant effect obtained on pupils' interest in Mathematics.

4.3.1 H0$_3$ (i): There is no significant main effect of gender on pupils' achievement in Mathematics.

The result presented in Table 4.1 reveals that the main effect was not significant on pupils' achievement in Mathematics ($F_{1, 325}$ = 0.844; p>0.05; partial eta squared = 0.003). This gives an effect size of 0.3 percent. Hence, the null hypothesis (H0$_3$ (i)) was retained. This implies that gender had no main effect on the pupils' achievement in Mathematics.

Despite the fact that gender had no main effect on the pupils' achievement in Mathematics, there is need to determine the magnitude of the mean scores of the groups' performance, as shown in Table 4.16.

Table 4.16. Estimated marginal mean analysis of the posttest scores of pupils' achievement in Mathematics by gender

Grand Mean = 15.575	Mean	Std Error	95% Confidence interval	
Gender			Lower	Upper
Male	15.681	0.194	15.299	16.062
Female	15.470	0.126	15.222	15.719

The result presented in Table 4.16 shows that the male pupils had a posttest mean score of 15.681, higher than the female pupils, with posttest mean score of 15.470.

4.3.2 H0$_3$ (ii): There is no significant main effect of gender on pupils' knowledge of mathematics concepts.

The result presented in Table 4.4 indicates that the main effect was not significant on pupils' knowledge of mathematics concepts ($F_{1, 325}$ = 0.437; p>0.05; partial eta squared = 0.001), which gives an effect size of 0.1 percent. Therefore, the null hypothesis (H0$_3$ (ii)) was retained. This simply means that gender had no main effect on pupils' knowledge of mathematics concepts.

Despite the fact that gender had no main effect on the pupils' knowledge of mathematics concepts, there is need to determine the magnitude of the mean scores of the groups' performance, as shown in Table 4.17.

Table 4.17. Estimated marginal mean analysis of the posttest scores of pupils' knowledge of mathematics concepts by gender

Grand Mean = 12.812	Mean	Std Error	95% Confidence interval	
Gender			Lower	Upper
Male	12.729	0.213	12.310	13.147
Female	12.895	0.137	12.624	13.165

The result presented in Table 4.17 shows that the male pupils had a posttest mean score of 12.729, less than the female pupils, with a posttest mean score of 12.895.

4.3.3 $H0_3$ (iii): There is no significant main effect of gender on pupils' interest in Mathematics.

The result presented in Table 4.7 reveals that the main effect was not significant on pupils' interest in Mathematics ($F_{1, 325} = 0.388$; $p>0.05$; partial eta squared = 0.001). This gives an effect size of 0.1 percent. Hence, the null hypothesis ($H0_3$ (iii)) was retained. This implies that gender did not have main effect on the pupils' interest in Mathematics.

Despite the fact that gender had no main effect on the pupils' interest in Mathematics, there is need to determine the magnitude of the mean scores of the groups' performance, as indicated in Table 4.18.

Table 4.18. Estimated marginal mean analysis of the posttest scores of pupils' interest in Mathematics by gender

Grand Mean = 13.512	Mean	Std Error	95% Confidence interval	
Gender			Lower	Upper
Male	13.446	0.181	13.090	13.802
Female	13.579	0.118	13.347	13.811

The result presented in Table 4.18 indicates that the male pupils had a posttest mean score of 13.446, less than the female pupils with a posttest mean score of 13.579.

4.4.1 $H0_4$ (i): There is no significant interaction effect of treatment and verbal ability on pupils' achievement in Mathematics.

The result presented in Table 4.1 indicates that the interaction effect was not significant on pupils' achievement in Mathematics ($F_{4, 325} = 0.721$; $p>0.05$; partial eta squared = 0.009). This gives an effect size of 0.9 percent. Hence, the null hypothesis ($H0_4$ (i)) was upheld. This implies that treatment and verbal ability did not have interaction effect on pupils' achievement in Mathematics.

4.4.2 $H0_4$ (ii): There is no significant interaction effect of treatment and verbal ability on pupils' knowledge of mathematics concepts.

The result presented in Table 4.4 indicates that the interaction effect was significant on pupils' knowledge of mathematics concepts ($F_{4, 325} = 2.731$; $p < 0.05$ partial eta squared = 0.033). This gives an effect size of 3.3 percent. Therefore, the null hypothesis ($H0_4$ (ii) was not accepted. This implies that treatment and verbal ability had interaction effect on pupils' knowledge of mathematics concepts.

4.4.3 $H0_4$ (iii): There is no significant interaction effect of treatment and verbal ability on pupils' interest in Mathematics.

The result presented in Table 4.7 reveals that the interaction effect was not significant on pupils' interest in Mathematics ($F_{4, 325} = 2.364$; $p > 0.05$ partial eta squared = 0.028). This gives an effect size of 2.8 percent. Hence, the null hypothesis ($H0_4$ (iii)) was retained. This implies that treatment and verbal ability had no interaction effect on the pupils' interest in Mathematics

4.5.1 $H0_5$ (i): There is no significant interaction effect of treatment and gender on pupils' achievement in Mathematics.

The result presented in Table 4.1 indicates that the interaction effect was not significant on pupils' achievement in Mathematics ($F_{2, 325} = 0.439$; $p > 0.05$; partial eta squared = 0.003). This gives an effect size of 0.3 percent. Therefore, the null hypothesis ($H0_5$ (i)) was retained. This implies that treatment and gender had no interaction effect on the pupils' achievement in Mathematics.

4.5.2 $H0_5$ (ii): There is no significant interaction effect of treatment and gender on pupils' knowledge of mathematics concepts.

Table 4.4 shows that the interaction effect was not significant on pupils' knowledge of mathematics concepts ($F_{2, 325} = 2.512$; $p > 0.05$; partial eta squared = 0.015). This gives an effect size of 1.5 percent. Hence, the null hypothesis ($H0_5$ (ii)) was retained. The implication is that treatment and gender had no interaction effect on the pupils' knowledge of mathematics concepts.

4.5.3 $H0_5$ (iii): There is no significant interaction effect of treatment and gender on pupils' interest in Mathematics.

The result presented in Table 4.7 reveals that the interaction effect was not significant on pupils' interest in Mathematics ($F_{2, 325} = 0.646$; $p > 0.05$; partial eta squared = 0.004). This gives an effect size of 0.4 percent. Therefore, the null hypothesis ($H0_5$ (iii)) was retained. This implies that treatment and gender had no interaction effect on the pupils' interest in Mathematics.

4.6.1 $H0_6$ (i): There is no significant interaction effect of verbal ability and gender on pupils' achievement in Mathematics.

The result in Table 4.1 shows that the interaction effect was not significant on pupils' achievement in Mathematics ($F_{2, 325} = 1.397$; $p > 0.05$; partial eta squared = 0.009). This gives an effect size of 0.9 percent. Therefore, the null hypothesis ($H0_6$ (i)) was retained. This implies that verbal ability and gender did not have any interaction effect on the pupils' achievement in Mathematics.

4.6.2 $H0_6$ (ii): There is no significant interaction effect of verbal ability and gender on pupils' knowledge of mathematics concepts.

The result presented in Table 4.4 indicates that the interaction effect was not significant on pupils' knowledge of mathematics concepts ($F_{2, 325} = 0.616$; $p > 0.05$; partial eta squared = 0.004). This gives an effect size of 0.4 percent. Therefore, the null hypothesis ($H0_6$ (ii)) was retained. This implies that verbal ability and gender had no interaction effect on the pupils' knowledge of mathematics concepts.

4.6.3 $H0_6$ (iii): There is no significant interaction effect of verbal ability and gender on pupils' interest in Mathematics.

The result presented in Table 4.7 reveals that the interaction effect was not significant on pupils' interest in Mathematics ($F_{2, 325} = 1.530$; $p > 0.05$; partial eta squared = 0.009). This also gives an effect size of 0.9 percent. Therefore, the null hypothesis ($H0_6$ (iii)) was retained. This implies that verbal ability and gender had no interaction effect on the pupils' interest in Mathematics.

4.7.1 $H0_7$ (i): There is no significant interaction effect of treatment, verbal ability and gender on pupils' achievement in Mathematics.

Table 4.1 shows that the interaction effect was not significant on pupils' achievement in Mathematics ($F_{4, 325}$=1.392; p>0.05; partial eta squared = 0.017). This result gives an effect size of 1.7 percent. Hence, the null hypothesis ($H0_7$ (i)) was retained. This implies that treatment, verbal ability and gender had no interaction effect on the pupils' achievement in Mathematics.

4.7.2 $H0_7$ (ii): There is no significant interaction effect of treatment, verbal ability and gender on pupils' knowledge of mathematics concepts.

The result presented in Table 4.4 indicates that the interaction effect was not significant on pupils' knowledge of mathematics concepts ($F_{4, 325}$ = 0.714; p > 0.05; partial eta squared = 0.009). This gives an effect size of 0.9 percent. Therefore, the null hypothesis ($H0_7$ (ii)) was retained. This implies that treatment, verbal ability and gender had no interaction effect on the pupils' knowledge of mathematics concepts.

4.7.3 $H0_7$ (iii): There is no significant interaction effect of treatment, verbal ability and gender on pupils' interest in Mathematics.

Table 4.7 reveals that the interaction effect was not significant on pupils' interest in Mathematics ($F_{4, 325}$ = 2.139; p > 0.05; partial eta squared = 0.026). This gives an effect size of 2.6 percent. Hence, the null hypothesis ($H0_7$ (iii)) was upheld. This implies that treatment, verbal ability and gender had no interaction effect on pupils' interest in Mathematics.

4.2 Summary of findings

(1i). There was a significant main effect of treatment on pupils' achievement in Mathematics. Pupils exposed to GEIS were significantly better than those exposed to both PEIS and MLIS in their achievement in Mathematics. The result showed that 46.7 percent of the total variance of pupils' achievement in Mathematics was attributable to the influence of treatment.

(1ii). There was a significant main effect of treatment on pupils' knowledge of mathematics concepts. Pupils exposed to PEIS were significantly better than those exposed to both GEIS and MLIS in their knowledge of mathematics concepts. The result showed that 33.3 percent of the total variance of pupils' knowledge of mathematics concepts was attributable to the influence of treatment.

(1iii). There was a significant main effect of treatment on pupils' interest in Mathematics. Pupils exposed to PEIS were significantly better than those exposed to both GEIS and MLIS in their interest in Mathematics. The result indicates that 50.1 percent of the total variance of pupils' interest in Mathematics was attributable to the influence of treatment.

(2i). There was a significant main effect of verbal ability on pupils' achievement in Mathematics. Pupils with high verbal ability were significantly better than those with medium and low verbal ability respectively in their achievement in Mathematics. The result showed that 18.1 percent of the total variance of pupils' achievement in Mathematics was attributable to the influence of verbal ability.

(2ii). There was a significant main effect of verbal ability on pupils' knowledge of mathematics concepts. Pupils with high verbal ability were significantly better than those with both medium and low verbal ability in their knowledge of mathematics concepts. The result also showed that 3.4 percent of the total variance of pupils' knowledge of mathematics concepts was attributable to the influence of verbal ability.

(2iii). There was a significant main effect of verbal ability on pupils' interest in Mathematics. Pupils with high verbal ability were significantly better than those with both medium and low verbal ability in their interest in Mathematics. The result also revealed that 10.6 percent of the total variance of pupils' interest in Mathematics was attributable to the influence of verbal ability.

(3i). There was no significant main effect of gender on pupils' achievement in Mathematics.

(3ii). There was no significant main effect of gender on pupils' knowledge of mathematics concepts.

(3iii). There was no significant main effect of gender on pupils' interest in Mathematics.

(4i). There was no significant interaction effect of treatment and verbal ability on pupils' achievement in Mathematics.

(4ii). There was a significant interaction effect of treatment and verbal ability on pupils' knowledge of mathematics concepts. The result also revealed that 3.3 percent of the total variance of pupils' knowledge of mathematics concepts was attributable to the combined influence of treatment and verbal ability.

(4iii). There was no significant interaction effect of treatment and verbal ability on pupils' interest in Mathematics.

(5i). There was no significant interaction effect of treatment and gender on pupils' achievement in Mathematics.

(5ii). There was no significant interaction effect of treatment and gender on pupils' knowledge of mathematics concepts.

(5iii). There was no significant interaction effect of treatment and gender on pupils' interest in Mathematics.

(6i). There was no significant interaction effect of verbal ability and gender on pupils' achievement in Mathematics.

(6ii). There was no significant interaction effect of verbal ability and gender on pupils' knowledge of mathematics concepts.

(6iii). There was no significant interaction effect of verbal ability and gender on pupils' interest in Mathematics.

(7i). There was no significant interaction effect of treatment, verbal ability and gender on pupils' achievement in Mathematics.

(7ii). There was no significant interaction effect of treatment, verbal ability and gender on pupils' knowledge of mathematics concepts.

(7iii). There was no significant interaction effect of treatment, verbal ability and gender on pupils' interest in Mathematics.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDAITONS

This study determines the effects of game and poem-enhanced instructional strategies on pupils' learning outcomes in Mathematics. The effect of verbal ability and gender as moderator variables on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics was also examined. Seven hypotheses were tested at 0.05 level of significance. The discussion of result is presented in this chapter.

5.0 Discussion

5.1 Effect of treatment on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics

The findings from the study revealed that there was a significant main effect of treatment on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics. Pupils exposed to Game-Enhanced Instructional Strategy (GEIS) obtained the highest mean score, followed by pupils exposed to Poem-Enhanced Instructional Strategy (PEIS), while the pupils exposed to Modified Lecture Instructional Strategy (MLIS) had the least mean achievement score. This shows that the GEIS and PEIS were found to have facilitated achievement in Mathematics more than the MLIS.

The findings of the study are consistent with many previous studies on the effectiveness of the use of game in mathematics instruction (Aremu, 1998; Ezeamenyi in Udegbe, 2009; Dotun, 2005; Onwuka, Iweka and Moseri, 2010; Okigbo and Okeke 2011), that students who are exposed to game instructional strategy achieved significantly better in Mathematics than the lecture instructional strategy. On the use of PEIS, this study agrees with the views of Pugalee (2005), Bahls (2009) and Albool (2012) that poems and poetic aspects of learning Mathematics increase achievement in Mathematics.

The superiority of the GEIS over the PEIS in achievement could be as a result of the fact that pupils exposed to GEIS had the opportunity to solve whole mathematics problems while pupils in PEIS solved a part or step in mathematics problems because it was a role-play. Again the writing activity of PEIS also failed, which might have enhanced pupils' achievement in Mathematics. Also, that GEIS had advantage over MLIS, with an improved mean score, could be due to the fact that pupils exposed to GEIS were all actively involved in solving series of mathematics problems through games. This finding confirms the assertion of Abubakar and Bawa (2006) and Kankia (2008) that the use of game makes students to be actively involved in the daily lesson and academically rewarding. The pupils exposed to PEIS also had an edge over the MLIS group. This was because the pupils in PEIS were exposed to reading or reciting the poems, dramatizing or role-play and writing, which made them to be actively involved in parts of the lesson. This agrees with the findings established by the National Institute for Literacy (2007), that reading and writing skills improves students' capacity to learn. Urquhart (2009) and Burns (2004) aver that writing enhances the meta-cognitive aspect of learning Mathematics, problem-solving, and invention, increased reading and improved content understanding. This also confirms the statement of Owen (2010) and St.Cyr (2008) that memorizing poetry increases a child's cognitive ability, ability to reason, think, imagine and helps children's memory to learn, grow and expand in understanding and knowledge. However, the pupils exposed to MLIS were not exposed to group work, which promotes pupils' interaction and did not demonstrate any skill. This explains why their performance was not as good as the other groups (Majanga, Nasongo, and Sylvia, 2011).

The findings also revealed that pupils exposed to GEIS and PEIS had a significant difference in knowledge of mathematics concepts. Also GEIS and MLIS, then PEIS and MLIS had significant differences. This finding agrees with the assertion of Aremu (1998), Agwagah (2001) and other studies, that the use of game enhances greater understanding of mathematics concepts. Also, the use of poems in developing pupils' knowledge of mathematics concepts confirms the assertion of Bahls (2009), that mastery of mathematics concepts often involves creativity more readily expected of a poet than a scientist. With poetical metaphors, students become more aware of mathematical metaphors and gain deeper understanding of mathematics concepts those metaphors describe.

The advantage PEIS had over GEIS could be as a result of the opportunity pupils of the PEIS group had, that is repeatedly reciting the poems beyond the classroom, which helped them to examine and re-examine mathematical ideas (Bahls, 2009). This is in conformity with the claim of St. Cyr (2008) and LeFebvre (2004) that the repetitive nature of poems helps children's memory to learn, expand and build listening skills.

Furthermore, the findings also showed that pupils exposed to PEIS had significantly better mean interest score than pupils exposed to MLIS. Also pupils exposed to GEIS were better than those exposed to MLIS. Similarly, there was a significant difference between those exposed to GEIS and PEIS (see Table 4.9). This implies that the significant difference shown by the ANCOVA analysis was as a result of the difference between GEIS and PEIS, GEIS and MLIS as well as that of PEIS and MLIS. These findings agree with the findings of Ezeamenyi in Udegbe (2009) that students taught with game achieved more and generate more interest than those taught with the lecture strategy. It also supports the findings of Okigbo and Okeke (2011), that game was effective in improving students' interest in Mathematics.

Also pupils exposed to PEIS had better mean interest scores than those exposed to GEIS and MLIS. This supports the assertion of St Cyr (2008), that children are natural lovers of poetry. Also, Mazzuco (1994) noted that children have a natural affinity for poetry. Ekine (2010), found a significant main effect of treatment on pupils' interest in primary science. All these results show that learner friendly strategies should be adopted in the teaching and learning of science, mathematics and technology (Aremu, 2008). These factors must have accounted for the better interest mean scores of GEIS and PEIS over MLIS. This confirms the assertions of some mathematics educators that the lecture instructional strategy diminishes students' interest in Mathematics, does not sustain the development of pupils' interest in Mathematics and poorly develops learners' cognitive, psychomotor and affective structures (Peng, 2002; Agwagah, 2004; Kankia, 2008).

5.2 Effect of verbal ability on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics

The result showed that pupils with high verbal ability obtained the highest mean achievement score, followed by the medium verbal ability group, while pupils with low verbal ability obtained the lowest mean achievement score. The study confirms the findings of Idogo (2011) that the high verbal ability group performed better than the average and low verbal ability pupils in reading and comprehension skills. Also, Awofala et al. (2011) lend credence to this finding that the high verbal ability students perform significantly better than the low verbal ability students in mathematical word problems. Hall in Binda (2006) found a positive correlation between students' verbal ability and Mathematics achievement, stressing that, when students are strong in verbal abilities, their understanding of Mathematics will be enhanced. Also, Iti (2005) found significant difference of verbal ability in the achievement of pupils in primary science. However, Oladunjoye (2003) and Adeosun (2004) assert that learners' verbal ability does not have any effect on learners' academic achievement in their various studies.

This study also showed that pupils of high verbal ability obtained the highest mean score, followed by medium verbal ability pupils, while the low verbal ability pupils obtained the lowest mean score in knowledge of mathematics concepts. Mathematics itself is a language (Amoo and Rahman, 2004; Akinsola, 2005) and understanding this language needs some level of verbal ability. Binda (2006) found a weak but positive correlation between the language of Mathematics and achievement in Mathematics. This confirms the findings of this study, that verbal ability significantly affects pupils' knowledge of mathematics concepts. Thus, pupils' level of verbal ability may enhance or impede a better performance in understanding the language of mathematics, which this study has established. This further justifies the findings of Awofala et al. (2011), that pupils with high verbal ability obtained the highest mean achievement score in worded mathematics problems, which depends on the understanding of the language of mathematics that is knowledge of mathematics concepts.

The findings of the study revealed that the high verbal ability group obtained the highest mean interest score, followed by the medium verbal ability pupils, while the low verbal ability group obtained the lowest mean interest score. This result contradicts Iti (2005), who found no significant difference of verbal ability on primary 3 pupils' interest in science. It also contends with the findings of Komolafe (2010) that there is no significant effect of verbal ability on primary 4 and primary 5 pupils' attitude in composition writing. This study found a significant effect of verbal ability on primary 6 pupils' interest in Mathematics. The difference in the results of these studies could be the nature of the instruments used for data collection. The interest and attitude scales of Iti (2005) and Komolafe

(2010) are on a four-point adapted Likert scale which according to Akinbote in Ekine (2010), note that the yes/no response mode, has been found to be more appropriate and better understood by the primary school pupils. Iti (2005) attributed the non-significant effect of verbal ability on pupils' interest in primary science to the method of data collection and immaturity of the pupils to appreciate what is of interest to them. Komolafe (2010), citing Akinbote (1999), gave a similar report.

However, the findings of this study are in conformity with those of Yoloye (2004), who notes that when students' level of participation in an instruction increases, students' interest is aroused; consequently their achievement also increases. Lazar (2004) asserts that verbal fluency of pupils determines easy understanding, comprehension and recall. The above reports are practical, especially in PEIS, where pupils boldly read, explain, write and role-play the actions in the poems.

5.3 Effect of gender on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics.

The findings of this study showed that there was no significant difference in the mean achievement scores of male and female pupils in Mathematics. This finding supports the report of Bawa and Abubakar (2008), who found no significant difference in the achievement of male and female students, taught linear equations using weighing balance approach. It also lend credence to the report of Ebisine (2010) that both male and female students had no significant difference in the level of difficulties encountered in understanding non-technical words in multiple choice mathematics tests. Contrary reports were made by Ogunkunle (2007), Onasanya (2008) and Shafi and Areelu (2010) that males achieved significantly better than females in Mathematics. However, Ogunkunle (2007) concludes that the result does not show any gender superiority. Also Muthukrishna (2010) and Eniayeju (2010) reported that the females achieved significantly better than the male students in Mathematics.

The result further showed that there was no significant main effect of gender on pupils' knowledge of mathematics concepts. The result of this study supports Inekwe (1997) and Galadima and Yusha (2007), who did not find significant differences of gender on pupils' knowledge of mathematics concepts.

Both male and female students performed poorly in the test administered on mathematics concepts, principles, terms and symbols.

The study also revealed no significant effect of gender on pupils' interest in Mathematics. The results of this study support the findings of Okigbo and Okeke (2011), who found no significant difference in the mean scores of males and females, using game and analogy, on the interest of students in Mathematics. It also supports Imoko and Agwagah (2006), that concepts mapping technique enhanced male and female students' interest in trigonometry. Iti (2005) also found no significant main effect of gender on pupils' interest in primary science. However, a contradicting finding was reported by Ekine (2010), that female pupils obtained a higher mean interest score in primary science than their male counterparts.

5.4 Interaction effect of treatment and verbal ability on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics

The study showed that the interaction effect of treatment and verbal ability was not significant on pupils' achievement in and interest in Mathematics. This implies that no particular treatment mode favoured one verbal ability group more than the other; neither did any of the instructional strategies facilitated learning more than the other. The result supports the assertion of Wilkinson and Ortiz (2000) and Komolafe (2010) that treatment of a group of learners and their verbal ability do not have anything to do with achievement of the learners in and attitude in language learning. This, however, negates the findings of Iti (2005) and Awofala et al. (2011), who used two levels of verbal ability in primary science and mathematical word problems on achievement, respectively. The study also showed that the interaction effect of treatment and verbal ability was found significant on pupils' knowledge of mathematics concepts. Therefore, the teacher must take into consideration the treatment he/she gives to the pupils along with their verbal ability levels in order for all to improve their performance equally, since different verbal ability pupils are in the same class.

5.5 Interaction effect of treatment and gender on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics

The results of the study showed that there was no significant interaction effect of treatment and gender on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics. This implies that treatment is gender insensitive; in other words, the effects of treatment on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics does not vary from male to female. This result lends credence to the findings of Aremu (1998), Olagunju (2001), Imoko and Agwagah (2006), Ekine (2010) and Okigbo and Okeke (2011). It, therefore, follows that teachers of Mathematics should apply games and poems to enhance mathematics instruction irrespective of the pupils' gender in order to improve their achievement, knowledge of mathematics concepts and interest in Mathematics.

5.6 Interaction effect of verbal ability and gender on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics

The findings of the study revealed no significant interaction effect of verbal ability and gender on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics. These findings agree with those of Adeosun (2004), Iti (2005) and Komolafe (2010), who found no significant interaction effect of verbal ability and gender on the dependent variables. The result, suggests that verbal ability and gender do not interact to affect pupils' achievement, knowledge of mathematics concepts and interest in Mathematics. Therefore, teachers should realize that irrespective of the level of pupils' verbal ability and their gender, the learners are teachable and their performance can improve in Mathematics.

5.7 Interaction effect of treatment, verbal ability and gender on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics

The results of the study showed that there was no significant interaction effect of treatment, verbal ability and gender on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics. The results support those of Olowoyaiye (2004) and Komolafe (2010) on achievement measure. This result is also consistent with the findings of Iti (2005) and Awofala et al. (2011), that treatment, verbal ability and gender/cognitive style have no significant interaction effect on primary science and mathematics, respectively. The result implies that pupils' achievement, knowledge of mathematics concepts and interest in Mathematics do not vary according to high verbal ability male and female, medium verbal ability male and female and low verbal ability male and female. That is, games and poems could be used to improve pupils' achievement, knowledge of mathematics concepts and interest in Mathematics irrespective of their verbal ability and gender.

5.8 Educational implications of the study

The study has the following implications for classroom practices.

The findings in this study revealed that the use of game-enhanced instructional strategy is more effective in improving the achievement of pupils in mathematics at the primary school level. The implication of this to classroom teaching is that the achievement of pupils in primary mathematics will be enhanced with the introduction of game-enhanced instructional strategy in the teaching and learning process.

The use of poem-enhanced instructional strategy is more effective in improving pupils' knowledge of mathematics concepts and interest in Mathematics. This implies that, if teachers are encouraged to create and use poems in the mathematics classroom, it will enhance pupils' understanding and recall of mathematics concepts readily and also improve their interest in mathematics.

The significant verbal ability on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics is worthy of note as the high verbal ability pupils had higher mean score in all the variables of study. The implication of this to classroom teaching is that the medium and low verbal ability pupils' are at disadvantage and so appropriate measures be taken to enhance these two levels of verbal abilities of pupils. One way is to engage all public primary school pupils from primary one to primary six in the verbal reasoning exercise, which some of the schools in this study area are doing.

A non-significant main effect of gender on pupils' achievement, knowledge of mathematics concepts and interest in Mathematics was observed. The implication is that boys and girls can learn mathematics without much difference at the primary school level. It therefore means that both boys and girls could be given the same opportunity in the classroom and exposed to the same activities like responding to questions without fear and intimidation. It then implies that game and poem-enhanced instructional strategies are good for this purpose.

5.9 Conclusion

On the basis of the findings in this study, it could be concluded that:

Game-enhanced instructional strategy is most effective in improving pupils' achievement in Mathematics, while poem-enhanced instructional strategy is most effective in improving pupils' knowledge of mathematics concepts and interest in Mathematics. Therefore, GEIS and PEIS are better activities to improve pupils' achievement, knowledge of mathematics concepts and interest in Mathematics than the modified lecture instructional strategy.

Pupils' verbal ability has a significant effect on pupils' achievement, knowledge of mathematics concepts and interest in mathematics. Thus, pupils' verbal ability has a significant role to play in learning Mathematics.

Gender difference in achievement, knowledge of mathematics concepts and interest in Mathematics was not significant. Thus, females can perform as good as the males in mathematics. Therefore, teachers should give equal attention to the two groups while teaching mathematics.

5.10 Recommendations

Based on the findings of this study, the following recommendations are made:

Mathematics teachers should use games and poems to enhance pupils' achievement, knowledge of mathematics concepts and interest in Mathematics. Teachers of Mathematics should give special attention to the use of poems to enhance pupils' knowledge of mathematics concepts and interest in Mathematics.

Teachers should find a means of enhancing the verbal ability of the pupils by engaging all public primary school pupils in the verbal reasoning exercise taught in schools. Another way is to use activities like poems, where every child is involved in reading, writing, verbal communication with the whole class and teachers.

Teachers should give both males and females' equal opportunity to ask and respond to questions without fear and intimidation in the classroom. This will create conducive learning environment for both boys and girls and also enhance their performance in mathematics.

The National Mathematical Centre (NMC) and the state government should embark on in-service training for Mathematics teachers to equip them with new skills, such as the use of games and poems needed for effective teaching.

Nigeria Educational Research and Development Council (NERDC) should emphasize that teachers should embrace the use of innovative strategies, like the use of games and poems while implementing the Mathematics curriculum. Games and poems should be included in the curriculum as activities to enhance mathematics instruction.

Authors of mathematics text books should write books on mathematical poems as they have done on mathematical games for easy access and use.

5.11 Limitations of the study

There were many factors that constituted one impediment or the other to this study. Some of them are mentioned below.

It was not possible to go round all the public primary schools in Bayelsa State to carry out the investigation; only 2 local government areas out of 8 were used in the study. Within the local government areas, only 12 schools were used and only primary 6 pupils were used. This militated against the generalizability of the results of the study.

On the moderating variables, only verbal ability and gender were considered among other variables. All these may impose a limitation on the extent to which the results of this study could be generalized. The duration of the experiment was another major constraint. The period of 8 weeks for treatment may not be adequate for a comprehensive study. Therefore, it imposed a limitation on generalization of results.

Also, not all the pupils in the classes could read and write. Thus, the writing activity of the pupils of the poem-enhanced instructional strategy failed because most pupils could not write their poems meaningfully, and as poets. This must have made the game-enhanced instructional strategy have an edge over the poem-enhanced instructional strategy in achievement test.

5.12 Suggestions for further study

In view of the fact that this study was carried out using only public primary schools, further studies could be done using private schools. The use of only public schools for the study was done to ensure relatively uniform standard of schools and pupils in the conduct of the research.

The use of games and poems to enhance mathematics instruction can further be replicated in other local government areas of the state and any state of the federation.

The study can also be carried out at the secondary school level since the writing activity of the poem-enhanced instructional strategy failed at the primary school level.

This study can also be further investigated with other mathematics concepts not used in this study.

REFERENCES

AAAS. 1990. The American Association for the Advancement of Science. The nature of Mathematics. Retrieved March 15, 2011, from http://www.project2061.org/publications/sfaa/online/chap2.htm

Abakporo, J.E. 2005. Effective problem solving in mathematics: challenges and prospects. *Journal of Issues on Mathematics STAN* 8.1:19-33.

Abubakar, B. and Bawa, M. 2006. Effect of the use of number base game on senior secondary school students' achievement in number bases. *ABACUS: Journal of Mathematical Association of Nigeria* 31.1:103-114.

Aburime, F.E. 2007. Challenges of universal basic education: a quasi-experimental study of the role of manipulative. *ABACUS: Journal of the Mathematical Association of Nigeria* 32.1: 133- 144.

Adeniyi, M.E. 1988. Mathematics in secondary schools. *ABACUS. Journal of the Mathematical Association of Nigeria* 18. 1: 89-90.

Adeosun, A. O. 2004. Relative effects of prior language experience and whole language base instructional strategies on students' achievement in and attitude to composition in English. Ph.D. Thesis, University of Ibadan 11 + 154pp.

Adesina, A. E. 2011. Perceived impact of primary education on the attainment of Nigeria vision 20:2020. *Mediterranean Journal of Social Sciences* 2.5: 61-69. Retrieved March 14, 2012, from http://www.mcser.org/images/stories/MJSS-special-issues/MJSS-october2011/adesina.pdf.

Adesoji, F. A. 2004. Science and curriculum development: an unpublished M.ED lecture note.

Adetula, L.O. 2001. Potential generators of interest in Mathematics. A paper presented during a workshop for mathematics teachers of primary and secondary school in South East Geopolitical Region at Asaba; June 23-30th.

Aguele, L. I. and Usman, K. O. 2007. Mathematics education for dynamic economy in Nigeria in the 21st century. *Journal of Social Science* 15.3: 293-296. Retrieved March 23, 2012, from www.krepublishers.com/.../JSS-15-3-293-07-613-Aguele-L-I-Tt.pdf

Agwagah, U.N.V. 1996. Instructional deficiency in some secondary schools Mathematics: challenge of mathematics educators for future mathematics education. A paper presented at the 33rd Annual Conference of Mathematical Association of Nigeria (MAN) held at Ilorin.

______. 2001. *Mathematical Games for Primary Schools.* Nsukka: Mike Social Press.

______. 2004. Sustaining development in secondary school mathematics through constructivist framework: a model lesson plan. *ABACUS: Journal of the Mathematical Association of Nigeria* 29. 1: 29-38.

______. 2005. Teaching Mathematics for critical thinking, essential skill for effective living. *ABACUS: Journal of the Mathematical Association of Nigeria* 30.1: 38-45.

______. 2006. Primary Mathematics and Information and Communication Technology (ICT). *ABACUS: Journal of the Mathematical Association of Nigeria* 31.1:11-26.

______. 2008. Mathematics beyond calculation: aesthetic values. *ABACUS. Journal of the mathematical Association of Nigeria* 33. 1: 70-79.

Akinsola, M.K. and Popoola A.A. 2004. A comparative study of the effectiveness of two strategies of solving mathematics problems on the academic achievement of secondary school students. *ABACUS: Journal of Mathematical Association of Nigeria* 29. 1: 67-76.

Akinsola, M. K. 2005. Mathematics and language: any relationship? *Issues in language communication and education.* A. Dada, A. Abimbade and C.O. O. Kolawole. Eds, Ibadan, Constellation Books. 324-331.

Akpan, A. A. 1988. The Relationship between performance in mathematics, problem-solving and effective behaviour among secondary schools students. *Nigerian Education Forum* 11. 1: 22-23.

Albool, M. R. 2012.The effect of utilizing storytelling strategy in teaching mathematics on grade four students' achievement and motivation towards learning mathematics. Retrieved Nov. 27, 2012 from www.pixel.online.net/edu...1354-ITL54-FP-Albool-FOE2012.pdf-Cached

Alio, B.C. and Harbor-Peters, V.F. 2000. Effect of polya's problems solving technique on secondary school students' achievement in mathematics. *ABACUS: Journal of Mathematical Association of Nigeria* 25.1: 27-39.

Alvermann, D. E. 2002. Effective literacy instruction for adolescents. Journal of Literacy Research 34. 2:189-208. Retrieved April 1, 2009, from http://www.coe.uga.edu/reading/faculty/alvermann/effective2.pdf

Amao, A. T. 2010. Effect of medium of instruction on pupils' participation an achievement in two core subjects in selected primary schools in Osun State. PhD. Thesis.Dept. of Teacher Education. University of Ibadan, Ibadan.

Amazigo, J. C. 2002. Mathematics phobia; diagnosis and prescription. National Mathematical Centre, First Annual Lecture: Abuja.

Amoo, S.A. and Onasanya, W.A. 2010. Maintaining gender-free culture in mathematics classroom practice in junior secondary schools for the attainment of millennium development goals. *ABACUS: Journal of Mathematical Association of Nigeria* 35. 1: 70-79.

Amoo, S. A. and Rahman, M. A. 2004. Secondary school students' attitude to learning of mathematics in the world of information and technology: implications for mathematics teachers and teacher preparation. *Journal of the Science Teachers' Association of Nigeria* 45.34: 175-187

Anaduaka, U. S. 2011. The Multiple intelligences teaching method and mathematics teaching. *JORIND*. 9. 1: 116-123. Retrieved March 23, 2012, from www.transcampus.org/journals,www.ajol.info/journals/jorind

Apex, M. C. 2002. Mathematics in technological development: focus in the next millennium. A paper presented at the 39th annual conference of the Mathematical Association of Nigeria, MAN, 29th August, 2-4.

Aremu, A. I998. Effects of card and geoboard game-based instructional strategies on primary school pupils' achievement in practical geometry. PhD. Thesis. Dept. of Teacher Education University of Ibadan, Ibadan.

Aremu, S. A. 2008. A cry for help: endangered species in the science and technology classrooms. A paper presented at the staff and higher degree seminar of teacher education department, University of Ibadan.

Asoegwu, A. O. 2008. Problems and prospects of gender and STM education in curriculum development in Nigeria. Science Teachers' Association of Nigeria. 49th annual conference proceedings. HEBN (PLC), 186-188.

Ausubel, D. 1963. *The psychology of meaningful verbal learning.* New York: Grune and Stratton.

_______. 1978. In defense of advance organizers: a reply to the critics. *Review of Educational Research* 48: 251-257.

Awofala, A .O. A, Balogun, T. A. and Olagunju, M. A. 2011. Effects of three modes of personalisation on students' achievement in mathematical word problems in Nigeria. Retrieved March 15, 2012, from www.cimt.plymouth.ac.uk/journal/awofala.pdf

Ayebola, P.A. 2006. The relevance of literature in English to Science Students: The UNAAB Experience ASSET Series C 1.1

Azuka, B. 2002. Strategies for popularization of mathematics in secondary schools. Proceedings of the Workshop for Re-Training Mathematics Teachers at the University of Nigeria Secondary School, Nsukka. 9th – 11th December. 57-62.

_______. 2008. Use of mathematical kits in teaching measurement in schools. *National Mathematical Centre (NMC), Training Workshop*. Abuja: Marvelous Mike Press Ltd. 22-40

Backhouse, J.; Haggarty, Li; Pirie, S. and Stratton, J. 1992. *Improving the Learning of Mathematics*. London: Cassel.

Badmus, G. A. 2002. Interest and attitude as correlates of mathematics achievements of secondary school students. Unpublished Paper presented in the Faculty of Education, University of Benin.

Bahls, P. 2009. Mathematics and metaphor: using poetry to teach college mathematics. *The WAC Journal* 20. 75-90. Retrieved Nov. 12, 2011, from http://wac.colostate.edu/journal/vol20/bahls.pdf

Balakrishnan, C. 2008. Teaching secondary school mathematics through storytelling. Retrieved March 11, 2010 from http://www.bing.com/search?srch=1068FORM=AS68q=TEACHING+SECONDARY+SCHOOL+MATHEMATICS

Bassey, S. W., Joshua, M. T. and Asim, A. E. 2009. Gender differences and mathematics achievement of rural senior secondary students in Cross River State, Nigeria. Retrieved March 15, 2012, from cys.gnowledge.org/epistem3/pro_pdfs/09-bassy-joshua-asim.pdf

Bawa, M. and Abubakar, B. 2008. The effect of using weighing balance approach on junior secondary school students' performance in the learning of linear equations. ABACUS: Journal of Mathematical Association of Nigeria 33.1: 89-98.

Binda, S.I. 2006. The relationship between understanding the language of mathematics and performance in mathematics. *ABACUS: Journal of the Mathematical Association of Nigeria* 31. 1: 94-102.

Boeree, C. G. 2006. B.F. Skinner: 1904-1990. Retrieved, Dec. 17, 2011, from http://webspace.ship.edu/cgboer/skinner.htm

Burns, M. 2004. Writing in Mathematics. *Educational Leadership* 30-33.

Califonia Infant/ Toddler Learning and Development Foundations. 2010. Cognitive development domain. Retrieved March 10, 2012, from http://www.slideshare.net/.../cognitive-and-language-d...-unitedstates-cached.

Cooper, S. 2009. Theories of learning in educational psychology. David Ausubel: meaningful verbal learning and subsumption theory. Retrieved Nov. 3, 2011, from http://www.lifecircles inc.com/Learningtheories/constructivism/ ausubel...

Dahiru, B.M. 2010. Practical approach to the teaching of directed numbers operations. *ABACUS: Journal of the Mathematical Association of Nigeria* 35. 1: 106-114.

Dalton, E. 2007. The effect of higher-order learning games on problem solving ability and effect toward mathematics among college remdial pre-calculus students. Retrieved May 22, 2011 from gaeacoop.org/Dalton/publications/math_games.pdf-Cached-Similar

Darling-Hammond, L. 2000. Teacher quality and student achievement. A review of state policy evidence, Stanford University. Retrieved June, 10, 2005 from http://wwwericaenet

Diaw, P. W. 2009. The influence of storytelling as prewriting activity (in the writing process) on narrative writing in the no child left behind learning environment. Retrieved Nov. 27, 2012 from http:/proquest.umi.com/pqdweb?index=18&did=1850721671&SrchMode= 18sid=4&Fml=6&Vlnst=PROD&Vtype=PQD&RQT=309&Vname=PQD& TS=1268306771&clientld=131697.

Dotun, F. 2005. Mathematical game for teaching simple substitution of values into algebraic expressions. *Journal of Issues on Mathematics STAN* 8. 1: 97-105.

Ebisine, S.S. 2010. Difficulties encountered by senior secondary school students' in understanding non-technical words in mathematics multiple choice tests. *ABACUS: Journal of the Mathematical Association of Nigeria* 35. 1: 97-105.

Eccles, J. S; Denissen, J. J. and Zarret, N. R. 2007. I Like to do it, I'm able, and I know I am: longitudinal couplings between domain-specific achievement, self concept and interest. *Child Development* 78. 2: 430-447.

Ekine, A. O. 2010. Impact of videotaped instructional strategies on pupils' interest and achievement in primary science in selected private schools in Ibadan, Nigeria. PhD. Thesis. Dept. of Teacher Education. University of Ibadan, Ibadan.

Eniayeju, A.A. 2010. Effects of cooperative learning strategy on the achievements of primary six boys and girls in mathematics. *ABACUS: Journal of Mathematical Association of Nigeria* 35. 1: 1-9.

Eraikhuemen, L. and Oteze, K.I. 2008. Students' choice of mathematics as a course of study: implications for scientific and technological development. *ABACUS: Journal of Mathematical Association of Nigeria* 33. 1: 64-69.

ESA, 2004. Nigeria education sector analysis, monitoring of learning achievement project; assessment of learning achievement of primary four & primary six pupils. Federal ministry of education, Abuja.

Etukudo, U.E. 2002. Effect of computer assisted instruction on gender and performance of junior secondary school students' in mathematics. *ABACUS: Journal of Mathematical Association of Nigeria* 27. 1: 1-8.

________. 2006. Refocusing primary school mathematics curriculum to reflect everyday mathematics skills need of the learners. *ABACUS: Journal of the mathematical Association of Nigeria* 31. 1: 67-79.

Eze, J.E. 2007. Repositioning mathematics education for job creation: implication for tertiary education. *ABACUS: Journal of the Mathematical Association of Nigeria* 32. 1: 145-153.

______. 2008. Effect of mapping heuristic on students' achievement and retention in mathematics. *ABACUS: Journal of the Mathematical Association of Nigeria* 33. 1: 80-88.

Fakeye, D. O. 2006. Componential analysis as a model of ESL vocabulary instruction. *African Journal of Educational Research* 10. 1&2: 14-24.

Federal Ministry of Education. 2004. *National policy on education*. Lagos: NERDC press.

Federal Republic of Nigeria (FRN). 2013. *National policy on education*. 6th edition; Lagos: NERDC press.

Fennema, E. 1995. Gender equity for mathematics and science (GEMS). Retrieved June 28, 2005, from http://www.wordrom.org.teachersmath/gender

Foundation for Critical Thinking. 2004. The Critical Thinking Community. Retrieved Dec. 2010 from *www.criticalthinking.org.*

Galadima, I. and Yusha'u, M.A. 2007. An investigation into mathematics performance of senior secondary school students in Sokoto State. *ABACUS: Journal of Mathematical Association for Nigeria* 52. 1: 24-33.

Gershon, J.D.; Guwal, T.P. and Awuya, M.A. 2008. Factors that inhibit the teaching and learning of word problems involving fractions. *Journal of Issues on Mathematics STAN* 11.1: 61-66.

Harbor- Peters, V.F.A. 2000. Mathematics language for the new millennium: implication to the society. Proceedings of the 37th Annual Conference of Man.

___________. 2001. Unmasking some aversive aspect of schools mathematics and strategies for averting them. Inaugural lecture. Enugu: University of Nigeria.

__________. 2001: The target and formal methods of presenting some secondary school geometric concepts: Their effects on retention. *Journal of Studies in Curriculum* 1. 1: 95-97.

_________. 2002. Teaching strategies. Proceedings of the Workshop for Re-Training Mathematics Teachers at the University of Nigeria Secondary School, Nsukka: Ucheakonam Foundation, Nig. Ltd. Nsukka, Abuja.

Haury, D. L. 2001. Literature-based mathematics in elementary school. Eric Digest. Retrieved Nov. 3, 2011,from http://www.ericdigests.org/2003-1/school.htm

Hogan, I.E.C. 2002. The teaching of geometry in schools. *Journal of Issues on Mathematics STAN* 5. 1: 8-13.

__________. 2005. Basic skills and strategies for the teaching of word problems and algebra at the primary level. *Journal of Issues on Mathematics (STAN)* 8.1: 34-40

Hyde, J .S. and Mertz, J . E. 2009. Gender, culture and mathematics performance. Retrieved March, 23, 2012, from http://tctvideo.madison.com/uw/gender.pdf.

Ibrahim, G. 2004. The state of further mathematics curriculum in secondary schools of Sokoto and Zamfara States. *ABACUS. Journal of Mathematical Association of Nigeria* 29. 1: 24-28.

Idogo, G. 2011. Instructional strategies in primary schools in Ibadan North Local Government Area: An empirical investigation of the effects on children basic reading and comprehension skills. Retrieved August, 5, 2012 from sachajournals.com/documents/G.IdogoAJETI.PDF-Cached

Iji, C.O and Harbor – Peters' V.F.A. 2005. Effects of logo and basic programs on achievement in geometry of junior secondary school students. *ABACUS. Journal of the Mathematical Association of Nigeria* 30. 1: 67-77

Iji, C.O. 2007. Challenges of primary mathematics for universal basic education (UBE). *ABACUS: Journal of the Mathematical Association of Nigeria* 32. 1: 14-23.

_____. 2008. Conceptual descriptions for teaching and learning of fractions. *Journal of Issues on Mathematics STAN 11*. 1: 42-47.

_____. 2008. Relationship between mathematics knowledge of Nigerian Certificate in Education (NCE) mathematics students and their performance in computer science. *ABACUS: Journal of the Mathematical Association of Nigeria* 33. 1: 42-48.

_____. 2010. Actualizing mathematics achievement and retention among primary school pupils using interactive logo programming package. *ABACUS: Journal of the Mathematical Association of Nigeria* 35. 1: 80-90.

Imoko, I. B and Agwagah, U. N. V. 2006. Improving students' interest in mathematics through the concept mapping technique: a focus on gender. *Journal of research in curriculum and teaching* 1.1: 30-38

Inekwe, O.I. 1997. Algebraic and geometric reasoning difficulties affecting remediation at the secondary level. *Journal of Sokoto Educational Review* 4. 1: 83-92.

Iti, P. 2005. Effect of teaching with songs and rhymes on interest, class participation and achievement of pupils in primary science. M.ED. Thesis. Dept. of Teacher Education.University of Ibadan. Ibadan.

Juhun, I.U. and Momoh, J.S. 2001. The effects of environment and sex on mathematics achievement of junior secondary school three students in Kwara State. *ABACUS: Journal of Mathematical Association of Nigeria* 27. 1: 53-58.

Kankia, A.D. 2008. A strategy for effective learning of natural sciences in Nigeria secondary schools. *ABACUS: Journal of the Mathematical Association of Nigeria* 33.1: 99-109.

Kankia, A.D. 2008. The importance of games in the teaching and learning of lowest common multiples of numbers in overcrowded junior secondary classes. *Journal Issues on Mathematics (STAN)* 11. 1: 1-12.

Kojigili S.T., Tumba, P. and Zira, D.J. 2007. Perception of primary teachers on the effective implementation of mathematics curriculum in the universal basic education (UBE) Programme. *ABACUS: Journal of the Mathematical Association of Mathematics Nigeria* 32. 1: 154-163.

Koko, G.M. 2008. Teaching and learning of fractions in primary schools using practical approach. *Journal Issues on Mathematics (STAN)* 11. 1: 53-60.

Kolawole, E.B. and Oluwatayo, J.A. 2006. Societal mathematics and information communication technology: *ABACUS: Journal of the Mathematical Association of Nigeria* 31. 1: 115-121.

Komolafe, A. T. 2010. Impact of sentence combining and explicit grammar instructional strategies on primary school pupils' achievement in and attitude to composition writing. PhD. Thesis. Dept. of Teacher Education. University of Ibadan, Ibadan.

Kurumeh, M.S and Imoko, B.I. 2008. Universal basic education: a way forward for the development of primary school pupils in mathematics education. *ABACUS. Journal of the Mathematical Association of Nigeria* 33.1: 49-56

Kurumeh, M.S. 2006. Effect of ethno-mathematics approach on students' achievement in geometry and mensuration. *ABACUS: Journal of Mathematical Association of Nigeria* 31.1: 35-44.

__________. 2007. Effect of ethno-mathematics approach on students' interest in geometry and Mensuration. *ABACUS: Journal of the Mathematical Association of Nigeria*. 32.1: 103-114.

Kwok, C.C. 2009. Tips to help children understand mathematics Concepts. Retrieved November 5, 2010, from http://www.helium.com/items/1475787-tips-for-understanding-maths-...

Lazar, M. 2004. Iteractive music strategies for the academic curriculum. New horizon for learning U.S.A. Retrieved Nov. 2010 from *http.//.www.newhorizon.org/.mailto.*

LeFebvre, J.E. 2004. Parenting the Preschooler. Rhyme and alliteration. Retrieved Oct. 2011, from http://www.uwex.edu/ces/flp/pp/

Maduabuchi, C.H. 2008. Effects of three modes of graphic organizers on senior secondary school II students' comprehension and attitude to expository and narrative texts. PhD. Thesis. Dept. of Teacher Education. University of Ibadan, Ibadan.

Maduabuchi, N. 2002. Methods of teaching vocabulary in secondary schools. M.ED Project. Dept. of Teacher Education. University of Ibadan. Ibadan.

Maduabum, M.A. and Odili, G.O. 2007. Trends in male and female students' performance in senior school certificate further mathematics in Nigeria: A survey. *ABACUS: Journal of the Mathematical Association of Nigeria* 32. 1: 115-123.

Maduagwu, S.N. 2002. The place of primary schools in Nigeria educational system. *Nigeria Journal of Professional Studies in Education NJPSE* 8. 56: 48-52.

Majanga, E. K., Nasongo, J. W. and Sylvia, V. K. 2011. The Effect of class size on classroom interaction during mathematics discourse in the wake of free primary education: A study of public primary schools in Nakuru Municipality. *Current research Journal of Social Sciences* 3. 1: 44-49. Retrieved March 26, 2012, from *journaldatabase.org/journal/issn2041-3238*

Mazzucco, R. 1994. Sharing poetry with children. Retrieved January 1, 2010, from http://www.yale.edu/ynti/curriculum/units/1994/.../94.02.x.html-cached

Muthukrishna, N. 2010. Gender differences in mathematics achievement: an exploratory study in primary school in Kwazulu-Natal. Retrieved March 16, 2012, from http:/readperiodicals.com/201012/2187713391.htm

NAUBEP, 2009. .National Assessment of the Universal Basic Education Programme. Final report.

National Council of Teachers of Mathematics (NCTM). 2000. Principles and standard for school mathematics. Reston, VA: Author.

National Council of Teachers of Mathematics (NCTM). 2000. Reasoning and proof. Principles and standards for school mathematics. Reston VA: Author.

National Council of Teachers of Mathematics (NCTM).1989. Curriculum and evaluation standards for school mathematics. Reston VA: Author.

National Examination Council (NECO). 2008. *National Examination Examiner's Report.*

National Institute for Literacy. 2007. What content area teachers should know about adolescent literacy. Washington, DC: Author.

National Mathematical Centre (NMC). 2002. *Mathematical games for secondary school.* Abuja: Marvelous Mike Venture.

Nnaji, L.N. 2005. Concepts and algorihms in teaching word problems and algebraic expressions. *Journal of Issues on Mathematics (STAN)*. 8. 1:41-50

Nnaji, L.N. 2008. Tables to enhance the teaching and learning of fractions. *Journal of Issues on Mathematics (STAN)* 11. 1:73-77.

Nurudeen, T.S. 2007. Secondary school students' misconceptions in solving mathematics problems. *ABACUS: Journal of Mathematical Association of Nigeria* 32.1:84-102.

Obioma, G. 2005. Emerging issues in mathematics education in Nigeria with emphasis on the strategies for effective teaching and learning of word problems and algebraic expressions. *Journal of Issues on Mathematics STAN* 8. 1: 1-8.

Obiniyi, A.A. 2005. The personal digital assistant: A key to understanding mathematics. *ABACUS: Journal of the Mathematical Association of Nigeria* 31.1: 86-93.

Obodo, G. C. 2000. Mathematics – A language for computers in the new millennium: implications for Nigeria. Proceedings of the 37th annual national conference of MAN.

___________. 1997. *Principles and practice of mathematics education in Nigeria.* Enugu: General studies division, University of Science and Technology.

Odebode, S. O. 2001. Re- examining gender balance education in agricultural science, technology and mathematics in Nigeria: An overview. Ibadan, Nigeria.

Odili, G.A. 2006. *Mathematics in Nigeria secondary schools: A teaching perspective.* Port-Harcourt: Rex Charles and Patrick Ltd.

Ogunkunle, R.A. 2007. Effects of gender on the mathematics achievement of students in constructivist and non-constructivist groups in secondary schools. *ABACUS: Journal of Mathematical Association of Nigeria* 32.1: 42-50.

Ohuche, R.O. 1990. *Explore mathematics with your children.* Onitsha: Summer Educational Publishers Ltd.

Ohuche, R.O. and Ali, A. 1989. *Teaching senior secondary schools mathematics creatively. A book of methods.* Onitsha: Summer Educational Publisher (Nig.) Ltd.

Ojo, S.G. 2008. *Generating interest of pupils in mathematics. National mathematical centre (NMC), training workshop,* Abuja: Marvelous Mike Press Ltd. 41-45.

Okigbo, E. C. and Okeke, S. O. C. 2011. Effects of games and analogies on students interest in mathematics. Retrieved March 23, 2012, from stanonline.org/journal/pdf/JSTAN- Ebele&Sam%2011.pdf

Okigbo, E.C. 2008. Sustaining learners' interest in percentages, fractions and decimals through games. *Journal of Issues on Mathematics STAN* 11.1: 30-34.

Okoli, J. N. 2006. Effects of investigative laboratory approach and expository method on acquisition of science process skills by biology students of different levels of scientific literacy. *Journal of the Science Teachers' Association of Nigeria* STAN 41. 1&2: 79-88.

Okpala, N. P. 2006. Researching learning outcomes at the basic education level in Nigeria. Inaugural lecture, Ibadan: University of Ibadan.

Oladunjoye, S. A. O. 2003. The relationship between verbal ability and achievement in English Language: A case study of senior secondary 11 students. *African journal of educational research* 9, 1&2: 97-99

Olagunju, A. M. 2001. Increasing girls' interest, participation and achievement in science. A paper presented in 42nd STAN annual conference proceedings .p 288

Olayinka, A.Y. 2006. A survey of problems in the teaching of mathematics in secondary schools in Damaturu Local Government Area of Yobe State. *ABACUS: Journal of the Mathematical Association of Nigeria* 31.1:130-142.

Olkun, S. and Toluk, Z. 2005. Textbooks, word problems and students' success on addition and subtraction. Retrieved May, 13, 2005, from http://www.exac.uk/cimt/ijmetl/olkun.pdf

Olowojaiye, F. B. 2004. Effects of behavioral objective-based and study question-based outcomes in senior secondary mathematics in Lagos State. Ph.D Thesis, University of Ibadan, Ibadan 11 + 208

Olokun, M. 2005. Language influences on the learning of mathematical word problems. *Journal of Issues on Mathematics (STAN)* 8. 1:10-18

Onasanya, A.W. 2008. Effectiveness of team teaching in mathematics with respect to universal basic education. *ABACUS: Journal of Mathematical Association of Nigeria* 33.1:1-5.

Onwuka, P.I., Iweka .S. and Moseri, P.O. 2010. Games and simulation for teaching selected concepts in basic mathematics. *ABACUS: Journal of the Mathematical Association of Nigeria* 35.1: 115-119.

Opolot-Okurot, C. 2005. Students' attitudes to toward mathematics in Uganda secondary schools. *African Journal of Research in Mathematics, Science and Technology Education* 9. 2: 167- 174.

Osafehinti, I.O. 1993. Mathematics language and mathematics achievement at pre-university level. *ABACUS: Journal of the Mathematical Association of Nigeria* 23. 1:73-87.

Osinubu, O. 2004. Constructivist methods of teaching a meta cognitive strategy as determinants of learning outcomes in primary school science. PhD. Thesis. Institute of Education. University of Ibadan. Ibadan.

Owen, C. 2010. The Importance of memorizing poetry in childhood. Retrieved November 27, 2010, from http://catherineowen.suite101.com/the-importance-of-memorizing-poe...

Pappas, T. 1999. Mathematical footprints: discovering mathematical impressions all around us. San Carlos, CA: Wide World Publishing, p.149.

Peng, G. 2002. Two students-centred teaching methods in mathematics. The China papers. Retrieved on March 26, 2012, from Sydney.edu.au/science/umserve_science/pubs/china/vol1/peng.pdf

Pollak, H.O. 1986. The Effects of technology on the mathematics curriculum. In C. Marjorie (ed.). Proceedings of the fifth international congress on mathematical education. Boston: Birkhauser. Inc.

Pugalee, D. K. 2004. A comparison of verbal and written descriptions of students' problem-solving processes. *Educational studies in mathematics* 55: 27-47.

Pugalee, D. K. 2005. Writing to develop mathematical understanding. Norwood, MA: Christopher- Gordon.

Reys, B. J. 1989. The calculator as a tool for instruction and learning. New directions for elementary school mathematics. NCTM 1989 Yearbook, 168-176.

Salau, M.O. 2000. Options in sustaining mathematics as the language of science and technology in the 21st century. Proceedings of September 2000 annual conference of mathematical association of Nigeria. 41-60.

Salman, M. F. 2009. Active learning techniques (ALT) in a mathematics workshop: Nigerian primary school teachers' assessment. *International electronic journal of mathematics education* 4,1. Retrieved March 14, 2012, from www.iejme.com

Shafi, A. and Areelu, F. 2010. The effect of improvised instructional materials on students' performance in solid geometry. *ABACUS: Journal of mathematical association of Nigeria* 35.1:46-52.

Shirley, J. M. 2008. Storyteller, story teacher: A portrait of three teachers' use of story in elementary classes. Retrieved March 15, 2010 from http://etd.qsu.edu/theses/available/etd 07262005-161522/unsrestricted/shirley james m 200508 phd.pdf.

Skinner, B . F. 1938. Behavior of organisms. Appleton-Century-Crofts.

Slideshare, 2011. Cognitive learning theories and its implication on science classroom teaching. Retrieved December 3, 2011, from http://www.Slideshare.net/niena17/learnjng-theory-by-ausubel

Soyemi, B.O. 2003. Students' dictionary of mathematics educare foundation projects in collaboration with O.S and associated limited. Publishers' Text and Leisure Publishers' Co. Nig.

St.Cyr, L. 2008. How to teach poetry to kids. Retrieved Nov. 27, 2010, from http://www.helium.com/items/1178174-teaching-poetry-children-poe...

STAN. 2000. Communique issue at the end of the 12th session of the mathematics panel workshop; *Issues on Mathematics Education:* 110-112.

Sternberg, R.J. and Grigorenko, E.L. 2004. Why we need to explore development in its cultural context: Merrill-Palmer Quarterly. 50. 3:369-386

Udegbe, G.I. 2009. Students' interest as an important factor in improving the teaching and learning of mathematics. Proceedings of the annual national conference of the mathematical association of Nigeria. September. 77-83.

Ugwuanyi, C. 2002. Generating interest in the teaching and learning of sequences and series through the use of games and simulation. *Journal of issues on mathematics STAN* 5,1:40-50

Ugwuanyi, C. 2005. Introducing word problems to primary school children. *Journal of issues on mathematics STAN* 8.1: 51-58.

Ukeje, B.O. and Obioma, G. 2002. *Mathematical games for primary and secondary school*. Abuja: National Mathematical Centre, Sheda, Nigeria.

Ukeje, B.O. 1997. The challenges of mathematics in Nigeria economic goals of vision 2010: implication for secondary school mathematics. A lead paper presented at the 34th annual national conference of the mathematical association of Nigeria (MAN).

Ukpebor, N.J. 2006. The use of information and communication technology as instructional material in school mathematics: implication for secondary schools. *ABACUS: Journal of mathematical association of Nigeria* 31.1: 80-86.

Urquhart, V. 2009. Using writing in mathematics to deepen student learning. Retrieved Oct. 5, 2011, from http://www.mcrel.org/pdf/mathematics/0121tg_writing_in_mathematics.pdf

Wechsler, D. 1974. The Wechsler intelligence scale for children-revised. New York: psychological corporation.

West African Examination Council (WAEC). 2001. West African Secondary School Certificate Examination May/June 1998/2002: Nigeria statistics of entries and results: Lagos.

West African Examination Council (WAEC). 2005. Chief examiners' report of West African Examination Council.

West African Examination Council (WAEC). 2009. Chief examiners' report in senior secondary certificate examinations in mathematics.

Yoloye, T. W. 2004. That we may learn better. Inaugural lecture, University of Ibadan

Wilkinson, C. Y. and Ortiz, A. 2000. Test review: the bilingual verbal abilities tests (BVAT). Communique, 28, 2-3. Retrieved April 7, 2002, from *http:/www.nku.edu/-walkerst/ceds.htm*

Wilmot, E. M. 2001. Gender differences in mathematics achievement in primary schools in Ghana. Retrieved June 2, 2012 from *www.ajol.info/index.php/mc/article/view/21479*

Zazkis, R. and Lijedahl, P. 2009. Teaching mathematics as storytelling. Retrieved Dec. 19, 2010 from *http://www.sensepublishers.com/catalog/files/978908 7907358PR. pdf*

APPENDICES

Appendix 1

PUPILS' MATHEMATICS ACHIEVEMENT TEST (PMAT)

Instruction: Answer all the questions. Use pencil to tick the correct option on the answer sheet provided. Do not write on the question paper.

Time Allowed: 1hour

1. Arrange the following fractions in descending order. ¾ , $^4/_5$, ½ , $^9/_{10}$.

   (a) ¾, ½, $^9/_{10}$, $^4/_5$ (b) $^9/_{10}$, $^4/_5$, ¾, ½, (c) ½, ¾, $^4/_5$, $^9/_{10}$

   (d) $^4/_5$, ½ , ¾, $^4/_5$

2. Calculate the value of 5 $^2/_3$ – 1½ + 3 $^3/_4$

   (a) $8^1/_3$ (b) 3¼ (c) $7^{11}/_{12}$ (d) $^5/_{12}$.

3. Find the difference between 188.371 and 240.642.

   (a) 51.271 (b) 52.271 (c) 62.271 (d) 52.371.

4. Find the product of 6.02 x 0.4.

   (a) 2408 (b) 240.8 (c) 2.408 (d) 24.08

5. Simplify 8950 litres + 10,000 litres + 9,050 litres giving your answer in kilolitres.

   (a) 28kl (b) 280kl (c) 2.8kl (d) 2800kl

6. An empty box weighing 0.95kg is filled with 36 tins of milk, each of which weighs 0.75kg. What is the total weight of the box?

   (a) 27kg (b) 28kg (c) 26kg (d) 27.95kg.

7. Express 11.75kg in grams.

   (a) 117.50g (b) 11750g (c) 1175g (d) 117500g

8. The weights of five boys are 45kg, 42kg, 40kg, 36kg and 37kg. Find the average weight of the boys.

   (a) 35kg (b) 40kg (c) 50kg (d) 25kg

9. A tank measures 100cm long by 40cm wide and it is filled with water up to a depth of 30cm. What is the capacity of the tank in litres?

   (a) 120litres (b) 1200litres (c) 170litres (d) 195litres.

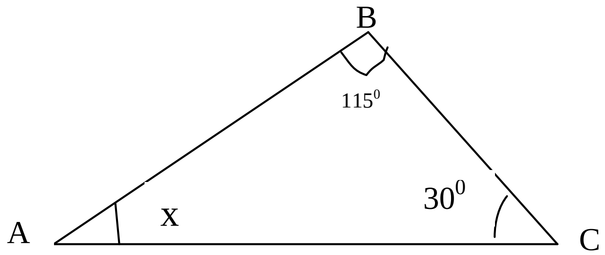
10. Calculate the volume of a triangular prism whose base area is $6cm^2$ and height 25cm.

    (a) $300cm^3$ (b) $32cm^3$ (c) $100cm^3$ (d) $150cm^3$

11. What is the volume of a sphere whose radius is 3cm? (Take π = 3.14cm).

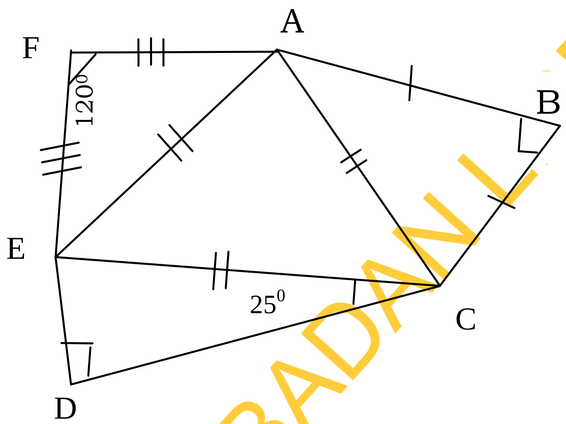
    (a) $113.14cm^3$ (b) $112.04cm^3$ (c) $103.04cm^3$ (d) $113.04cm^3$

12. Find the size of the marked angle



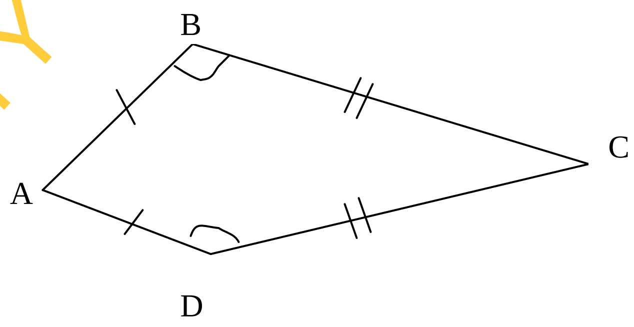
(a) 85^0 (b) 20^0 (c) 35^0 (d) 25^0

13. In the diagram below, name the triangle that is equilateral.



(a) ABC (b) EDC (c) AFE (d) ACE

14. The diagram below is a kite. How many lines of symmetry do a kite has.



(a) 1 (b) 2 (c) 3 (d) 4.

15. Calculate the sum of angles of a 4-sided polygon?

(a) 540^0 (b) 180^0 (c) 360^0 (d) 720^0

16. A nail $3\ ^2/_5$cm is driven into a piece of wood. If $2\ ^3/_{10}$ cm of the nail protrudes from the surface, what is the length of the nail embedded in the wood?

(a) $5\ ^3/_{10}$cm (b) $1\ ^4/_{10}$cm (c) $5\ ^2/_5$cm (d) $1\ ^1/_{10}$ cm.

17. In a class, there are 39 pupils. If $^1/_3$ of them wear spectacles, how many pupils do not wear spectacles?

(a) 26 (b) 23 (c) 13 (d) 24

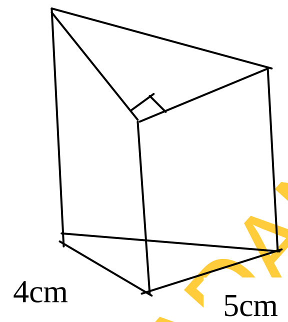
18. A dress requires 2.7m of cloth. How many such dresses can be made from a piece of cloth measuring 45.9m?

(a) 43.2 (b) 17 (c) 123.93 (d) 48.6.

19. A 504 saloon car consumes 1 litre of petrol covering a distance of 9km. How many litres of petrol will it consume for a journey of 288km?

(a) 25 litres (b) 20 litres (c) 32 litres (d) 9 litres

20. Calculate the height of the triangular prism below if its volume is 140cm^3.



(a) 20cm (b) 9cm (c) 28cm (d) 14cm.

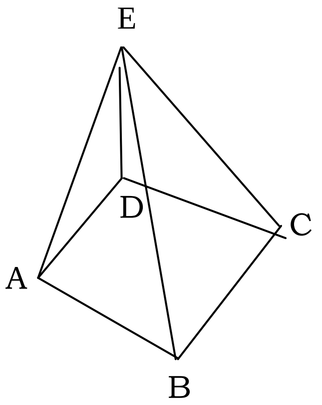
21. Calculate the volume of a cylinder of radius 7cm and height 4cm (Take $\pi = {}^{22}/_{7}$).

(a) 600cm^3 (b) 28cm^3 (c) 616cm^3 (d) 520cm^3

22. A cylinder is filled with water. The water level is 16cm in the cylinder. If the radius of the cylinder is 14cm, what is the volume of the water in the cylinder? (Take $\pi = {}^{22}/_{7}$).

(a) 9856cm^3 (b) 9846cm^3 (c) 9756cm^3 (d) 8946cm^3

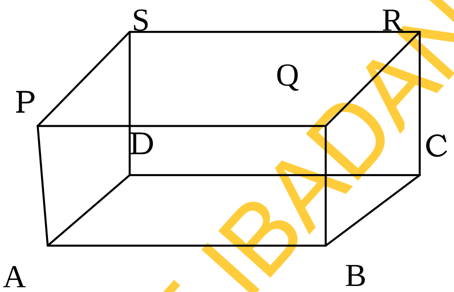
23. How many faces, edges and vertices do the square pyramid has.



(a) 5 faces, 7 edges, 4 vertices (b) 5 faces, 6 edges, 5 vertices

(c) 5 faces, 8 edges, 5 vertices (d) 4 faces, 8 edges, 5 vertices

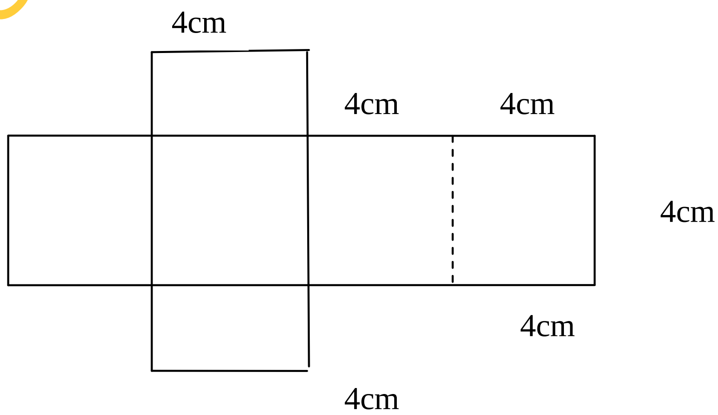
24. In the diagram below, list 2 pairs of parallel lines.



(a) AB and PA, DS and BC (b) AB and PQ, DC and SR

(c) SR and PA, BQ and AB (d) RC and PQ, SD and BC

25. Give the name of the solid made from the net below



(a) Cube (b) Cuboid (c) Pyramid (d) Cylinder

Appendix 2

PUPILS' KNOWLEDGE OF MATHEMATICS CONCEPT TEST (PKMCT)

Instruction: Answer all the questions. Use pencil to tick the correct option on the answer sheet provided. Do not write on the question paper.

Time Allowed: 30 mins

1. A four sided figure is called _______

(a) Triangle (b) Polygon (c) Quadrilateral (d) Pentagon.

2. ______ is the word that describe part of whole

(a) Fraction (b) Decimal (c) Numerator (d) Quotient

3. Find the product is the same as ______

(a) Addition (b) Subtraction (c) Division (d) Multiplication.

4. A seven sided polygon is called _____

(a) Octagon (b) Heptagon (c) Pentagon (d) Hexagon.

5. A triangle that has all its sides equal is called _____ triangle

(a) Equilateral (b) Scalene (c) Isosceles (d) Right-angle

6. ______ is the name of a quadrilateral.

(a) Triangle (b) Pyramid (c) Square (d) Cuboid.

7. Find the sum is the same as __________

(a) Multiplication (b) Addition c) Subtraction (d) Division.

8. ______ is not a 3-dimensional shape.

(a) Cube (b) Cylinder (c) Rectangle (d) Pyramid.

9. Find the difference is the same as

(a) Addition (b) Subtraction (c) Multiplication (d) Division.

10. Find the quotient is the same as _______

(a) Addition (b) Subtraction (c) Multiplication (d) Division.

11. A rectangle has _____ lines of symmetry.

(a) 1 (b) 2 (c) 3 (d) 4

12. ______ is called the space an object occupies.

(a) Capacity (b) Weight (c) Volume (d) Litre

13. Mathematically, volume is expressed as _______

(a) Length x breadth (b) ½ x base x height

(c) πr^2 (d) Area of cross section x height

14. ____ is the formula for volume of a triangular prism.

(a) ½ a x b x height (b) Length x breadth x height (c) πr^2 x height (d) $^4/_3\pi r^3$

15. ______ represents the volume of a cylinder.

    (a) $^4/_3\pi r^2$ (b) πr^2 x h (c) ½ a x b x height (d) πr^2.

16. _____ describes the amount a container can hold.

    (a) Volume (b) Weight (c) Capacity (d) Polygon.

17. _____ is the term that describe how heavy an object is

    (a) Volume (b) Weight (c) Capacity (d) Circumference.

18. _____ is called the line that divides a shape into two equal fitted parts

    (a) Perpendicular (b) Edge (c) Symmetry (d) Parallel

19. _____ best describes parallel lines.

    (a) They form 90^0 (b) They move at equal distance apart

    (c) They form 360^0 (d) They are polygons.

20. Two faces of a 3-dimensional shape meet to form______

    (a) Vertex (b) An edge (c) Circle (d) Perimeter.

Appendix 3

PUPILS' VERBAL ABILITY TEST (PVAT)

Instruction: Use pencil to tick the correct answer among the options (a) – (d) on the answer sheet provided. **Do not write on the question paper.**

Time allowed: 45 mins

Which of the following is different from the others?

1. a) Monday
   b) Thursday
   c) January
   d) Saturday
2. a) Duck
   b) Turkey
   c) Cock
   d) Aeroplane
3. a) Yam
   b) Sweet Potato
   c) Cocoyam
   d) Water
4. a) Tree
   b) Hibiscus flower
   c) Arm
   d) Stem
5. a) Mushroom
   b) Apple
   c) Mango
   d) Pawpaw
6. a) Fish
   b) Crayfish
   c) Lizard
   d) Crab
7. a) December
   b) Wednesday
   c) October
   d) June

8. a) Teacher
   b) Pupil
   c) Principal
   d) Farmer
9. a) Parrot
   b) Camel
   c) Cat
   d) Dog
10. a) Friday
    b) Morning
    c) Evening
    d) Afternoon

Which words are the correct ones to complete each of the following statements? Tick the correct answer on the answer sheet provided.

11. As thin as a
    a) Biro
    b) Cain
    c) Broomstick
    d) Candle
12. As white as
    a) Cloth
    b) Cotton wool
    c) Iron
    d) Bronze
13. As gentle as a
    a) Dove
    b) Lamb
    c) Baby
    d) Duck
14. As dirty as a
    a) Duck
    b) Cat
    c) Pig
    d) Rat

15. As cunning as a

a) Goat

b) Parrot

c) Tortoise

d) Monkey

16. As beautiful as a

a) Bride

b) House

c) Car

d) Man

17. As sharp as a

a) Sharpener

b) Razor blade

c) Tooth

d) Cutlass

Tick the correct answer on the answer sheet provided.

18. Hat (Cowboy), Head tie ( )

a) Man

b) Father

c) Woman

d) Grandfather

19. Finger (Hand), Head ( )

a) Feet

b) Hair

c) Leg

d) Hear

20. Fisherman (hook) Farmer ( )

a) Gun

b) Dog

c) Hoe

d) Animal

21. Sit (chair) Sleep ( )

a) Marked

b) Tree

c) Bed

d) Pot

22. Candle (light) Water ( )

a) Eat

b) Bed

c) Axe

d) Drink

23. Shirt (nicker), Skirt ( )

a) Wrapper

b) Scarf

c) Blouse

d) Trouser

24. Piano (pianist), Drum ( )

a) Hunter

b) Swimmer

c) Drummer

d) Farmer

25. Laugh (Happy), Cry ( )

a) Wonder

b) Sad

c) Hide

d) Laugh

26. Cow (Milk), Hen ( )

a) Chick

b) Egg

c) Food

d) Feather

27. Fly (Disease), Cleanliness ( )

a) Health

b) Sickness

c) Medicine

d) Water

28. First (last), Front ( )

a) Led

b) Head

c) Back

d) Middle

29. She – goat (He-goat), Sheep (   )

a) Dog

b) Rat

c) Cat

d) Ram

30. Moon (Night), Sun (   )

a) Star

b) Water

c) Hot

d) Day

Appendix 4

PUPILS' INTEREST IN MATHEMATICS INVENTORY (PIMI)

This inventory is designed to show your interest in mathematics as a subject. It includes several areas pertaining to mathematics and showing interest oriented actions.

SECTION A: GENERAL INFORMATION

Student Number: ……………………………………………………………

School Number: ……………………………………………………………

Class: Primary ( )

L. G. A: Yenagoa ( ) Ogbia ( )

Age:……………………… Sex: Male ( ) Female ( )

SECTION B: INSTRUCTION

Consider the following statements and indicate your answer by a tick in the appropriate column.

Code: Y - Yes N - No

	ITEM	YES	NO
1.	Do you like being in the Mathematics class?		
2.	Do you hate reading Mathematics books or notes?		
3.	Do you enjoy doing Mathematics exercise?		
4.	Is Mathematics a good subject?		
5.	Do you hate discussing about Mathematics subject with your friends?		
6.	Do you find Mathematics test difficult?		
7.	Do you listen attentively during Mathematics lessons?		
8.	Do you understand what your Mathematics teacher teaches you?		
9.	Is Mathematics an easy subject to understand?		
10.	Is Mathematics for boys?		
11.	Does Mathematics teach what you need to know about life?		
12.	Do you get to know more things during the Mathematics class?		
13.	Do you think that someone who does not learn Mathematics is an illiterate?		
14.	Do you want to do Mathematics -related jobs in future?		

15.	Can you become what you want to be without doing Mathematics?		
16.	Do you think that you need Mathematics to live at all?		
17.	Mathematics is too difficult to read and pass.		
18.	Will you do everything necessary to become a Mathematician?		
19.	Only the intelligent can do Mathematics.		
20.	Mathematics is not for someone like me.		

Appendix 5

Teaching Assessment Sheet for Teachers on the use of games

Name of Teacher:………………………………………………………………….

School: ……………………………………………………………………………

Date: ………………………………………………………………………………

Guidelines Involved	**V. Good 5**	**Good 4**	**Average 3**	**Poor 2**	**V. Poor 1**
Teacher introduction of the lesson whether it is based on pupils' previous knowledge.					
Teacher's ability to teach the new topic.					
Teacher's ability to organize the class, distribute and explanation of game materials and rules to pupils.					
Teacher's ability to give pupils opportunity to play game with less intervention.					
Teacher's ability to ask pupils questions to further clarify the concept and problems					
Teachers' ability to give follow-up activities and homework.					

Appendix 6

Teaching Assessment Sheet for Teachers on the use of poems

Name of Teacher:……………………………………………………………….

School: ……………………………………………………………………….

Date: ………………………………………………………………………..

Guidelines Involved	**V. Good 5**	**Good 4**	**Average 3**	**Poor 2**	**V. Poor 1**
Teacher introduction of the lesson whether it is based on pupils' previous knowledge.					
Teacher's ability to give pupils opportunity to read poems aloud (choral, in small groups, individually and at random).					
Teacher's ability to ask pupils to explain and role play the actions in the poems.					
Teacher's ability to ask pupils questions to clarify the concept.					
Teacher's ability to teach the new topic with reference to the poems.					
Teachers' ability to give pupils class work/ homework which also involves writing of poems in content, process and affective.					

Appendix 7

Primary Mathematics topics identified as difficult by Salman (2009)

S/No	Identified difficult primary mathematics topics	Frequency counts	Percentages of respondents
1	Practical & descriptive geometry (solids or 3-D figures)	65	76.5
2	Word problems	59	69.4
3	Weight, capacity & volume	51	54.1
4	Graphs	46	44.7
5	Compound interest	37	43.5
6	Decimal fraction	35	41.2
7	Everyday statistics	33	38.8
8	Ratio & proportion	32	37.6
9	Measurement (length & area)	31	36.5
10	Place value	29	34.1
11	Algebra (simple equations)	28	32.9
12	Number line	27	31.8
13	Approximation & estimation	26	30.6
14	Binary number	26	30.6
15	Equivalent fractions	24	28.2

Appendix 8

Percentage mean and standard deviation of performance in Mathematics across classes

States	Primary 6		JSS 1		JSS 2		JSS 3	
	X (%)	SD	X (%)	SD	X (%)	SD	X (%)	SD
ABIA	48.86	16.79	36.41	11.19	29.18	8.48	NA	NA
ADAMAWA	45.69	18.27	39.32	16.10	35.17	9.08	40	12.25
AKWAIBOM	47.24	15.41	50.96	12.22	39.35	10.54	45	14.30
ANAMBRA	NA	NA	57.22	16.21	53.59	17.37	NA	NA
BAUCHI	44.91	17.93	23.85	6.61	24.48	6.31	28.13	7.40
BAYELSA	55.96	17.53	40.00	11.66	34.11	7.01	32.14	10.30
BENUE	38.27	13.02	33.15	9.75	33.07	13.41	NA	NA
BORNO	38.52	19.13	37.38	17.35	24.48	6.31	29.45	9.35
CROSS RIVER	39.00	12.96	44.05	14.47	33.10	10.31	27.68	9.63
DELTA	29.73	8.93	38.46	13.31	27.84	6.92	NA	NA
EBONYI	34.51	11.94	33.85	11.05	27.89	7.30	NA	NA
EDO	38.40	13.21	47.01	14.44	33.10	10.31	27.68	9.63
ENUGU	43.89	17.35	36.33	11.16	21.84	5.99	NA	NA
EKITI	48.40	18.23	25.79	10.43	35.73	7.69	28.13	7.40
GOMBE	44.91	17.93	33.95	13.04	24.48	6.31	49.58	15.48
IMO	46.49	19.12	40.26	11.30	30.85	9.74	NA	NA
JIGAWA	58.26	15.71	54.55	17.79	41.37	12.81	49.58	15.48
KADUNA	38.42	13.45	37.34	11.03	30.85	8.91	34.18	4.08
KANO	23.35	6.20	42.76	13.16	36.09	8.96	27.35	6.68
KASTINA	44.27	15.32	28.78	9.29	27.11	6.30	29.40	7.85
KEBBI	43.91	17.50	35.56	11.05	31.41	7.81	36.15	17.20
KOGI	45.70	18.10	41.94	18.78	33.28	18.45	24.90	7.78
KWARA	43.56	16.23	32.14	7.41	29.74	8.08	24.28	7.78
LAGOS	45.06	16.29	40.36	11.04	34.32	8.69	NA	NA
NASARAWA	36.46	14.95	26.78	7.66	27.07	6.79	31.50	10.53
NIGER	34.84	13.62	32.81	12.84	33.28	18.45	24.90	7.78

OGUN	42.27	16.22	36.80	11.37	32.59	8.66	NA	NA
ONDO	39.23	14.56	33.44	10.13	32.27	5.78	26.04	8.23
OSUN	54.00	16.77	34.14	12.34	31.80	7.47	30.60	10.22
OYO	47.16	15.44	50.96	12.22	39.35	10.54	45.83	14.42
PLATEAU	32.44	12.34	33.15	9.06	28.52	8.20	NA	NA
RIVERS	36.03	20.61	37.19	19.43	24.53	7.34	NA	NA
SOKOTO	47.98	17.50	31.78	10.18	32.94	11.81	29.90	11.16
TARABA	44.63	13.60	35.52	9.97	32.47	12.36	34.50	14.93
YOBE	45.22	14.98	38.36	12.11	51.51	19.08	44.49	16.46
ZAMFARA	34.66	14.68	30.05	12.58	27.50	7.13	34.24	12.65
FCT, ABUJA	27.24	15.49	44.74	14.08	36.44	12.87	42.00	14.82
National	42.87	17.51	37.68	14.72	34.42	12.28		13.63

Source: Final Report (NAUBEP), January, 2009.

Appendix 9

Weekly mathematical poems

Week 1

1. **Concept of Fraction**

Chnedu can break bread,
Latei learns Latin.
In Latin, fractio means ‘break’
In English, fraction means ‘to break’.
Have you seen a valley dividing two mountains?
Have you seen cream dividing biscuits?
Have you seen nose dividing two eyes?
So does a line divide a fraction?
Like my new cap on my head,
Like my meat on my rice, a number stands on another to form a fraction.

Your younger brother, a fraction of your family;
My smiling sister, the little lily of our house,
A fraction of our family

Bassey baked bread for breakfast.
If his six smiling sisters share from it;
They take a fraction each.
Oh fraction!
Come divide this drink for us,
Come share this shrimp for us.

2. **Concept of Decimal**

Numoebi defines different numbers $^{1}/_{10^1}$, $^{1}/_{10^2}$, $^{1}/_{10^3}$ . . .
Edidubamo defines even number as divisible by 2
Fipadei defines fraction as part of a whole $^{1}/_{10}$, $^{1}/_{100}$, $^{1}/_{1000}$ . . .
Dipamo defines decimal as a number
expressed in powers to base tenth parts.
Alas! Alamini exclaim

0.5,   0.65, 0.781 are decimals.

3. Express Fractions as Decimals

Chwukudi converts corn to popcorn

Chika converts cassava to garri

Francis converts fraction to decimal too.

Fraction to decimal

Takes three steady steps

Francis expresses fraction denominator in powers to base 10

By multiplying numerator and denominator

By the same number.

Bright from the right,

Count the places of decimal represented,

By the number of zeroes on the denominator

Pat put the decimal point

Finah has her final answer.

Oh! Fraction to decimal

A sweet simple formula

For any fraction

Is the long division method

Telma tells teacher

Show us example

4. Express Decimals as Fractions

Epretari expresses good morning as nuwan

Eyitayo expresses good afternoon as ekaasun

Decimal can be expressed as fraction.

Decimal change to fraction

In six steady steps
Starting from the decimal point,
Express the decimal in powers to base tenth parts.

Fentei expresses first number in tenth part — 1st number/10
Selepre expresses second number in hundredth part. — 2nd number/100
Telemo expresses third number in thousandth part — 3rd number/1000 . . .
So it goes on and on to last number

Adifere add the ordinary fraction.
Enifiyemi expresses the final answer in its lowest term

Oh! Decimal with whole number,
Add it to the ordinary fraction.

5. Ordering of Fractions

Left! Right!
Left! Right!
At ease!
On a single file!
Like Captain Columbus of Colombian Cantonment,
I will order my fractions.

From the least to the highest
With less than sign,
Go in ascending order.

From the highest to the least,
With greater than sign,
Go in descending order

With ‘equal to’ sign,
You are equal fractions;
Going together like a couple.

Week 2

1. Addition and Subtraction of Like Fractions

Orange to orange

Mango to mango

Number to number

Fraction denominator to fraction denominator

Equal denominator to equal denominator

Is all about like fractions.

I have like fractions,

I want to add like fractions,

I want to subtract like fractions,

I have two tasks.

I have few steps to follow.

I have three steps to follow.

Step one: I add or subtract the numerators;

Step two: I write result over single denominator;

Step three: I write final answer in lowest term.

2. Addition and Subtraction of Fractions with Different Denominators

Principal Patani's podium

On the academy's assembly.

It has six steeply steps,

Six steeply steps

That shakes like skeletons.

Unlike those steeply steps;

Addition and subtraction of fraction

Has six solid steps:

You find the denominator's LCM;

You divide LCM by denominator;

You multiply result by numerator;

You add or subtract the result;

You write the answer over LCM;

You write the final answer in lowest term.

3. Addition and Subtraction of Mixed Numbers

Madam Pat's porridge
Makes my mouth salivate.
It is a mixture of many edibles.

Like that palatable porridge,
Where snail meets with shrimps,
Where yam meets with oil,
Numbers can mix.
When numbers mix,
We have mixed numbers.

We can add and subtract mixed numbers.
Like willing workers at Madam's Pat's pots;
We add or subtract whole number,
We find LCM of denominator,
We divide LCM by each denominator,
We multiply result by numerators,
We add or subtract the result,
We write answers over LCM, with the whole number.
We write final answer in lowest term.

Oh! When I involve carrying
What I carry
Is equal to my L.C.M.

4. Word Problems on Addition

Blow a balloon,
You increase the size.
Blow a ball,
You increase the size.
Blow a tube,
You increase the size.
It is all about addition!

To find the sum
Is addition,
To find the total
Is addition,
To add together
Is addition,
Sign of plus (+)
Is addition,
Any extra
Is addition.

5. Word Problems on Subtraction

David draws water from well,
Dre drinks Dano every day,
Esther eats plates of rice,
When he drinks Dano,
When she eats rice,
Quantity decrease.

Find the difference is subtraction;
Act of removal is subtraction,
Act of waste is subtraction;
Act of use is subtraction;
Act of spending is subtraction;
Act of decrease is subtraction;
Sign of minus (-) is subtraction.

6. Standard to Compare Fraction.

The whole is one (1),
Dividing to fractions;
The whole is one (1),
Breaking to fractions;
The whole is one (1),

Creating the fraction

7. Addition and Subtraction of Given Decimals

Ade and Susan add or subtract whole numbers

Adeleke and Francis add or subtract fractions

Adebi and Desmond add or subtract decimals too.

Five steady steps to add or subtract decimals

Bright writes whole numbers on one column

according to place value.

Desmond writes decimal points on one column

Numobi and Columbus write numbers

After decimal point in their columns

according to place value.

Ade and Susan add or subtract

Numbers by their columns from the right

Finah and Anita write final answer

Week 3

1. Multiply Fraction by Fraction

Whyte Nubere multiplies whole numbers by whole numbers
Detonye multiplies decimal by decimal
Francis multiplies fraction by fraction too.

To multiply fraction involves five steady steps

Sample simplify numerators and denominators
By cancelling with a common factor

Arthur Murphy multiply the numerators
To get the numerator of the answer

Desmond Murphy multiply the denominators
To get the denominator of the answer

Whyte writes numerator's answer
Over denominator's answer

Andrew Bright writes final answer in its lowest term
Finah has her final answer.

Look! A mixed number fraction
Change to improper fraction
Then, apply the five steady steps.

2. Word Problems on Multiplication

Grandma Golden has a gold pot
Fostinah add four cups of corn in it
Florence add another four cups of corn in it
Foster add another four cups of corn in it
It is all about multiplication.

Repeated addition, is multiplication

Find the product, is multiplication

Sign of '×', is multiplication

Oh! Operation on 'of', is multiplication.

3. Multiply Decimal by Decimal

Promise multiplies her provision shop

Whyte Noble multiplies whole numbers by whole numbers

Destiny multiplies decimal by decimal too.

To multiply decimal by decimal involves five steady steps

Desmond writes the decimal numbers as whole numbers

Mustapha Wole multiply the whole numbers

Adabel add the result

County Dila-emi count all the decimal places

Pat Decard put the decimal point

Counting from the right to left

Finah has her final answer.

4. Divide Decimal by 2 or 3-Digit Numbers

Have you seen things dividing to 13 places?

Have you seen whole numbers dividing to 606 places?

Like Banabas' bunch of banana dividing to 13 places

Like Florence's fried fish dividing to 14 places.

Like 3,636, dividing to 606 places

It is all about division by 2 or 3-digit numbers.

So, Dila-emi divides decimals by 2 or 3-digit numbers.

Terrified! Destiny asks Dila-emi, how?

By long division method,
Divide as in whole numbers
Telma tells teacher
Show us example!

5. Word Problems on Division of Decimals

Bere share her bread into two
Banabas share his banana into three
Finima share her fish into four
It is all about division.

Find the quotient, is division
Sign of '÷', is division
Sign of $^{a}/_{b}$ is division
Ah! Action of share is division.

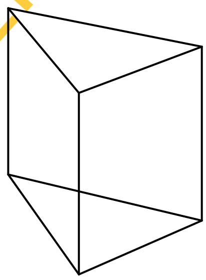
Week 4

1. Volume

Airplane flies on air and occupies a space
Benidou sleeps on bed and occupies a space
John Bull jump into water and occupies a space
Seiye sits on chair and occupies a space
It is all about volume.
It is the occupied space

To mathematicians, volume is area of cross-section × height

Triangular Prism

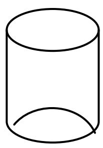


2. Volume of *a* Triangular Prism

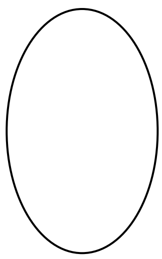
Oh! Tarima find triangular prism
Meet triangular prism at prison
Your formula for volume fools me!
Terrified! Triangular prism said
My formula for volume is,
½ a × b × h

3. Volume of Cylinder

Chima meets cylinder at the chamber
Zachy Zoo zooms out of the chamber
And ask cylinder;
What is your formula for volume?
With loud voice
My formula for volume is $\pi r^2 \times h$



Cylinder



Sphere

4. Volume of a Sphere

Seiyefa meets sphere on the space
Ask the formula for volume
But spheroid a friend to sphere said
The formula for volume of sphere is $^4/_3 \times \pi \times r^3$

5. Word Problems on Volume of Triangular Prism, Cylinders and Spheres

We have words bringing us together
We have words defining us
We are defined by shape and formula while solving word problems

Like Wole who gives word problems on volume
Wode lookout for solution in word problems
Stephen outline seven sequential steps
Sharon shares the seven sequential steps.

Redeem reads question carefully
Idisemi identifies the shape
Noble notes the shape of the cross-section
Claudius calculate the area of the cross-section
Wilson writes down the equation for volume
Whyte writes the given values in the equation
So, Solomon solves the equation
And Domotimi writes down the answer.

Week 5

1. Capacity

Cup contains an amount of water

Classroom contains certain number of pupils

Cupboard contains certain number of books

It is all about capacity

It is the amount a container can hold

It is the same as length × breadth × height

And the unit of capacity is the litre.

2. Compare Capacities of Containers

Seiye's Spoon contains small water

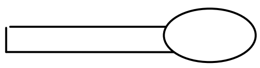
Bolade's bottle contains more water.

Buky's bucket contains still more water

Domotimi's drum contains still more water

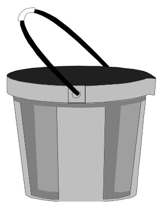
It is all about capacities of containers

So, different containers contain different amounts.

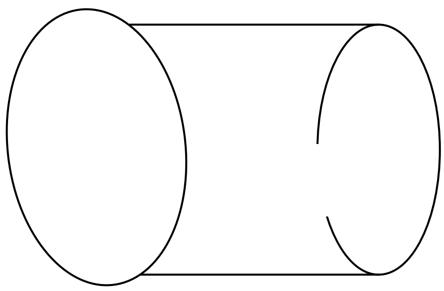


Spoon

Bottle



Bucket



Drum

3. Table of Capacity

1 litre = 1,000 cubic centimeter (cm^3)

1 litre = 1,000 millilitres (ml)

1,000 litres = 1 kilolitre (kl)

1,000 litres = 1 cubic metre (m^3)

4. Conversion of Capacities

Martha grandma convert corn to popcorn

Chika convert cassava to garri

Mathematicians convert units of capacities too.

Ha!   Ha!   Ha! How?
Mama Maria puts soup
From a big pot to small pots
By multiplying the number of small pots

Rita puts rice
From a small bag to a big bag
By dividing the big bag

From larger unit to smaller unit, multiply.
So, from kilolitre to litre, multiply

From smaller unit to larger unit, divide.
So, from litres to kilolitres, divide.
So, mathematicians convert capacities of containers.

5. Word Problems on Capacity

Bruce always brushes mouth
Beatrice always takes breakfast
Banabas always takes bath
Solving word problems on capacity,
always requires the following too.

Redeem reads the question carefully
Idendou identifies the units
Chima converts to the same units
Idris identifies the related operation;
Addition, subtraction, multiplication or division
Catherine carries out the operation
Whyte writes the answer.
It is all about word problems on capacity.

Week 6

1. Weight

How heavy is Luke's lunch box

How heavy is Sola's school bag

How heavy is Catherine's car

It is all about weight

It measures how heavy an object is

Its' units are the kilogram (kg) and gram (g)

2. Weights of Objects

Miela measures his milk tin in grams

West measures his weight in kilograms

Carmela measures his car in tonnes

Makama, the mathematician

Measures small objects in grams

Measures medium sized objects in kilograms

Measures heavy objects in tonnes

3. Tables of Weight

1000 grams (g) = 1 kilogram (Kg)

1000 kilograms = 1 tonne (t)

So, 1 tonne = 1,000,000 grams (g)

4. Conversion of Weights

Florence converts flour to bread

Grandma converts groundnut to groundnut oil

Mathematician Comfort converts different weights.

Hail ! Hail ! How?

From a larger unit to a smaller unit, multiply

So, 5 kg = (5×1000)g = 5000g

4t = (4×1000)kg = 4000kg.

From a smaller unit to larger unit, divide

So, 5000g = $^{5000}/_{1000}$ kg = 5kg

5000kg = $^{5000}/_{1000}$ t = 5t

5. Express the Same Weight in Different Units: Grams, Kilograms and Tonnes

Comfort converts cassava to fufu, farina and garri.

Comfort converts corn to pap, agidi and popcorn.

Martha, the mathematician expresses

The same weight of object in grams, kilograms and tonnes.

Epretari expresses 80,000 grams to kilograms and tonnes.

Hail! Hail! Shout Sharon

80,000 grams = $^{80,000}/_{1000}$ kg = 80kg

What! What! Esther exclaim

80kg = $^{80}/_{1000}$ t = 0.08 tonnes

Oh! What an amazing knowledge

80,000 grams = 80 kilograms = 0.08 tonnes.

6. Word Problems on Weight

Bruce always brushes mouth

Beatrice always takes breakfast

Banabas always takes bath

Solving word problems on weight

Always requires the following too.

Redeem reads the question carefully

Idendou identifies the units

Comfort converts to the same units

Idris identifies the related operation

Addition, subtraction, multiplication or division.

Catherine carries out the operation

Whyte writes the answer.

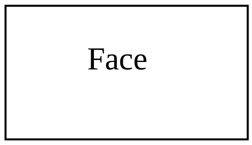
It is all about word problems on weight

Week 7

1. 2-Dimensional Shapes

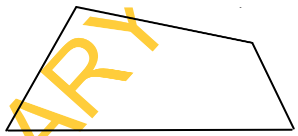
Dinky 2-Dimensional shapes
I want to know you well.
2-Dimensions, I have
Length, I have
Breath, I have
I am a plane shape
Like a plane sheet of paper
I have one face
Know me by length, breadth and one face

Length

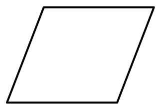


Breadth

Trapezium



So, Kite belongs to me
Parallelogram belongs to me
Rectangle belongs to me
Rhombus belongs to me
Square belongs to me
Trapezium belongs to me



Rhombus

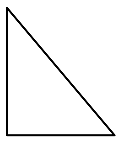
Rectangle

Oh! Triangle, you belong to me

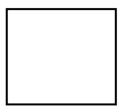
2. Names of Quadrilaterals

A table has four legs
A table has four sides
A table is a shape
It is all about quadrilaterals.
Quadrilaterals are four sided shapes.

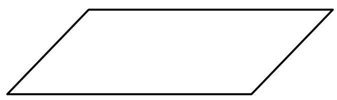
Triangle



Square



Kite is a quadrilateral
Parallelogram is a quadrilateral
Rectangle is a quadrilateral
Rhombus is a quadrilateral
Square is a quadrilateral
So! Trapezium is a quadrilateral



Parallelogram

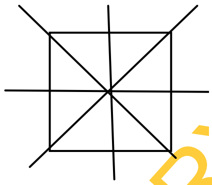
3. Features of Quadrilaterals

Handy has two hands equal

Legacy has two legs equal

Sympathy Noble's nose is a line of symmetry of her face

It is all about features of quadrilaterals

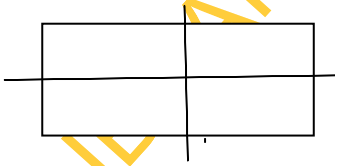


Square

Square has four equal sides

Square has four right angles

Square has four lines of symmetry

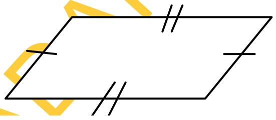


Rectangle

Rectangle has its opposite sides equal

Rectangle has four right angles

Rectangle has two lines of symmetry.



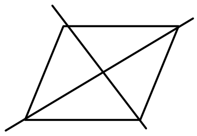
Parallelogram

Rhombus has its four sides equal

Rhombus has its opposite angles equal

Rhombus has two lines of symmetry.

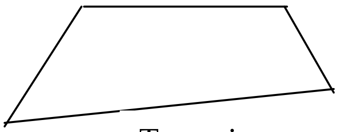
Rhombus



Parallelogram has its opposite sides equal

Parallelogram has its opposite angles equal

Parallelogram has no line of symmetry.



Trapezium

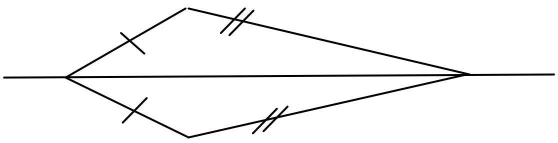
Trapezium has sides of different lengths

Trapezium has angles of different sizes

Trapezium has no line of symmetry

Like my little lilies of different heights

Kite



Kite has its neighboring sides equal

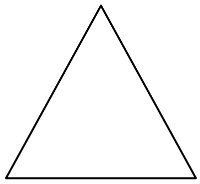
Kite has one pair of opposite angles equal

Kite has one line of symmetry.

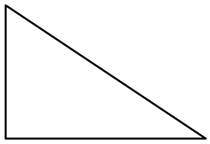
4. Types and Features of Triangles

Triangle has three sides

Triangle has three angles, total to 180^{o}



Equilateral triangle

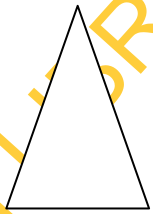


Right angled triangle

Triangles are four types in all.
Like a table that has four legs.
Oh! Ha! See my types and features.

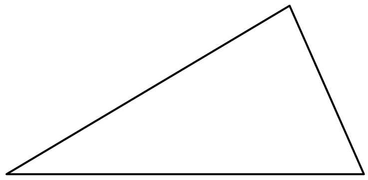
I am right angled triangle
When I have a right angle

I am equilateral triangle
When my three sides are equal
When my three angles are equal
When I have three lines of symmetry.



Isosceles triangle

I am isosceles triangle
When two sides are equal
When my base angles are equal
When I have one line of symmetry.

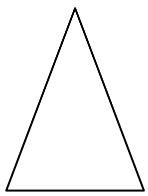


Scalene triangle

I am scalene triangle
When my three sides are unequal
When my three angles are unequal
When I have no line of symmetry
Like three unequal triplets, so I look.

5. Regular Polygons

Remi Difiye defines regular polygons
Polygons are plane shapes
With at least three straight sides
And three angles.



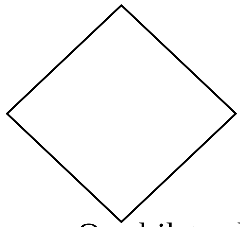
Triangle

6. Types of Polygons

Triangle has types

Quadrilateral has types

So, polish polygon has types



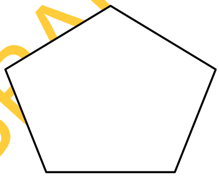
Quadrilateral

With three sides and sum of angles equals 180°

Call me triangle

With four sides and sum of angles equals 360°

Call me quadrilateral.

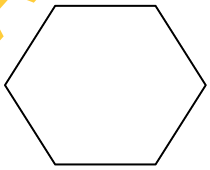


With five sides and sum of angles equals 540°

Pentagon

Call me pentagon

With six sides and sum of angles equals 720°



Call me hexagon.

With seven sides and sum of angles equals 900°

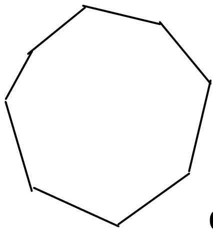
Hexagon

Call me heptagon.

With eight sides and sum of angles equals 1080°

Call me octagon.

So ,I end at the primary school.



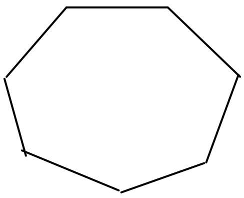
But as polish and pretty, I am

Octagon

I have simple fine formula

For the sum of my angles

It is pretty as (n-2) × 180°



Heptagon

Week 8

1. 3-Dimensional Shapes

Dinky 3-Dimensional shapes
I want to know you well.
3 dimensions, I have
Length, I have
Breadth, I have
Height, I have
More than one face, I have

So, Cube like sugar belongs to me
Cuboid like match box belongs to me
Cylinder like bournvita tin belongs to me
Know me by length, breadth, height and more than one face

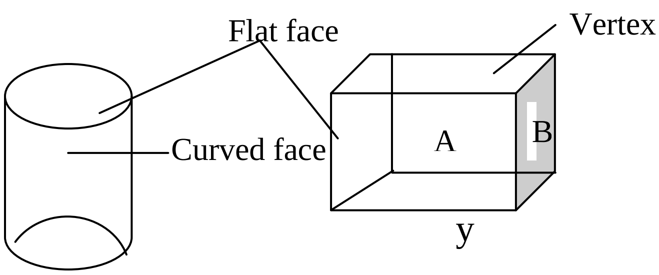
2. Faces, Vertices and Edges of 3-Dimensional Shapes

FACE

Peter's face is pretty round face
Earth's face is flat surface
So, solid's face is flat or curve surface
Like a plane sheet of paper
Like a face of a table fan.
It is all about face of 3-D shapes

EDGE

Pat close her two palms to pray
Martha's and Maria's faces meet
Solid's two faces meet
Like two walls meeting together
It is all about an edge
So, two faces meet to form an edge
Face A meet face B
Form edge XY
Look, an edge XY is a line

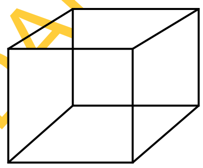


VERTEX

A table has sides and corners
One side of the table AB
Meet and end at point B
Another side of the table BC
Meet and end at point B
Form a corner at point B
So, edges AB and BC of 3-D shapes
Meet each other to form a corner
It is all about vertex.
So, edges meet to form a vertex.

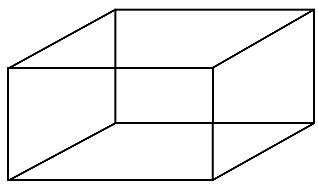
2. 3-Dimensional Shapes and their Features.

Cube is a 3-D shape
Cube has all sides equal
Cube has 6 flat faces
Cube has 12 edges
Cube has 8 vertices
Oh! Cube looking like the cube sugar



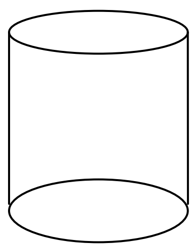
Cube

Cuboid is a 3-D shape
Cuboid has two opposite sides equal
Cuboid has 6 flat faces
Cuboid has 12 edges
Cuboid has 8 vertices
Oh! Cuboid, looking like a match box.



Cuboid

Cylinder is a 3-D shape
Cylinder has 1 curved and 2 flat faces
Cylinder has 2 circular edges
Cylinder has no vertex
Oh! Cylinder, looking like a milk tin.



Cylinder

4. Measurement of Angles of 3-Dimensional Shapes

Ruler measures length

Thermometer measures temperature

Speedometer measures speed

So, protractor measures angles.

5. Perpendicular and Parallel lines

Perpendicular line

Hurry! Hurry! Hurry!

Vero drop vertical line down

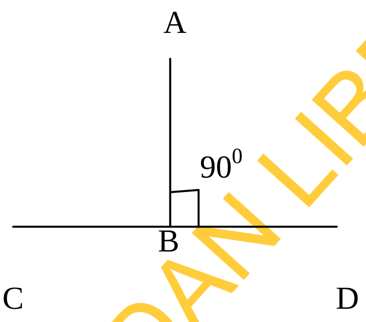
Hit horizontal line CD hot

Form perpendicular line at B

Form right angle or 90^o

Line AB perpendicular to line CD

Form right angle at B.



Parallel lines

Ernest is an enemy to Eremo

Nestor never meets with Nimi

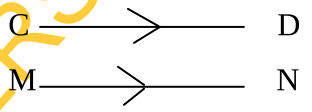
Railway lines never meet at a point

It is all about parallel lines

Two parallel lines never meet at a point

With equal distance apart

They move on and on



Appendix 10

Weekly mathematical games

Week 1 game (adapted from NMC (2002) Abuja.

Title: Fraction/Decimal Grid

Class level: Primary 6

Topic: Fraction and Decimal

Objectives: Pupils should be able to:

1. Arrange a set of fractions and decimals in order of magnitude
2. Express fractions as decimals
3. Express decimals as fractions

Materials: 45 cards containing all positive fractions and decimals with highest denominator of 10 are used for the game.

2. A checklist showing the order of magnitude of each fraction and decimal

Plan: The game can be played by two or more pupils at a time. Each player is to arrange four cards in order of magnitude. To check for correctness, the judge will check from the check list of cards and their orders of magnitude. For example, the four cards

$^2/_7$ $^5/_7$ 0.1 0.125

Their orders of magnitude on the check are

9 17 1 3

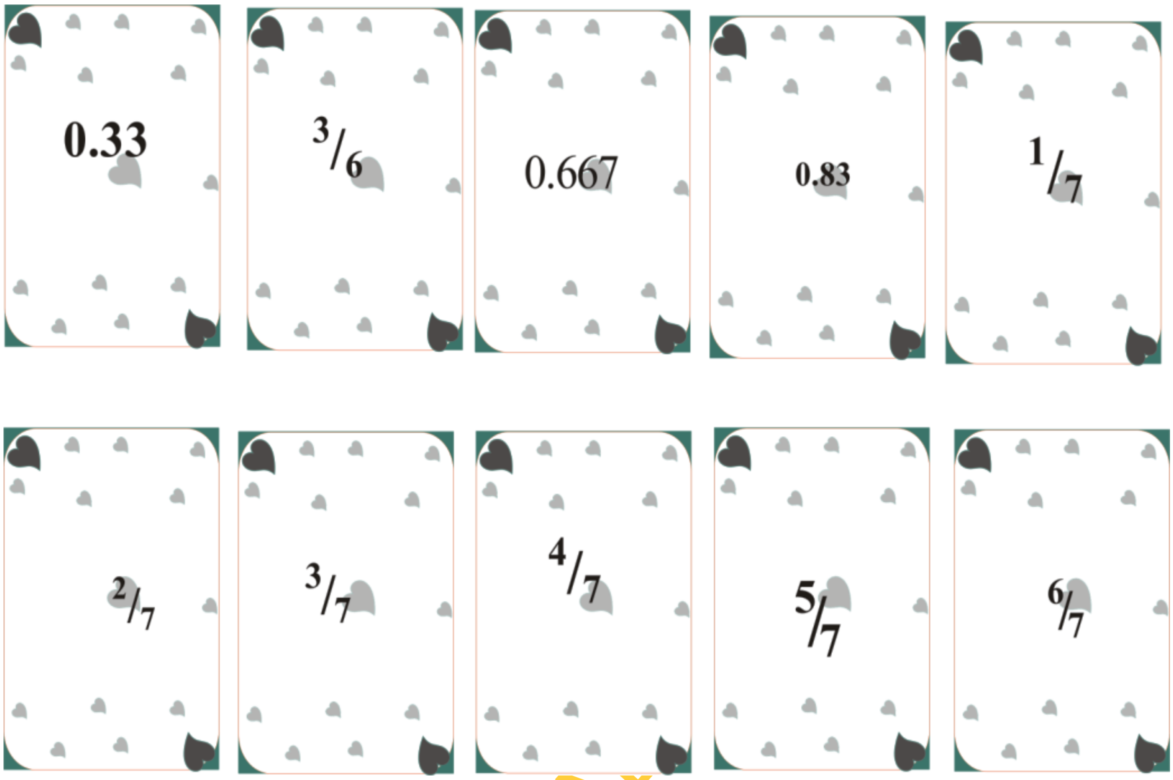
Procedure: Each player is dealt four cards after shuffling and players are to arrange their cards from left to right in increasing order (ascending). The first player to complete correctly becomes the winner.

Strategies: Players must use a strategy of comparing two fractions by finding two other fractions which are equivalent to the given fractions but whose denominators are the same. Then comparing the numerators gives the correct order.

Also fast ways of reducing fractions to l owest term will help the player. Again, expressing fractions as decimals or decimals as fractions depending on the cards a player has will be of help.

Follow-up activities: The pupils are asked to arrange sets of numbers in ascending or descending order.

Sample cards



Week 2 game (adapted from NMC (2002) Abuja).

Title: Expression Whot

Topic: Fraction and Decimal

Class level: Primary 6

Objectives: Pupils should be able to:

1. Add fractions and decimals
2. Subtract fractions and decimals
3. Solve word problems on addition and subtraction of fractions and decimals.

Materials: 30 question cards of (9x12cm).

Plan: The game may involve two or more players (maximum of six). The teacher or a pupil so appointed can serve as judge. The player with the highest value is declared the winner.

Procedure: After shuffling, each player is dealt with 5 cards (in case of 6 players). A player will also be given 5 game tokens of the same color. A total of 10 minutes will be given to each player to solve the five questions, i.e. 2 minutes for each question. If a player solves a problem and got the correct answer, he/she takes a token and places it on the game board that has that answer. Then, the judge will check the correct answer to that question from the check list. If it is correct, the token will remain on the game board. If it is wrong, the token will be removed and the question card will be placed face down on the floor for any other players who may finish his/her question cards before the allotted time. Players that got their answers wrong will be corrected during the follow-up activities.

The winner of the game is the player with the highest score when the allotted time is finished.

Scores are as follows:

Black	=	Scores 4 points
Green	=	Scores 3 points
Red	=	Scores 2 points
White	=	Scores 1 point

Wrong answers score zero point.

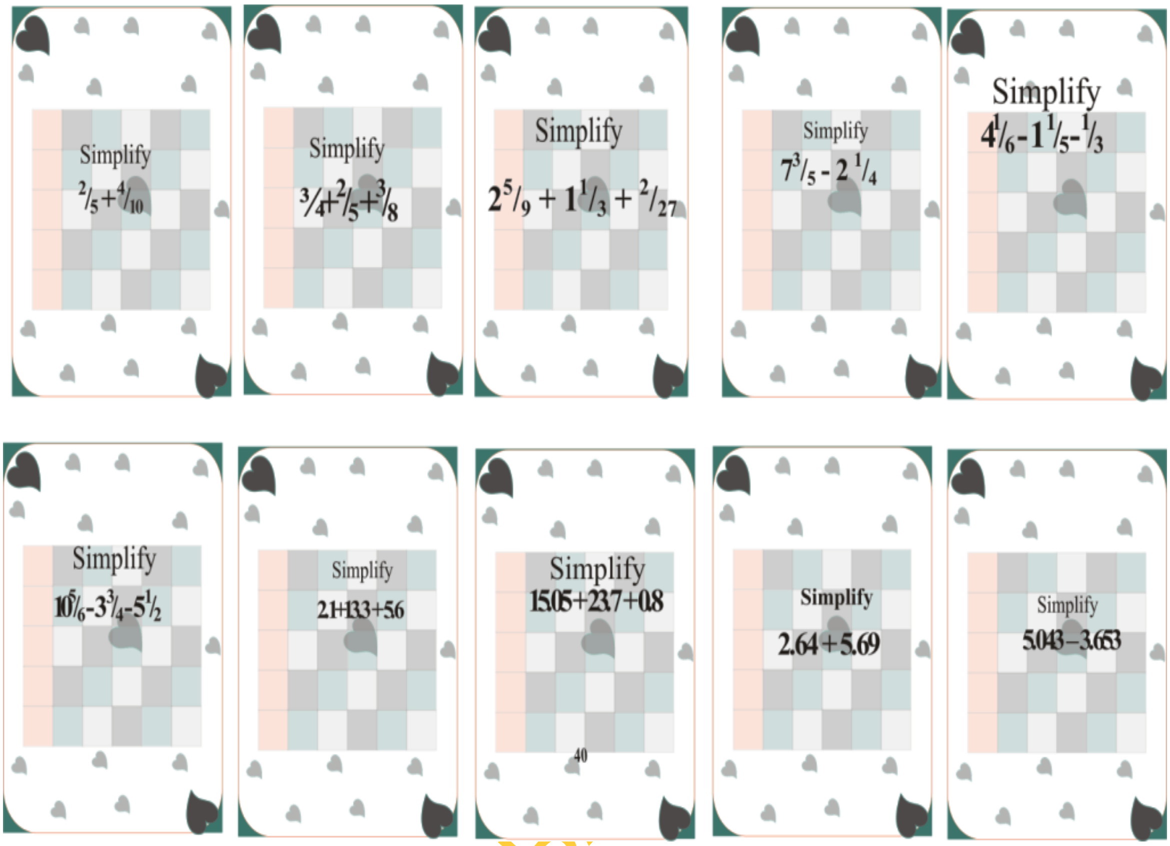
Strategies: Each player considers the cards that are easier to solve first in less than 2 minutes with speed and accuracy in solving each card.

Follow-up activities: Pupils will be asked to solve 2 cards on the board and explain to the class.

EXPRESSION WHOT BOARD GAME

$1\frac{1}{12}$	$2\frac{19}{30}$	42.2	1.39	$2\frac{1}{2}$	$3\frac{26}{27}$
0.654	$\frac{3}{8}$	$1\frac{21}{40}$	$\frac{1}{2}$	$9\frac{1}{12}$	4.93
95.96	39.55	$3\frac{7}{15}$	21	8.33	$1\frac{1}{40}$
$5\frac{7}{20}$	$1\frac{7}{12}$	1.1	10.88	1.15	$10\frac{19}{20}$
$\frac{4}{5}$	127.7	$10\frac{11}{12}$	16.75	87.37	4.824

Sample cards



Week 3 game (adapted from NMC (2002) Abuja).

Title: Mathematics Circle Race Game

Class level: Primary 6

Topic: Fraction and Decimal

Objectives: Pupils should be able to;

1. Multiply decimals by decimals
2. Multiply fractions by fractions
3. Divide decimals by 2- digit and 3- digit numbers
4. Solve word problems on multiplication and division of fraction and decimal

Materials:

1. A game board. This board is in circular form and centre is where the race starts and ends at where 'out' is written. There are 42 squares of six different colors excluding the empty zone.
2. 36 Problem cards
3. A die
4. Cards slots' (6)
5. Game tokens
6. Checklist
7. Pen and paper

Plan: The game is played by 2 or at most 3 players. A time keeper is essential. A maximum of 2 minutes is given to solve a problem. A time keeper can also be the recorder and the checker. There is a check list with the checker.

Procedure: (1) To start the game, a die is tossed. A player with a six will start the game. The game starts from the area marked centre.

2. The cards' slots are numbered 1-6 and each slot will be placed 6 problem cards after shuffling properly.

3. The cards are well shuffled before the start, the number shown on the die will determine what problem square the player finds himself, i.e. if a player plays a 'six', he gets to the centre, if he plays a 'four' at the second throw he counts four, looks at the color, then goes to the appropriate cards slot and picks a problem card.

4. If the player solves the problem correctly he looks for the reward at the bottom of the problem card i.e. move 2 or 3 steps forward. If wrong, move 2, 3, or 4 steps backward.

5. F and E on the game board represent free and empty zones respectively. If a player falls in free zone (F), he will relax; he will not forfeit his chance. But if in empty zone (E), he will forfeit his chance; that is, come back to the former position and wait for another turn.

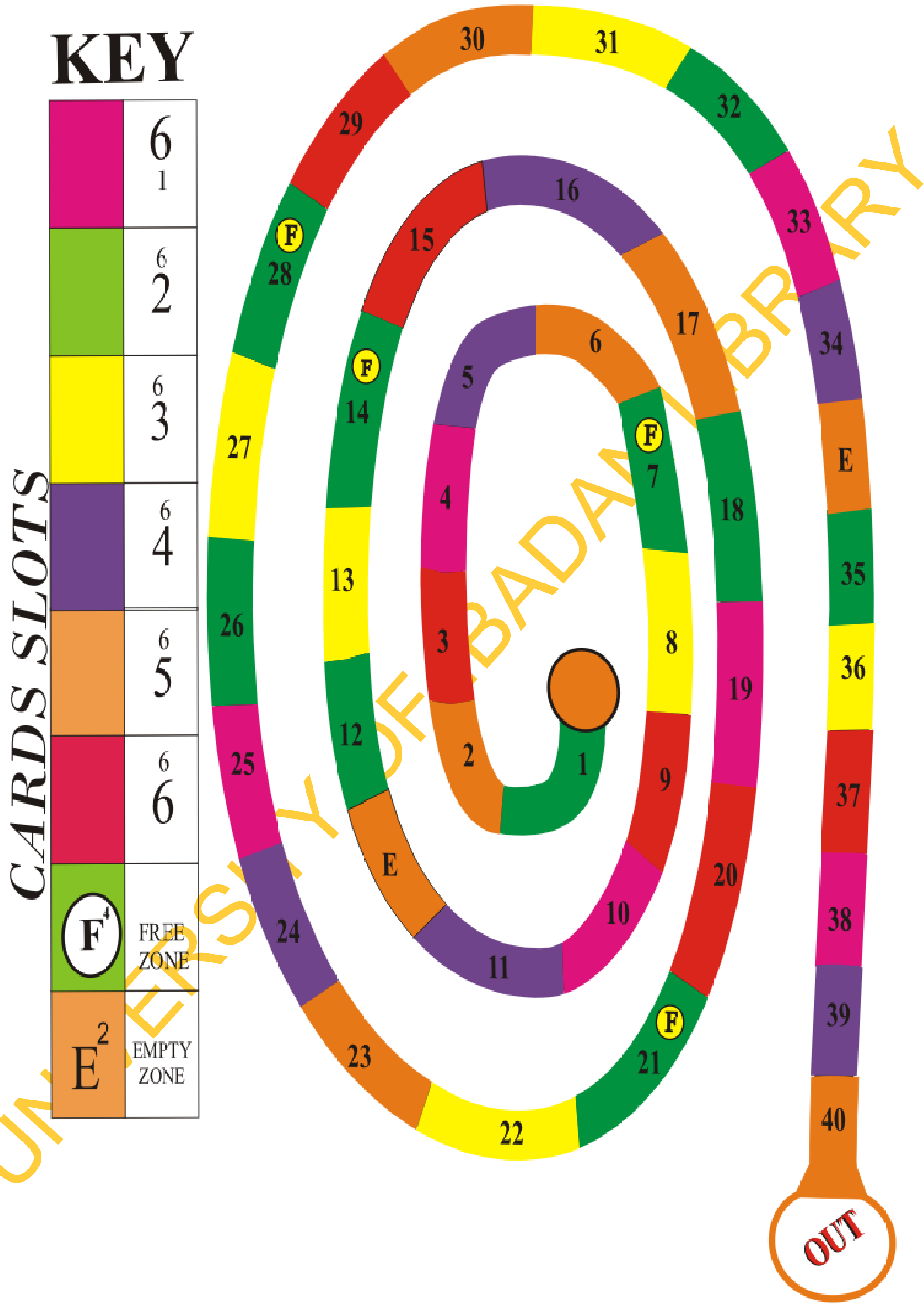
Scoring:

1. For 3 players, the first player to get out will score 30 points, while the second and third players score 20 and 10 points respectively.
2. For 2 players, it will be 20 and 10 points respectively.
3. The total mark will depend on the number of rounds they play and the player with the highest point declared the winner.

Strategy: Each player struggles to get high numbers in order to run very fast and get out. But if numbers shown are always low, the chance of getting out fast is very low.

Follow-up activities: Students should try to go over their textbooks and solve related problems on the topics.

CIRCLE RACE GAME
(Fraction and Decimal)



Sample cards

Week 4 game (adapted from NMC (2002) Abuja

Title: Mathematics Palace Game

Topic: Volume

Class level: Primary 6

Objectives: Pupils should be able to:

1. Use formula to calculate the volume of triangular prisms
2. Use formula to calculate the volume of cylinders.
3. Use formula to calculate the volume of spheres
4. Solve word problems involving the volume of the shapes.

Materials:

1. Game board made from cardboard sheets.
2. Pack of 13 cards with questions on volume of solids
3. A die and eight game tokens of four colors and two tokens for each color.
4. Check list

Plan: The game board is prepared by drawing about 30 squares on a cardboard sheet. The square spaces contain instructions which involve reciting some formulae and picking questions from a pack of questions. The questions will be on a topic under discussion. The questions are numbered for easy identification. There is a solution sheet showing all the answers to the questions in the pack. A die and game tokens used in ordinary ludo could be used for this game or the teacher could improvise the game tokens. Besides, the teacher should write out a summary of the basic concepts on the topic to help players to recollect some basic facts. This will help them to respond to the questions involved in the game.

The game could be played by at least two players but a maximum of four players is recommended. There should be only one judge to monitor the game. The judge should keep the solution sheet and checks answers for the players. But where there is no judge, the solution sheet could be turned face down by the players and should be referred to when necessary.

Procedure: Any of the players can start the game by throwing the die and other players will play in a clockwise direction. But to qualify his entering any of his game tokens on the game board, a player must get a six and the second throw will determine where to place his game token. He has to follow the instruction on that number square. For example, 'pick a question and solve'.

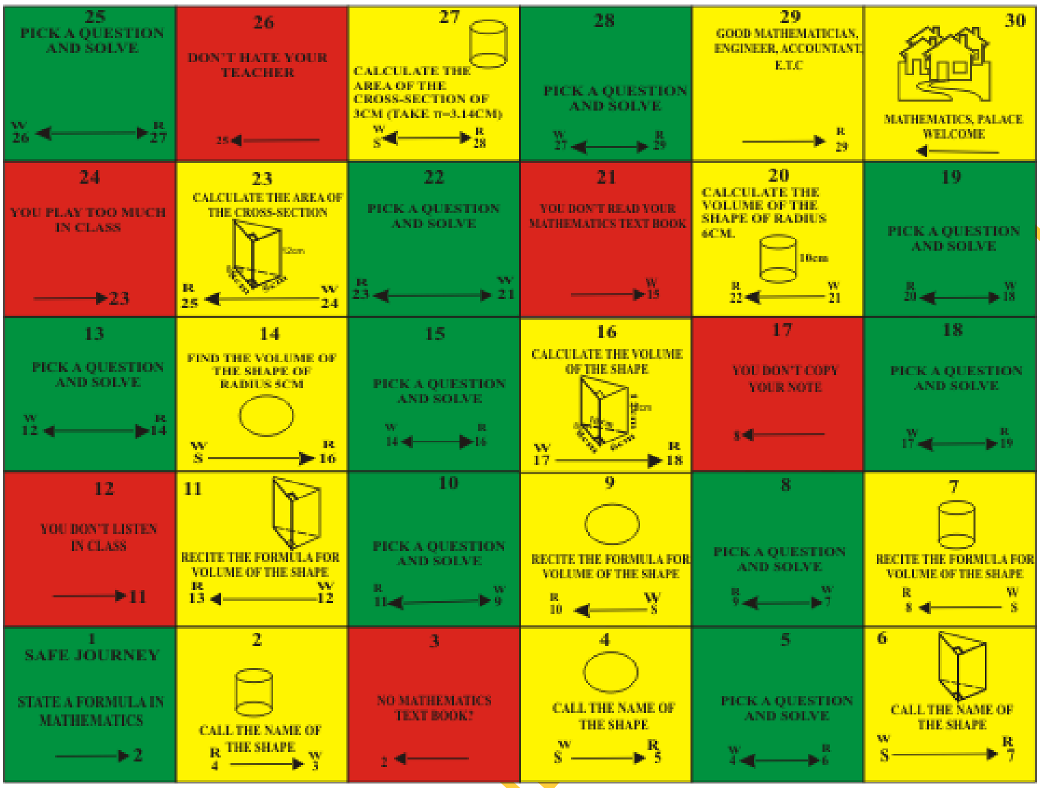
Correct response will move the game token forward to the number shown on the arrow. Wrong answer implies that the player will move his game tokens backward as directed on the game board. In this case he has to perform the instruction on the number square again as part of penalty. If he gets it right, he moves forward to the former position. Otherwise, he will remain in that number square. He could then refer to his note book or ask the teacher for correction.

If a player falls in a square where he has to recite a formula in mathematics, he has to do so loudly. If he gets it correct, he can move forward, otherwise he will remain there. A player should spend a maximum of two minutes on a question. A winner is decided by the first player to get all his game tokens to the 'mathematics palace numbered thirty on the game board.

Strategies: The interest of every player is to get to the Mathematics Palace first. Since each player has two game tokens, he has to move the one that will reward him more at any particular throw of the die. As much as possible, a player should avoid penalties that will move him backwards. Another defensive strategy is that if your game token meets another player's game token, then that token should be taken back by two steps.

Variations: This game 'Mathematical Palace' could be prepared for any level of the education system. It could be used to revise or practice any topic with the students. Many game boards could be prepared to enable more students participate in the game. But, the game could be played in schools, homes, offices and relaxation centers to generate interest of the people in mathematics.

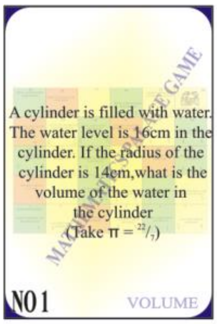
MATHEMATICS
PALACE GAME

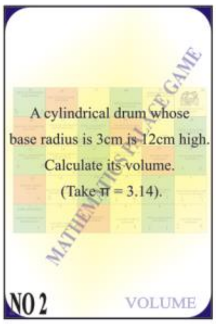


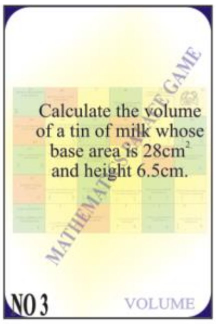
KEYS TO THE GAME

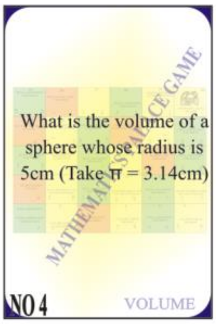
R = RIGHT ANSWER
W = WRONG ANSWER
S = STAY FOR CORRECTION

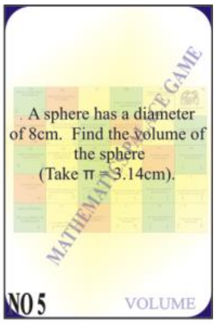
Sample cards

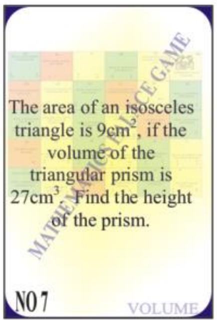


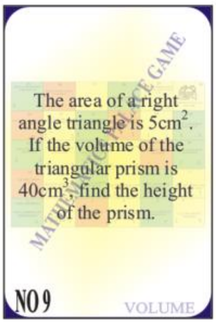












Week 5 game (adapted from Agwagah, 2001)

Title: Capacity Board Game

Class level: Primary 6

Topic: Capacity

Objectives: Pupils should be able to:

1. Solve word problems involving capacity

Materials:

1. A 4 by 4 square board made of card board or wood which contains answers of problems to be solved.

2. A deck of sixteen question cards of 9cm by 12cm on capacity made of cardboard and answer to the problem on the reverse side.

3. Four different sets of colored game tokens or ludo seeds, for covering the correct answers on the small squares in the game board.

4. A die

5. Checklist

6. Paper and pencil or pen

Plan: The game may involve two or more players (maximum of four). The teacher or a pupil appointed can serve as judge or caller.

Procedure: The deck of cards is shuffled and placed on the table with problems face up in front of the caller or judge to open the problem cards on the table. When a problem is opened, the players solve it on their paper, and the first to finish, places one of his game tokens on the small square that contains the answer on the game board. The caller then checks the number covered by the player to make sure it tallies with the answer of that problem card on the checklist.

Game continues until a player covers four numbers in a row horizontally, vertically or diagonally, and calls out '**Down**'.

Rules: Once a player covers a number, he does not remove his token unless he is wrong, after the check by the caller. In this case, another player has the chance of covering the correct answer.

Winner: The first player to cover four correct numbers in a row horizontally, vertically, or diagonally wins the game.

CAPACITY BOARD GAME

396	40	27	6
2.85	0.75	36	50
750	75.36	30	1,250
32	717.5	86.4	5

Sample cards

Week 6 game (adapted from NMC (2002) Abuja)

Title: Mathematics Palace Game

Topic: Weight

Class level: Primary 6

Objectives: Pupils should be able to:

1. Express the same weight in different units: grams, kilograms and tonnes.
2. Convert weights in tonnes to kilograms and vice versa.
3. Identify objects whose weights could be expressed in tonnes, kilograms and grams.
4. Solve word problems on weight

Materials:

1. Game board made from cardboard sheets
2. Pack of 17 cards with questions on weight
3. A die and eight game tokens of four colors and two tokens for each color.
4. Check list

Plan: The game board is prepared by drawing about 30 squares on a cardboard sheet. The square spaces contain instructions which involve reciting some formulae and picking questions from a pack of questions. The questions are based on the topic under discussion. The questions are numbered for easy identification. There is a solution sheet showing all the answers to the questions in the pack. A die and game tokens used in ordinary ludo could be used for this game or the teacher could improvise the game tokens. Besides, the teacher should write out a summary of the basic concepts on the topic to help players to recollect some basic facts. This will help them to respond to the questions involved in the game.

The game could be played by at least two players but a maximum of four players is recommended. There should be only one judge to monitor the game. The judge should keep the solution sheet and checks answers for the players. But where there is no judge, the solution sheet could be turned face down by the players and should be referred to when necessary.

Procedure: Any of the players can start the game by throwing the die and other players will play in a clockwise direction. But to qualify a player entering any of his game tokens on the game board, a player must get a six and the second throw will determine where to place his game token. He has to follow the instruction on that number square. For example, 'pick a question and solve'.

Correct response will move the game token forward to the number shown on the arrow. Wrong answer implies that the player will move his game tokens backward as directed on the game board. In this case he has to perform the instruction on the number square again as part of penalty. If he gets it right, he moves forward to the former position. Otherwise, he will remain in that number square. He could then refer to his note book or ask the teacher for correction.

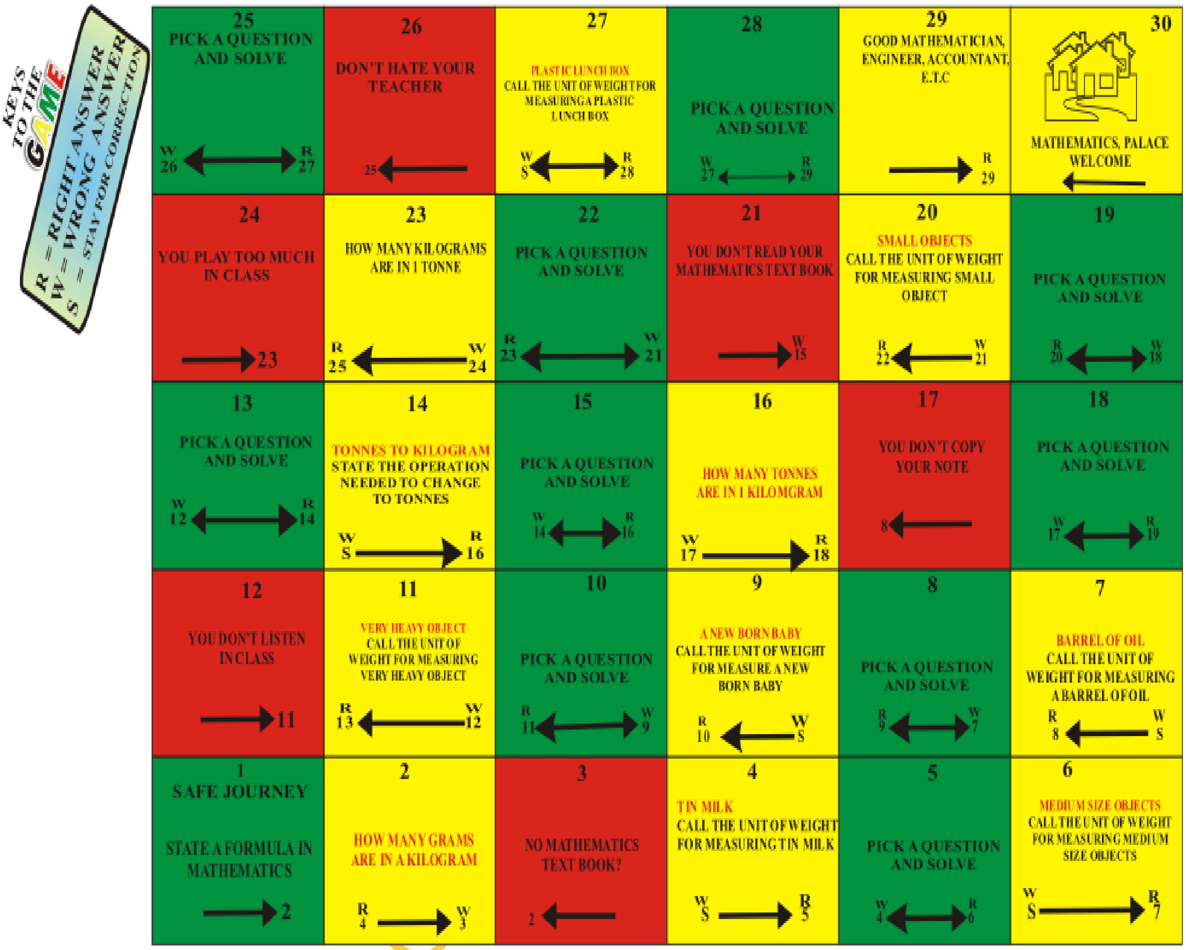
If a player falls in a square where he has to recite a formula in mathematics, he has to do so loudly. If he gets it correct, he can move forward, otherwise he will remain there. A player should spend a maximum of two minutes on a question. A winner is decided by the first player to get all his game tokens to the 'mathematics palace numbered thirty on the game board.

Strategies: The interest of every player is to get to the 'Mathematics Palace' first. Since each player has two game tokens, he has to move the one that will reward him more at any particular throw of the die. As much as possible, a player should avoid penalties that will move him backwards. Another defensive strategy is that if your game token meets another player's game token, then that token should be taken back by two steps.

Variations: Th is game 'Mathematical Palace' could be prepared for any level of the education system. It could be used to revise or practice any topic with the students. Many game boards could be prepared to enable more students participate in the game. But, the game could be played in schools, homes, offices and relaxation centers to generate interest of the people in mathematics.

Follow-up activities: At the end of the game, the teacher should give students more problems to solve on the topics covered in the game to ensure mastery of the key concepts in the topics.

PALACE GAME



KEYS TO THE GAME
R = RIGHT ANSWER
W = WRONG ANSWER
S = STAY FOR CORRECTION
25 PICK A QUESTION AND SOLVE
26 DON'T HATE YOUR TEACHER
27 PLASTIC LUNCH BOX CALL THE UNIT OF WEIGHT FOR MEASURING A PLASTIC LUNCH BOX
28 PICK A QUESTION AND SOLVE
29 GOOD MATHEMATICIAN, ENGINEER, ACCOUNTANT, E.T.C
30 MATHEMATICS, PALACE WELCOME
24 YOU PLAY TOO MUCH IN CLASS
23 HOW MANY KILOGRAMS ARE IN 1 TONNE
22 PICK A QUESTION AND SOLVE
21 YOU DON'T READ YOUR MATHEMATICS TEXT BOOK
20 SMALL OBJECTS CALL THE UNIT OF WEIGHT FOR MEASURING SMALL OBJECT
19 PICK A QUESTION AND SOLVE
13 PICK A QUESTION AND SOLVE
14 TONNES TO KILOGRAM STATE THE OPERATION NEEDED TO CHANGE TO TONNES
15 PICK A QUESTION AND SOLVE
16 HOW MANY TONNES ARE IN 1 KILOMGRAM
17 YOU DON'T COPY YOUR NOTE
18 PICK A QUESTION AND SOLVE
12 YOU DON'T LISTEN IN CLASS
11 VERY HEAVY OBJECT CALL THE UNIT OF WEIGHT FOR MEASURING VERY HEAVY OBJECT
10 PICK A QUESTION AND SOLVE
9 A NEW BORN BABY CALL THE UNIT OF WEIGHT FOR MEASURE A NEW BORN BABY
8 PICK A QUESTION AND SOLVE
7 BARREL OF OIL CALL THE UNIT OF WEIGHT FOR MEASURING A BARREL OF OIL
1 SAFE JOURNEY STATE A FORMULA IN MATHEMATICS
2 HOW MANY GRAMS ARE IN A KILOGRAM
3 NO MATHEMATICS TEXT BOOK?
4 TIN MILK CALL THE UNIT OF WEIGHT FOR MEASURING TIN MILK
5 PICK A QUESTION AND SOLVE
6 MEDIUM SIZE OBJECTS CALL THE UNIT OF WEIGHT FOR MEASURING MEDIUM SIZE OBJECTS

Sample cards

Week 7 game (adapted from NMC (2002) Abuja)

Title: Plane Figure Card Game

Class level: Primary 6

Topic: 2- Dimensional shapes

Objectives: Pupils should be able to:

1. Identify plane figures
2. Identify common properties of plane figures
3. Identify peculiar properties of plane figures

Materials: 60 cards (60mmX40mm) cards made of cardboard paper on which sketches of variety of plane figures are drawn. Five plane figures each on square, trapezium, rectangle, kite, rhombus, parallelogram, equilateral triangle, right-angle triangle, isosceles triangle, scalene triangle, 3-sided polygon, and 6-sided polygon.

Plan: There are normally two players at a time. Nevertheless, 3 or 4 persons can play at a time.

Procedure: Player 'A' shuffled the cards and shares them out at random to both of them. Each player gets 5 cards for a start. One card is thrown open by 'A' from the pile. Player 'B' starts the game by placing another card with a common property with the open one on its top and the judge ensures the common property. If player 'B' has no such card he draws a card from the pile. Then it is the next player's turn to place a correct card. If he cannot, he draws from the pile and it goes round.

The game is played alternatively till one of the players announces 'last card' when he/she has played second to the last card in his/her hand. If he/she successfully plays his/her last card, he calls for a check. The number of cards remaining in the opponent's possession is counted and the number recorded against the opponent. This is one round of the game. The game is played for four rounds before a winner emerges. The winner is the one with the least sum of all the rounds scores.

Rules of the game

1. A card with a sketch of scalene is known as Whort
2. A Whort is used to respond to any property requested for.
3. When a Whort card is placed, the player is free to request for any property in response.
4. If one calls for last card and is not able to end the game, he goes 'to market'.
5. A card with a sketch of polygon is known as hold-on card.

6. If a player plays a hold-on card, his/her opponent waits for him to play again.

7. A card with sketch of trapezium sends the opponent 'to market' to pick two cards.

Strategies

Reserve cards with plane figures with many common properties and/or WHORT for your last card call to enable you end the game, in your favor.

Knowledge of which plane figure is a sub-set of the other e.g. a square is a special rectangle while a rectangle is a special parallelogram, enables one to clear his/her cards to win.

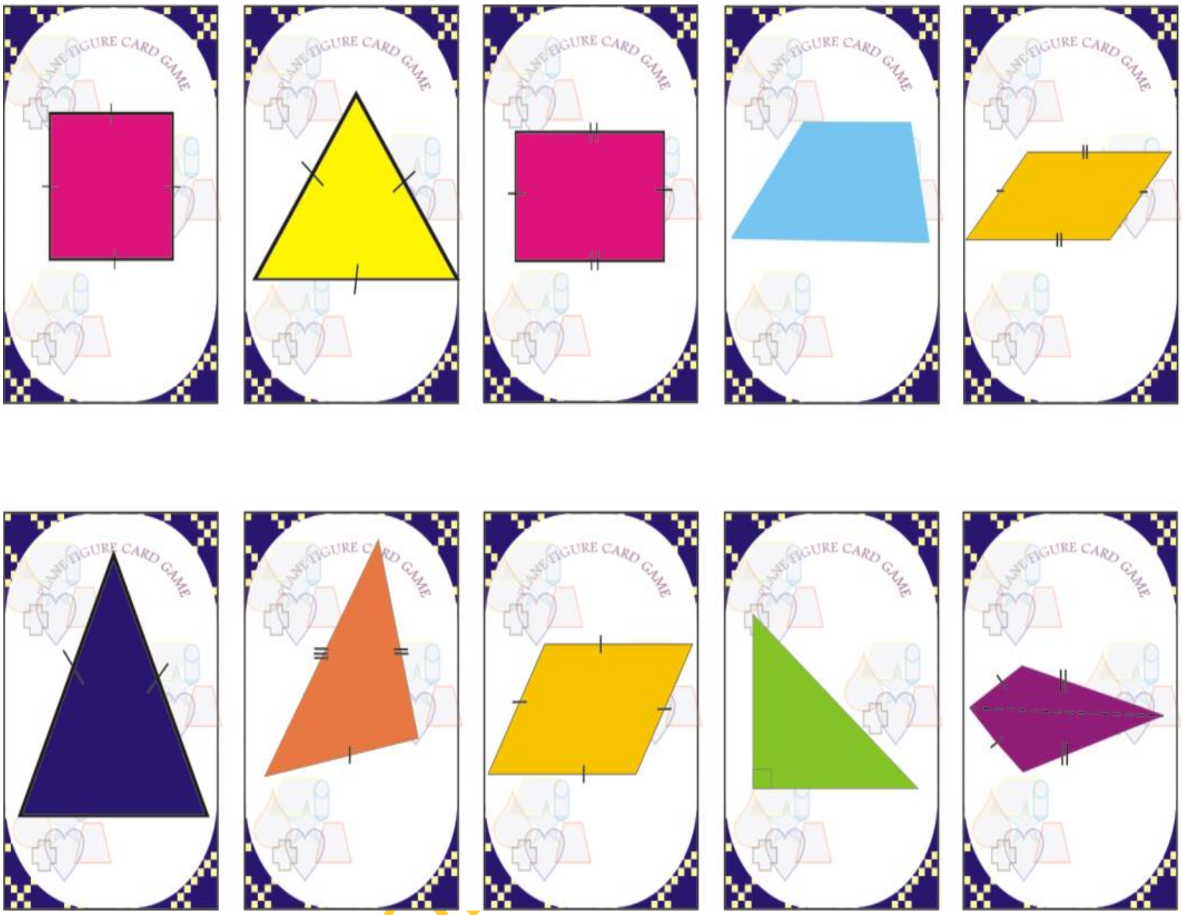
Common Properties in use for the Game

1. All sides are equal (AS)
2. Opposite sides are equal (OS)
3. All angles are equal (AA)
4. Base angles are equal (BA)
5. Opposite angles are equal (OA)
6. Equal pairs of parallel lines (P)
7. Two pairs of parallel lines (PP)
8. One line of symmetry (S1)
9. Two lines of symmetry (S2)
10. Three lines of symmetry (S3)
11. Four lines of symmetry (S4)

Follow-up activities:

Try to produce a graphic representation of relationship between the plane figures; one for triangles and another for quadrilaterals. Try to produce a table of plan figures against the properties of plan figures and observe their relationship as well as the special property for each plan figure. Hence or otherwise try to define each plane figure.

Sample cards



Week 8 game (adapted from NMC (2002) Abuja)

Title: Mathematics Circle Race Game

Class level: Primary 6

Topic: 2 and 3-dimensional shapes

Objectives: Pupils should be able to

1. Identify 2-dimensional shapes not exceeding the octagon.
2. Identify 3-dimensional shapes
3. Solve problems on 2 and 3-dimensional shapes.

Materials:

1. A game board. This board is in circular form and centre is where the race starts and ends at where 'out' is written. There are 42 squares of six different colors excluding the empty zone.
2. 30 Problem cards
3. A die
4. Cards slots' (6)
5. Game tokens
6. Pen and paper

Plan: The game is played by 2 or at most 3 players. A time keeper is essential. A maximum of 2 minutes is given to solve a problem. A time keeper can also be the recorder and the checker. There is a check list at the back.

Procedure: (1) To start the game, a die is tossed. A player with a six will start the game. The game starts from the area marked centre.

2. The cards' slots are numbered 1-6 and each slot will be placed 5 problem cards after shuffling properly.

3. The cards are well shuffled before the start, the number shown on the die will determine what problem square the player finds himself, i.e. if a player plays a 'six', he gets to the centre, if he plays a 'four' at the second throw he counts four, looks at the color, then goes to the appropriate cards slot and picks a problem card.

4. If the player solves the problem correctly he looks for the reward at the bottom of the problem card i.e. move 2 or 3 steps forward. If wrong, move 2, 3, or 4 steps backward.

5. F and E on the game board represent free and empty zones respectively. If a player falls in free zone (F), he will relax; he will not forfeit his chance. But if in

empty zone (E), he will forfeit his chance that is come back to the former position and wait for another turn.

Scoring:

1. For 3 players, the first player to get out will score 30 points, while the second and third players score 20 and 10 points respectively.
2. For 2 players, it will be 20 and 10 points respectively.
3. The total mark will depend on the number of rounds they play and the player with the highest point declared the winner.

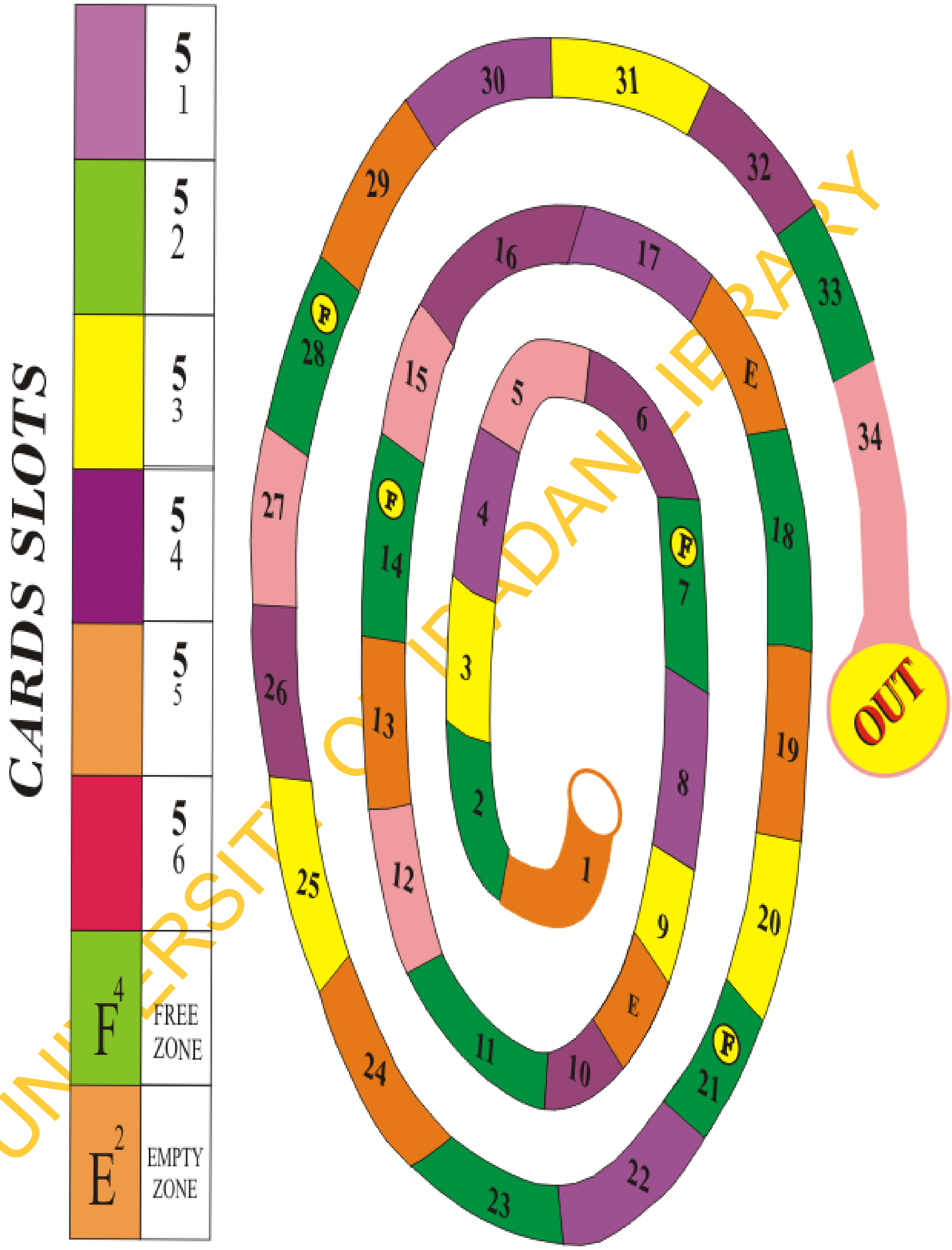
Strategy: Each player struggles to get high numbers in order to run very fast and get out. But if numbers shown are always low, the chance of getting out fast is very low.

Follow-up activities: Students should try to go over their textbooks and solve related problems on the topics.

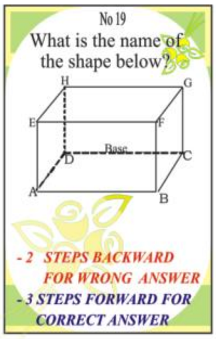
CIRCLE RACE GAME

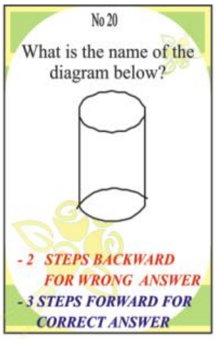
(2 & 3 Dimensional Shapes)

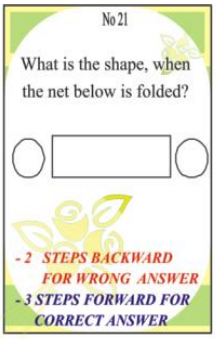
KEY

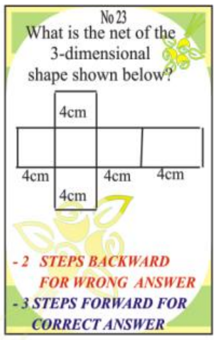


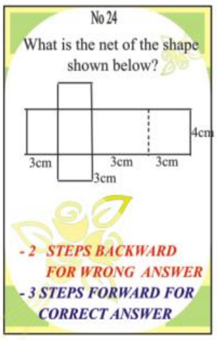
Sample cards

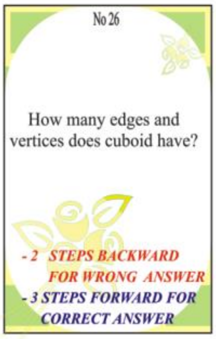


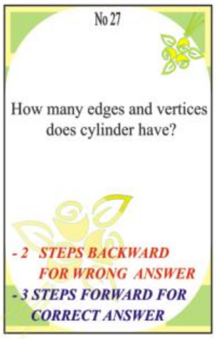


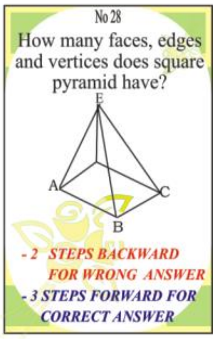












Game 9 for also week 8 (adapted from NMC (2002) Abuja)

Title: Mathematics Vocabulary Game

Class level: Primary 6

Topic: Fractions and Decimals, Volume, Capacity, Weight and Geometry.

Objectives: Pupils should be able to:

Explain common vocabulary within the above topics in the primary school mathematics curriculum

Materials: 30 cards (numbered 1-30) each containing a mathematical term within the topics specified and a check list.

A referee to determine the correctness or otherwise of response and ensure time keeping, proper scoring, addition of scores and declaration of winner.

Plan: Prepare and number problem cards that test knowledge of mathematics concepts in specified areas within the primary school curriculum. Set up a rule for deciding who plays first. Award 2 marks for each correct response for normal turn and 1 mark for each incorrect response whether during normal turn or bonus chance. Score zero for no response within stipulated time. Allow for 2 to 5 players.

Procedure: Toss for a start, shuffle the cards and place on the table with questions face down. Each player picks five cards one at a time in turn. The first player drops a card with question facing up and offers solution within 1 minute. The referee decides on the correctness or otherwise of a response and awards score as appropriate. The referee gives bonus chance where necessary or gives answer where no one gets it.

After every player might have dropped all cards in his hand, the total score for each player is calculated.

Strategy: A player should play his cards beginning with whichever the solution appears well known and most sure of. A player should play last the one that he finds the solution to be most difficult.

Follow-up activities: Teacher should arrange some lessons for a review of the topics by going over the various vocabularies to discuss related concept.

Part of a whole describes

____

No 9

The space occupied by an object is called ____________

No 10

Mathematically, volume is describe as

____

No 11

The formula for the volume of a trianglar prism is

____

No 12

The formula for the volume of a cylinder is

____

No 13

The formula for the volume of a sphere is __________

No 14

The amount of solid or liquid a container can hold is called its ____________

No 15

__________ is the standard unit for measuring capacity.

No 16

How many litres are in 1 kilolitres

No 17

__________ is the word that describes how heavy an object is.

No 18

Appendix 11

INSTRUCTIONAL GUIDE ON POEM-ENHANCED INSTRUCTIONAL STRATEGY (IGPEIS)

Experimental group 1 (lesson schedule)

Week I

Lesson I

Duration: 40 mins

Topic: Fraction and Decimal

Objectives: At the end of the lesson, pupils should be able to

1. Explain the concept of fraction
2. Explain the concept of decimal
3. Express fractions as decimals
4. Express decimals as fractions.
5. Order fractions and decimals

Topic	Duration	Steps	Day	Teacher's Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Fraction and Decimal	5 mins		1 to 3	Ask pupils questions on the previous lesson and introduce the new topic.	Listen and answer the questions		
	25mins	2	1	1.Distribute the poems' manual to pupils and ask pupils to read poems 1,2&3 in wk1(aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Concept of fraction. b. Concept of decimal c. Processes involve in expressing fractions as decimals. d. Solve problems on the chalk board e.g. express ¾ as a decimal 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes.		Give home work to: express: 1. fractions as decimals (correct to 2 or 3 decimal places)

	25mins		2	1.Distribute the poems' manual to pupils and ask pupils to read poem 4&5 in wk1(aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Processes involve in expressing decimals as fraction. b. Solve problems on the chalk board e.g. express 0.75 as a fraction; give answer in its lowest term c. Processes involved in ordering decimal numbers d. Order decimals in ascending or descending order of magnitude. 3.Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes.		Give home work to: express: 1. Decimals to fractions. Give answers in the lowest term. 2. Order decimals in ascending order. 3. Order a set of decimals in descending order.

	25 mins		3	1. Distribute the poems' manual to pupils and ask pupils to read poems 3&5 in wk1(aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems.	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images		Give home work to: 1.Order fractions in ascending order. 2. Order a set of fractions in descending order
	40mins		4	1. Present the poems for the week to pupils. Poems 1-5 in wk1. 2. Read poems aloud with emotions. 3. Ask pupils to read poems (choral reading by the whole class, small groups by row and individually at random). 4. Ask pupils to explain the images and role play the actions in the poems. 5. Revise the week's work with reference to the poems	1. Listen and read with the teacher 2. Read in small groups and individually. 3. Explain the images and role play the actions in the poems. 4. Listen to the revision and ask questions		1. Give more exercises as home work. 2.Give pupils poems to write a. Their feelings about mathematics. b. The content for the week. c. Process of solving a problem
	40 mins.		5	1. Give test for the weeks work	1. Write the test.		Give test to: 1. Order a set of

				2. Mark the test and do the correction.	2. Do their corrections.		fraction in ascending and descending order. 2. Order a set of decimal in ascending and descending order. 3. Express fractions as decimals. 4. Express decimals as fractions. Give answers in the lowest term.
	10mins	3		1. Give pupils problems to solve in the class. 2. Go round to mark pupils work and do the correction. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teachers. 2. Do their correction. 3. Copy the home work in their notes.		Give 1 or 2 questions as class work.

Week 2

Lesson 2

Duration: 40 mins

Topic: Fraction and Decimal

Objectives: At the end of the lesson, pupils should be able to:

1. Add fractions and decimals
2. Subtract fractions and decimals
3 .Combined addition and subtraction of fraction
4. Solve word problems on addition of fraction and decimal
5. Solve word problems on subtraction of fraction and decimal.

Topic	Duration	Steps	Day	Teacher's Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Addition and subtraction (Sub-topic)	5 mins	1	1 to 3	Ask pupils' questions on the previous lesson and introduce the new topic.	Listen and answer the questions.		
	25mins	2	1	1.Distribute the poems' manual to pupils and ask pupils to read poems 1&2 in wk2(aloud by the whole class, in small groups by rows and individually at random).	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain		Give home work to: 1. Add fractions only 2. Subtract fractions only.

				2. Ask pupils to explain and role play the following as pictured in the poems. a. Process involve in solving problems on addition of fraction. b. Process involve in solving problems on subtraction of fraction. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		
	25 mins		2	1. Distribute the poems' manual to pupils and ask pupils to read poems 3, 4,5&6 in wk2 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play		Give home work to 1. Solve problems on combined addition and subtraction of fraction. 2. Solve problems that

				explain and role play the following as pictured in the poems. a. Process involve in solving problems on combined addition and subtraction of fraction. b. Process involve in solving word problems on addition and subtraction of fraction. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		involve carrying. 3. Solve word problems involving addition and subtraction of fraction.
			3	1. Distribute the poems' manual to pupils and ask pupils to read poems 7& repeat 4,5 in wk2 (aloud by the whole class, in small groups by rows and	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually.		Give home work to 1. Solve word problems on addition of decimal. 2. Solve word problems on

				individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Process involve in solving problems on addition of decimal. b. Process involve in solving problems on subtraction of decimal. c. Process involve in solving word problems on addition and subtraction of decimals. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		subtraction of decimal. 3. Solve word problems involving addition and subtraction of decimal

	40mins		4	1. Present the poems for the week to pupils. 2. Read poems aloud with emotions. 3. Ask pupils to read poems (choral reading by the whole class, in small groups by row and individually at random). 4. Ask pupils to explain the images and role play the actions in the poems. 5. Revise the week's work with reference to the poems	1. Listen and read poems with the teacher 2. Read poems in small groups and individually. 3. Explain the images and role play the actions in the poems. 4. Listen to the revision and ask questions		1. Give more exercises as home work. 2.Give pupils poems to write a. Their feelings about mathematics. b. The content for the week. c. Process of solving a problem
	40mins		5	1. Give test for the week's work. 2. Mark the test and do the correction.	1. Write the test. 2. Do the correction.		Give Test to 1. Add and subtract fractions. 2. Add and subtract fraction involving carrying.

							3. Word problems on addition and subtraction of fraction. 4. Add and subtract decimal. 5. Word problems on addition and subtraction of decimal.
	10 mins	3		1. Give pupils problems to solve in the class 2. Go round to mark pupils work and do the correction. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher. 2. Do their correction 3. Copy the home work in their notes.		Give 1 or 2 questions as class work.

Week 3

Lesson 3

Duration: 40 minutes

Topic: Fraction and Decimal

Objectives: At the end of the lesson, pupils should be able to

1 Multiply fraction by fraction

2 Solve word problems on multiplication of fraction

3 Multiply decimal by decimal

4 Divide decimal by 2-digit and 3 digit numbers

5 Solve word problems on multiplication and division of decimal.

Topic	Duration	Steps	Day	Teacher's Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Multiplication and Division (sub-topic)	5mins	1	1 to 3	Ask pupils questions on previous lesson and introduce the new lesson.	Listen and answer the questions.		
	25mins	2	1	1. Distribute the poems' manual to pupils and ask pupils to read poems 1&2 in wk3(aloud by the whole class, in small groups by rows and individually at random).	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain		Give home to 1. Multiply fraction by fraction 2. Solve word problems on multiplication of fraction.

				2. Ask pupils to explain and role play the following as pictured in the poems. a. Process involve in solving problems on the multiplication of fraction by fraction. b. Process in solving word problems on multiplication of fraction. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		
	25mins		2	1. Distribute the poems' manual to pupils and ask pupils to read poems 3& repeat 2 in wk3 (aloud by the whole class, in small groups by rows and individually at	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain		Give home work to 1. Multiply decimal by decimal (correct to 2 or 3 places of decimal. 2. Solve word problems on

				random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Process involve in solving multiplication of decimal by decimal. b. Process involve in solving word problems on the multiplication of decimal. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		multiplication of decimal.
	25 mins		3	1. Distribute the poems' manual to pupils and ask pupils to read poems 4& 5 in wk3 (aloud by the whole class, in small groups by rows and	1. Choral reading of poems aloud by the whole class, in small groups by rows and		Give home work to: 1. Divide decimal by 2-digit and 3-digit numbers. 2. Solve word

				individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Process involve in solving problems on division of decimals by 2-digit and 3-digit numbers. b. Process involve in solving word problems on division of decimals. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		problems on division of decimals.
	40 mins		4	1. Present the poems for the week to pupils. 2. Read poems aloud with emotions. 3. Ask pupils to read	1. Listen and read with the teacher 2. Read in small groups and		1. Give more exercises as home work. 2.Give pupils poems to write about

				poems (choral reading by the whole class, in small groups and individually at random). 4. Ask pupils to explain the images and role play the actions in the poems. 5. Revise the week's work with reference to the poems	individually. 3. Explain the images and role play the actions in the poems. 4. Listen to the revision and ask questions		a. Their feelings about mathematics. b. The content for the week. c. Process of solving a problem
40 mins			5	1. Give test for the week's work. 2. Mark the test and do the correction.	1. Write the test 2. Do the correction.		Give test to: 1. Multiply fraction by fraction 2. Solve word problems involving the multiplication of fraction. 3. Multiply decimal by decimal and solve word problems. 4. Divide decimal by 2 &

							3-digit numbers. 5. Solve word problems on division of decimal.
10 mins		3		1. Give pupils problems to solve in the class 2. Go round to mark pupils' work and do the correction for them. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher 2. Do their corrections 3. Pupils copy the home work in their notes.		Give 1 or 2 questions as class work.

Week 4

Lesson 4

Duration: 40 minutes

Topic: Volume

Objectives: At the end of the lesson, pupils should be able to

1. Calculate volume of triangular prism
2. Calculate volume of cylinders
3. Calculate volume of spheres
4. Solve word problems on volume

Topic	Duration	Steps	Day	Teacher's Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Volume	5 mins	1	1 to 3	Ask pupils questions on previous lesson and introduces the new topic.	Listen and answer questions.		
	25 mins	2	1	1. Distribute the poems' manual to pupils and ask pupils to read poems 1,2& 5 in wk4 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the	Diagrams of triangular prism on the chalk board.	Give home work to: 1. Solve problems on volume at triangular prism using the formula 2. Solve word problem

				following as pictured in the poems. a. Concept of volume b. Formula for calculating volume of triangular prism c. Process involve in solving problems on volume of triangular prisms d. Process involve in solving word problems on triangular prisms. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		involving volume of triangular prism.
	25 mins		2	1. Distribute the poems' manual to pupils and ask pupils to read poems 3& 5 in wk4 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images	Diagram of Cylinder on the chalk board	Give home to: 1. Solve problems on volume of cylinders using the formula. 2. Solve word problems involving volume of Cylinder.

				following as pictured in the poems. a. Formula for calculating the volume of cylinders b. Process involve in solving problems on volume of cylinders c. Process involve in solving word problems on volume of cylinder. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		
	25 mins		3	1. Distribute the poems' manual to pupils and ask pupils to read poems 4& 5 in wk4(aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Formula for	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems.	Diagram of sphere on the chalk board	Give home work to: 1. Solve problems on volume of sphere using the formula 2. Solve word problems involving the volume of sphere.

				calculating volume of sphere b. Process involve in solving problems on volume of sphere c. Process involve in solving word problems on volume of sphere. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	3. Listen to the teacher, ask questions and copy their notes		
	40 mins		4	1. Present the poems for the week to pupils. 2. Read poems aloud with emotions. 3. Ask pupils to read poems (choral reading by the whole class, small groups by row and individually at random). 4. Ask pupils to explain the images and role play the actions in the poems. 5. Revise the week's work with reference to	1. Listen and read with the teacher 2. Read in small groups and individually. 4. Explain the images and role play the actions in the poems. 4. Listen to the revision and ask questions		1. Give more exercises as home work. 2.Give pupils poems to write about a. Their feelings about mathematics. b. The content for the week. c. Process of solving a problem

				the poems			
	40 mins		5	1. Give test for the week's work 2. Mark the test and do corrections	1. Write the test 2. Do the corrections		Give test to: 1. Solve problems on volume of a triangular prism, cylinder and sphere.
	10 mins	3		1. Give pupils problems to solve in the class. 2.Go round to mark pupils' works and do the corrections for them 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher. 2. Do their corrections 3. Pupils copy the home work in their notes.		Give 1 or 2 questions as class work.

Week 5

Lesson 5

Duration: 40 minutes

Topic: Capacity

Objectives: At the end of the lesson, pupils should be able to

1. Explain the concept of capacity

2. Solve word problems on capacity.

Topic	Duration	Steps	Day	Teacher's Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Capacity	5 mins	1	1 to 3	Ask questions on previous lesson and introduce the new topic.	Listen and answer questions.		
	25 mins	2	1	1. Distribute the poems' manual to pupils and ask pupils to read poems 1& 2 in wk5 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Concept of capacity	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the		Give home work to: 1. Name and compare the capacities of containers in the home.

				b. Various containers and compare their capacities. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	teacher, ask questions and copy their notes		
	25 mins		2	1. Distribute the poems' manual to pupils and ask pupils to read poems 3& 4 in wk5(aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Tables of capacity b. Conversion of units of capacity. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		Give home work to: 1. Solve problems on conversion of units of capacity.

				reference to the poems.			
	25 mins		3	1. Distribute the poems' manual to pupils and ask pupils to read poems 4& 5 in wk5 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Process involve in solving word problems involving capacity. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		Give home work to: 1. Solve word problems involving capacity.
	40 mins		4	1. Present the poems for the week to pupils. 2. Read poems aloud with emotions. 3. Ask pupils to read poems (choral reading	1. Listen and read with the teacher 2. Read in small groups and		1. Give more exercises as home work. 2.Give pupils poems to write about

				by the whole class, in small groups and individually at random). 4. Ask pupils to explain the images and role play the actions in the poems. 5. Revise the week's work with reference to the poems.	individually. 4. Explain the images and role play the actions in the poems. 4. Listen to the revision and ask questions		a. Their feelings about mathematics. b. The content for the week. c. Process of solving a problem
	40 mins		5	1. Give test for the week's work 2. Mark pupils work and do corrections.	1. Write the test 2. Do the corrections		Give test to 1. Solve problems on conversion of units of capacity 2. Solve word problems involving capacity.
	10 mins	3		1. Give pupils problems to solve in the class. 2. Go round to mark pupils' works and do the corrections for them. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher. 2. Do their corrections 3. Pupils copy the home work in their notes.		Give1 or 2 questions as class work.

Week 6

Lesson 6

Duration 40 minutes

Topic: Weight

Objectives: At the end of the lesson, pupils should be able to:

1 Explain the concept of weight

2 Express the same weight in different units: grams, kilograms, and tonnes

3 Solve word problems involving weight.

Topic	Duration	Steps	Day	Teacher Activities	Pupils Activities	Teaching Aids	Evaluation Guide
Weight	5 mins	1	1 to 3	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer the questions.		
	25 mins	2	1	1. Distribute the poems' manual to pupils and ask pupils to read poems 1& 2 in wk6 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in		Give home work to list 5 objects each that can be expressed in 1. Grams 2. Kilograms 3. Tonnes

				the poems. a. Concept of weight b. Weight of small objects is expressed in grams, medium sized objects in kilograms, while heavy objects are expressed in tonnes. c. Name examples of objects and the unit of expression of weight. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	the poems. 3. Listen to the teacher, ask questions and copy their notes		
	25 mins		2	1. Distribute the poems' manual to pupils and ask pupils to read poems 3,4& 5 in wk6 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems.	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems.		Give home work to convert weights 1. in grams to kg 2. Kg to tonnes 3. Grams to tonnes 4. Tonnes to Kg and grams

				a. Tables on weight on the chalk board. b. Tables on conversion of weight c. Express the same weight in different units, e.g. 80,000 grams = 80kg = 0.08 tonnes. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	3. Listen to the teacher, ask questions and copy their notes		
	25 mins		3	1. Distribute the poems' manual to pupils and ask pupils to read poem 6 in wk6 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Process in solving word problems on	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the teacher,		Give home work to 1. Solve word problems involving weight.

				weight on the chalk board. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	ask questions and copy their notes		
	40 mins		4	1. Present the poems for the week to pupils. 2. Read poems aloud with emotions. 3. Ask pupils to read poems (choral reading by the whole class, in small groups and individually at random). 4. Ask pupils to explain the images and role play the actions in the poems. 5. Revise the week's work with reference to the poems.	1. Listen and read with the teacher 2. Read in small groups and individually. 4. Explain the images and role play the actions in the poems. 4. Listen to the revision and ask questions		1. Give more exercises as home work. 2.Give pupils poems to write about a. Their feelings about mathematics. b. The content for the week. c. Process of solving a problem
	40 mins		5	1. Give test for the week's work 2. Mark pupils work and do corrections.	1. Write the test 2. Do the correction.		Give test to; 1. Convert weights to different units. 2. Solve word problems involving

							weight.
	10 Mins	3		1. Give pupils problems to solve in the class. 2. Go round to mark pupils work and do the correction for them. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher 2. Do their corrections. 3. Copy the home work in their note.		Give 1 or 2 questions class work.

Week 7

Lesson 7

Duration: 40 minutes

Topic: 2-Dimensional figures

Objectives: At the end of the lesson, pupils should be able to

1. Explain what 2-dimensional shapes are
2. Identify 2-dimentional shapes by name
3. Identify the essential properties of 2-dimensional shapes
4. Identify polygons not exceeding the octagon
5. Solve more difficult problems on 2-dimensional shapes.

Topic	Duration	Steps	Day	Teacher Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
2-Dimensional Figures	5 mins	1	1 to 3	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer the questions.		
	25 mins	2	1	1. Distribute the poems' manual to pupils and ask pupils to read poems 1& 2 in wk7 (aloud by the whole class, in small groups by rows and	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the	Diagrams of 2- D shapes	Give home work to: 1. Name seven 2-dimensional shapes. 2. Name the types of triangles.

				individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. What 2-dimensional shapes are? b. Names of 2-dimensional shapes on the chalk board. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		

	15 mins		2	1. Distribute the poems' manual to pupils and ask pupils to read poems 3& 4 in wk7 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Features of 2-dimensional shapes on the chalk board. b. Solve problems on 2-dimensional shapes. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes	Diagrams showing the features of 2-dimensio nal shapes. Draw triangles, compoun d shapes on the chalk board.	Give Home work to 1. Complete a chart of shapes indicating lines of symmetry, and number of sides. 2. Number of angels contained in the shape. 3. Name the types of triangles 4. Write the features of each triangle. 5. Identify different shapes in a compound figure. 6. Find sizes of angles of triangles.

	25mins		3	1. Distribute the poems' manual to pupils and ask pupils to read poems 5& 6 in wk7 (aloud by the whole class, in small groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. What a polygon is. b. Call polygons not exceeding the octagon. c. Solve problems on polygons 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes	Diagram of polygons on the chalk-board	Give home work to; 1. List the names of polygons. 2. Calculate the angle at the centre of each polygon. 3. Calculate the sum of angles of each polygon. 4. Deduce the formula for the sum of angles of n-sided polygon.

	40 mins		4	1. Present the poems for the week to pupils. 2. Read poems aloud with emotions. 3. Ask pupils to read poems (choral reading by the whole class, in small groups and individually at random). 4. Ask pupils to explain the images and role play the actions in the poems. 5. Revise the week's work with reference to the poems.	1. Listen and read with the teacher 2. Read in small groups and individually. 4. Explain the images and role play the actions in the poems. 4. Listen to the revision and ask questions	.	1. Give more exercises as home work. 2.Give pupils poems to write about a. Their feelings about mathematics. b. The content for the week. c. Process of solving a problem
	40 mins		5	1. Give test for the week's work 2. Mark pupils work and do corrections.	1. Write the test. 2. Do the correction.		Give test to 1. Name and identify features of 2-dimensional shapes. 2. Name types of triangles and

							their features. 3. Identify shapes in a given compound figure. 4. Calculate angles in a given triangle. 5. Name the types of polygons 6. Calculate the sum of angles of a given polygon.
	10 mins	3		1. Give pupils class work 2. Go round to mark pupils' work and do the correction. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher. 2. Do their corrections 3. Copy the home work.		Give 1 or 2 questions as class work.

Week 8

Lesson 8

Duration: 40 minutes

Topic: 3-Dimensional shapes

Objectives: At the end of the lesson, pupils should be able to

1. Explain what 3-dimensional shapes are
2. Identify 3-dimentional shapes by name
3. Identify number of edges, faces and vertices of 3-dimensional shapes
4. Identify nets of 3-dimensional shapes
5. Measure angles of 3-dimensional shapes
6. Identify lines that are parallel and perpendicular in 3-dimensional shapes.

Topic	Duration	Steps	Day	Teacher Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
3-Dimensional Shapes	5 mins	1	1 to 3	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer the questions.		
	25 mins	2	1	1. Distribute the poems' manual to pupils and ask pupils to read poems 1 in wk8 (aloud by the whole class, in small	1. Choral reading of poems aloud by the whole class, in small groups by rows and	Diagrams of 3-dimensional shapes on the chalk board.	Give home work to: 1. List 3-dimensional shapes. 2. Draw and label 3-

				groups by rows and individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. What 3-dimensional shapes are? b. Names of 3-dimensional shapes on the chalk board. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	individually. 2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		dimensional shapes.
	25 mins		2	1. Distribute the poems' manual to pupils and ask pupils to read poems 2&3 in wk8 (aloud by the whole class, in small groups by rows and	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually.	Diagrams showing the edges, faces and vertices of 3-dimensional shapes.	Give home work to: 1. Make 3-dimensional shapes with cardboard. 2. Complete a chart of 3-

				individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. What are edges, faces and vertices of a given 3-dimensional shape? b. Indicate the edges, vertices and faces of 3-D shapes 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes		dimensional shapes indicating numbers of edges, faces and vertices. 3. Prepare nets of 3-dimensional shapes.
	25 mins		3	1. Distribute the poems' manual to pupils and ask pupils to read poems 4&5 in wk8 (aloud by the whole class, in small groups by rows and	1. Choral reading of poems aloud by the whole class, in small groups by rows and individually.	1. Diagram of 3-dimensional shapes. 2. Diagram of parallel and perpendicular	Give home work to: 1. Measure sizes of angles in 3-dimensional shapes. 2. List lines that are

				individually at random). 2. Ask pupils to explain and role play the following as pictured in the poems. a. Measure the sizes of angles in 3-dimensional shapes. b. Indicate lines that are parallel and perpendicular 3-dimensional shapes. 3. Teacher asks pupils questions to clarify the concept/teaches the new topic with reference to the poems.	2. Explain and role play the images pictured in the poems. 3. Listen to the teacher, ask questions and copy their notes	lines.	perpendicular. 3. List lines that parallel to each other.
	40mins		4	1. Present the poems for the week to pupils. 2. Read poems aloud with emotions.	1. Listen and read with the teacher 2. Read in small groups and		1. Give more exercises as home work. 2.Give pupils poems to write about

				3. Ask pupils to read poems (choral reading by the whole class, in small groups and individually at random). 4. Ask pupils to explain the images and role play the actions in the poems. 5. Revise the week's work with reference to the poems.	individually. 3. Explain the images and role play the actions in the poems 4. Listen to the revision and ask questions		a. Their feelings about mathematics. b. The content for the week. c. Process of solving a problem
	40 mins		5	1. Give test for the week's work 2. Mark pupils work and do corrections.	1. Write the test. 2. Do the correction.		Give test to: 1. List the names of 3-dimensional shapes. 2. Identify the number of edges, faces and vertices of 3-dimensional shapes. 3. Use protractor to

							measure the sizes of angles of 3-dimensional shapes. 4. List pair of parallel and perpendicular lines in a given 3-dimensional shape. 5. Identify nets of 3-dimensional shapes.
	10 mins	3		1. Give pupils class work. 2. Go round to mark pupils work and do the corrections. 3. Conclude the lesson by giving home work to pupils.	1. Solve the problems given by the teacher. 2. Do their corrections 3. Copy the home work.		Give 1 or 2 questions as class work.

Appendix 12

INSTRUCTIONAL GUIDE ON GAME-ENHANCED INSTRUCTIONAL STRATEGY (IGGEIS)

Experimental group 2 (lesson schedule)

Week I

Lesson I

Duration: 40 minutes

Topic: Fraction and Decimal

Objectives: At the end of the lesson, pupils should be able to:

1. Explain the concept of fraction
2. Explain the concept of decimal
3. Express fractions as decimals
4. Express decimals as fractions
5. Order fractions and decimals

Topic	Duration	Steps	Day	Teacher Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Fraction and Decimal	2 mins	1	1 to 3	Ask pupils questions on the previous lesson and introduce the new topic.	Listen and answer the questions		
	25mins	2	1	1.Teach the new topic 2.Distribute week 1 game materials/re-arrange the class 3. Explain the game	1. Listen, ask questions and copy the note.		Give home work to: express: 1. fractions as decimals (correct

				materials, rules and objectives of the lesson.	2. Play week 1 game		to 2 or 3 decimal places)
	25 mins		2	1.Teach the new topic 2. Distribute week 1 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 1 game		Give home work to: express: 1. Decimals as fractions. Give answers in the lowest term. 2. Order decimals in ascending order. 3. Order a set of decimals in descending order.
	25 mins		3	1.Teach the new topic 2.Distribute week 1 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 1 game		Give home work to: 1.Order fractions in ascending order. 2. Order a set of fractions in descending order
	40mins		4	1.Revise the week's work 2.Distribute week 1 game materials/re-arrange the class	1. Listen, ask questions and copy the		Give more exercises as home work and follow up

				3. Explain the game materials, rules and objectives of the lesson.	note. 2. Play week 1 game		activities.
	40 mins.		5	1. Give test for the weeks work 2. Mark the test and do the correction.	1. Write the test. 2. Do their corrections.		Give test to: 1. Order a set of fraction in ascending or descending order. 2. Order a set of decimal in ascending or descending order. 3. Express fractions as decimals. 4. Express decimals as fractions. Give answers in the lowest term.
	13mins	3		De- briefing session 1. Ask pupils questions to further clarify the concept and problems. 2. Ask pupils to come to the board to solve problems as follow-up	1. Pupils answer the questions. 2. Pupils solve the problems on the board.		1. Ask questions base on the day's work. 2. Call pupils to solve question cards that were difficult.

				activities. 3. Give home work. 4. Collect materials/re-arrange the class.	3. Pupils copy their home work		3. Give home work covering the day's work.

Week 2

Lesson 2

Topic: Fraction and Decimal

Objectives: At the end of the lesson, pupils should be able to:

1. Add fractions and decimals
2. Subtract fractions and decimals
3. Combined addition and subtraction of fraction
4. Solve word problems on addition of fraction and decimal
5. Solve word problems on subtraction of fraction and decimal.

Topic	Duration	Steps	Day	Teacher Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Addition and subtraction (sub-topic)	2 mins	1	1 to 3	Ask pupils questions on the previous lesson and introduce the new topic.	Listen and answer the questions.		
	25mins	2	1	1.Teach the new topic 2.Distribute week 2 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 2 game		Give home work to 1. Add fractions only 2. Subtract fractions only.
	25 mins		2	1.Teach the new topic	1. Listen, ask		Give home work

				2.Distribute week 2 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	questions and copy the note. 2. Play week 2 game		to 1. Solve problems on combined addition and subtraction of fraction. 2. Solve problems that involve carrying. 3. Solve word problems involving addition and subtraction of fraction.
	25mins		3	1.Teach the new topic 2.Distribute week 2 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 2 game		Give home work to: 1. Solve word problems on addition of decimal. 2. Solve word problems on the subtraction of decimal. 3. Solve word problems

							involving addition and subtraction of decimal
			4	1.Revise the week's work 2.Distribute week 2 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 2 game		Give more exercises as home work and follow up activities.
	40mins		5	1. Give test for the week's work. 2. Mark the test and do the correction.	1. Write the test. 2. Do the correction.		Give test to: 1. Add and subtract fractions. 2. Add and subtract fraction involving carrying. 3. Word problems on addition and subtraction of fraction. 4. Add and subtract

							decimal. 5. Word problems on addition and subtraction of decimal.
	13mins	3		De- briefing session 1. Ask pupils questions to further clarify the concept and problems. 2. Ask pupils to come to the board to solve problems as follow-up activities. 3. Give home work. 4. Collect materials/re-arrange the class.	1. Pupils answer the questions. 2. Pupils solve the problems on the board. 3. Pupils copy their home work		1. Ask questions base on the day's work. 2. Call pupils to solve question cards that were difficult. 3. Give home work covering the day's work.

Week 3

Lesson 3

Duration: 40 minutes

Topic: Fraction and Decimal

Objectives: At the end of the lesson, pupils should be able to

1. Multiply fraction by fraction
2. Solve word problems on multiplication of fraction
3. Multiply decimal by decimal
4. Divide decimal by 2-digit and 3 digit numbers
5. Solve word problems on multiplication and division of decimal.

Topic	Duration	Steps	Day	Teacher Activities	Pupils Activities	Teaching Aids	Evaluation Guide
Multiplication and Division (sub-topic)	2mins	1	1 to 3	Ask pupils questions on previous lesson and introduce the new lesson.	Listen and answer the questions.		
	25mins	2	1	1.Teach the new topic 2.Distribute week 3 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 3 game		Give home to 1. Multiply fraction by fraction 2. Solve word problems on multiplication of fraction.

	25mins		2	1.Teach the new topic 2.Distribute week 3 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 3 game		Give home work to: 1. Multiply decimal by decimal (correct to 2 or 3 places of decimal. 2. Solve word problems on multiplication of decimal.
	25 mins		3	1.Teach the new topic 2.Distribute week 3 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 3 game		Give home work to: 1. Divide decimal by 2-digit and 3-digit numbers. 2. Solve word problems on division of decimals.
	40 mins		4	1.Revise the week's work 2.Distribute week 3 game materials/re-arrange the class 3. Explain the game materials, rules and	1. Listen, ask questions and copy the note. 2. Play week 3 game		Give more exercises as home work and follow up activities.

				objectives of the lesson.			
	40mins		5	1. Give test for the week's work. 2. Mark the test and do the correction.	1. Write the test 2. Do the correction.		Give test to: 1. Multiply fraction by fraction 2. Solve word problems involving multiplication of fraction. 3. Multiply decimal by decimal and solve word problems. 4. Division of decimal by 2 & 3-digit numbers. 5. Word problems on division of decimal.
	13mins	3		De- briefing session 1. Ask pupils questions to further clarify the concept and problems. 2. Ask pupils to	1. Pupils answer the questions. 2. Pupils solve the problems on		1. Ask questions base on the day's work. 2. Call pupils to solve question cards that were

				come to the board to solve problems as follow-up activities. 3. Give home work. 4. Collect materials/re-arrange the class.	the board. 3. Pupils copy their home work		difficult. 3. Give home work covering the day's work.

Week 4

Lesson 4

Duration: 40 minutes

Topic: Volume

Objectives: At the end of the lesson, pupils should be able to

1. Calculate volume of triangular prism
2. Calculate volume of cylinders
3. Calculate volume of spheres
4. Solve word problems on volume

Topic	**Duration**	**Steps**	**Day**	**Teacher Activities**	**Pupils' Activities**	**Teaching Aids**	**Evaluation Guide**
Volume	2 mins	1	1 to 3	Ask pupils questions on previous lesson and introduces the new topic.	Listen and answer questions.		
	25 mins	2	1	1.Teach the new topic 2.Distribute week 4 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 4 game	Diagrams of triangular prisms on the chalk board.	Give home work to: 1. Solve problems on volume of triangular prism using the formula 2. Solve word problems

							involving volume of triangular prisms.
	25 mins		2	1.Teach the new topic 2.Distribute week 4 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 4 game	Diagram of Cylinder on the chalk board	Give home work to: 1. Solve problems on volume of cylinders using the formula. 2. Solve word problems involving volume of Cylinder.
	25mins		3	1.Teach the new topic 2.Distribute week 4 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 4 game	Diagram of sphere on the chalk board	Give home work to: 1. Solve a problem on volume of sphere using the formula 2. Solve word problems involving the volume of sphere.
	40 mins		4	1.Revise the week's	1. Listen, ask		Give more

				work 2.Distribute week 4 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	questions and copy the note. 2. Play week 4 game		exercises as home work and follow up activities.
	40 mins		5	1. Give test for the week's work 2. Mark the test and do corrections	1. Write the test 2. Do the corrections		Give home work to: 1. Solve problems on volume of a triangular prism, cylinder and sphere.
	13mins	3		De- briefing session 1. Ask pupils questions to further clarify the concept and problems. 2. Ask pupils to come to the board to solve problems as follow-up activities. 3. Give home work. 4. Collect materials/re-arrange the class.	1. Pupils answer the questions. 2. Pupils solve the problems on the board. 3. Pupils copy their home work		1. Ask questions base on the day's work. 2. Call pupils to solve question cards that were difficult. 3. Give home work covering the day's work.

Week 5

Lesson 5

Duration: 40 minutes

Topic: Capacity

Objectives: At the end of the lesson, pupils should be able to

1. Explain the concept of capacity
2. Solve word problems on capacity.

Topic	**Duration**	**Steps**	**Day**	**Teacher Activities**	**Pupils Activities**	**Teaching Aids**	**Evaluation Guide**
Capacity	2 mins	1	1 to 3	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer questions.		
	25 mins	2	1	1.Teach the new topic 2.Distribute week 5 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 5 game		Give home work to: 1. Name and compare the capacities of containers in the home.

	25 mins		2	1.Teach the new topic 2.Distribute week 5 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 5 game		Give home work to: 1. Solve problems on conversion of units of capacity.
	25mins		3	1.Teach the new topic 2.Distribute week 5 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 5 game		Give home work to: 1. Solve word problems involving capacity.
	40 mins		4	1.Revise the week's work 2.Distribute week 5 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 5 game		Give more exercises as home work and follow up activities.
	40 mins		5	1. Give test for the week's work 2. Mark pupils work	1. Write the test 2. Do the corrections		Give test to: 1. Solve problems on conversion of

				and do corrections.			units of capacity 2. Solve word problems involving capacity.
	13mins	3		De- briefing session 1. Ask pupils questions to further clarify the concept and problems. 2. Ask pupils to come to the board to solve problems as follow-up activities. 3. Give home work. 4. Collect materials/re-arrange the class.	1. Pupils answer the questions. 2. Pupils solve the problems on the board. 3. Pupils copy their home work		1. Ask questions base on the day's work. 2. Call pupils to solve question cards that were difficult. 3. Give home work covering the day's work.

Week 6

Lesson 6

Duration: 40 minutes

Topic: Weight

Objectives: At the end of the lesson, pupils should be able to:

1. Explains the concept of weight
2. Express the same weight in different units: grams, kilograms, and tonnes
3. Solve word problems involving weight.

Topic	Duration	Steps	Day	Teacher Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Weight	2 mins	1	1 to 3	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer the questions.		
	25 mins	2	1	1.Teach the new topic 2.Distribute week 6 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 6 game		Give Home work to list 5 objects each that can be expressed in: 1. Grams. 2. Kilograms. 3. Tonnes.
	25 mins		2	1.Teach the new topic 2.Distribute week 6 game materials/re-arrange the class 3. Explain the game	1. Listen, ask questions and copy the note. 2. Play week 6 game		Give home work to convert weights: 1. in grams to kg 2. Kg to tonnes

				materials, rules and objectives of the lesson.			3. Grams to tonnes 4. Tonnes to Kg and grams etc.
	25mins		3	1.Teach the new topic 2.Distribute week 5 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 5 game		Give home work to: 1. Solve word problems involving weight.
	40 mins		4	1.Revise the week's work 2.Distribute week 6 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 6 game		Give more exercises as home work and follow up activities.
	40 mins		5	1. Give test for the week's work 2. Mark pupils work and do corrections.	1. Write the test 2. Do the correction.		Give test to; 1. Convert weights to different units. 2. Solve word problems involving weight.
	13mins	3		De- briefing session 1. Ask pupils questions	1. Pupils answer the		1. Ask questions base on the day's

				to further clarify the concept and problems. 2. Ask pupils to come to the board to solve problems as follow-up activities. 3. Give home work. 4. Collect materials/re-arrange the class.	questions. 2. Pupils solve the problems on the board. 3. Pupils copy their home work		work. 2. Call pupils to solve question cards that were difficult. 3. Give home work covering the day's work.

Week 7

Lesson 7

Duration: 40 minutes

Topic: 2-Dimensional figures

Objectives: At the end of the lesson, pupils should be able to

1. Explain what 2-dimensional shapes are
2. Identify 2-dimentional shapes by name
3. Identify the essential properties of 2-dimensional shapes
4. Identify polygons not exceeding the octagon
5. Solve more difficult problems on 2-dimensional shapes.

Topic	Duration	Steps	Day	Teacher Activities	Pupils Activities	Teaching Aids	Evaluation Guide
2-Dimensional Figures	2 mins		1 to 3	Ask questions on previous lesson and introduce the new topic.	Listen and answer the questions.		
	25 mins	2	1	1.Teach the new topic 2.Distribute week 7 game materials/re-arrange the class 3. Explain the game materials, rules and	1. Listen, ask questions and copy the note. 2. Play week 7 game	Diagram of 2-dimensional shapes on the chalk	Give home work to; 1. Seven 2-dimensional shapes. 2. Name the types of triangles.

				objectives of the lesson.		board.	
	25 mins		2	1.Teach the new topic 2.Distribute week 7 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 7 game	Diagrams showing the features of 2-dimensional shapes. 2.Draw triangles, compound shapes on the chalk board.	Give home work to: 1. Complete a chart of shapes indicating lines of symmetry, and number of sides. 2. Number of angels contained in the shape. 3. Name the types of triangles 4. Write the features of each triangle 5. Identify different shapes in a compound figure. 6. Find sizes of angles of triangles.

	25mins		3	1.Teach the new topic 2.Distribute week 7 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 7 game	Diagram of polygons on the chalk-board.	Give home work to: 1. List the names of polygons. 2. Calculate the angle at the centre of each polygon. 3. Calculate the sum of angles of each polygon. 4. Deduce the formula for the sum angles of n-sided polygon.
	40 mins		4	1.Revise the week's work 2.Distribute week 7 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 7 game		Give more exercises as home work and follow up activities.

	40 mins		5	1. Give test for the week's work 2. Mark pupils work and do corrections.	1. Write the test. 2. Do the correction.		Give test to 1. Name and identify features of 2-dimensional shapes. 2. Name types of triangles and their features. 3. Identify shapes in a given compound figure. 4. Calculate angles in a given triangle. 5. Name the types of polygons 6. Calculate the sum of angles of a given polygon.
	13mins	3		De- briefing session 1. Ask pupils questions to further clarify the concept and	1. Pupils answer the questions. 2. Pupils solve		1. Ask questions base on the day's work. 2. Call pupils to

				problems. 2. Ask pupils to come to the board to solve problems as follow-up activities. 3. Give home work. 4. Collect materials/re-arrange the class.	the problems on the board. 3. Pupils copy their home work		solve question cards that were difficult. 3. Give home work covering the day's work.

Week 8

Lesson 8

Duration: 40 minutes

Topic: 3-Dimensional shapes

Objectives: At the end of the lesson, pupils should be able to:

1. Explain what 3-dimensional shapes are
2. Identify 3-dimentional shapes by name
3. Identify number of edges, faces and vertices of 3-dimensional shapes
4. Identify nets of 3-dimensional shapes
5. Measure angles of 3-dimensional shapes
6. Identify lines that are parallel and perpendicular in 3-dimensional shapes.

Topic	Duration	Steps	Day	Teacher Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
3-Dimensional Shapes	2 mins	1	1 to 3	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer the questions.		
	25 mins	2	1	1.Teach the new topic 2.Distribute week 8 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the	1. Listen, ask questions and copy the note. 2. Play week 8 game	Diagrams of 3-dimensional shapes on the board.	Give home work to: 1. List 3-dimensional shapes. 2. Draw and label 3-dimensional

				lesson.			shapes.
	25 mins		2	1.Teach the new topic 2.Distribute week 8 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 8 game	Diagrams showing the edges, faces and vertices of 3-dimensional shapes.	Give home work to: 1. Make 3-dimensional shapes with cardboard. 2. Complete a chart of 3-dimensional shapes indicating numbers of edges, faces and vertices. 3. Prepare nets of 3-dimensional shapes.
	25mins		3	1.Teach the new topic 2.Distribute week 8 game materials/re-arrange the class 3. Explain the game materials, rules and objectives of the	1. Listen, ask questions and copy the note. 2. Play week 8 game	1. Diagram of 3-dimensional shapes. 2. Diagram of parallel and perpendicular	Give home work to 1. Measure sizes of angles in 3-dimensional shapes. 2. List lines that

				lesson.		lines.	are perpendicular. 3. List lines that parallel to each other in 3-D shapes.
	40 mins		4	1.Revise the week's work 2.Distribute week 8&9 games materials/re-arrange the class 3. Explain the game materials, rules and objectives of the lesson.	1. Listen, ask questions and copy the note. 2. Play week 8&9 games		Give more exercises as home work and follow up activities.
	40 mins		5	1. Give test for the week's work 2. Mark pupils work and do corrections.	1. Write the test. 2. Do the correction.		1. List the names of 3-dimensional shapes. 2. Identify the number of edges, faces and vertices of 3-dimensional shapes. 3. Use protractor to measure the

							sizes of angles of 3-dimensional shapes. 4. List pair of parallel and perpendicular lines in a given 3-dimensional shape. 5. Identify nets of 3-dimensional shapes.
	13mins	3		De- briefing session 1. Ask pupils questions to further clarify the concept and problems. 2. Ask pupils to come to the board to solve problems as follow-up activities. 3. Give home work. 4. Collect materials/re-arrange the class.	1. Pupils answer the questions. 2. Pupils solve the problems on the board. 3. Pupils copy their home work		1. Ask questions base on the day's work. 2. Call pupils to solve question cards that were difficult. 3. Give home work covering the day's work.

Appendix 13

INSTRUCTIONAL GUIDE ON MODIFIED LECTURE INSTRUCTIONAL STRATEGY (IGLMIS)

Control group (lesson schedule)

Week I

Lesson I

Duration: 40 mins

Topic: Fraction and Decimal

Objectives: At the end of the lesson, pupils should be able to:

1. Explain the concept of fraction
2. Explain the concept of decimal
3. Express fractions as decimals
4. Express decimals as fractions.
5. Order fractions and decimals

Topic	Duration	Steps	Day	Teacher Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Fraction and Decimal	5 mins	1	1 to 3	Ask pupils questions on the previous lesson and introduce the new topic.	Listen and answer the questions		
	15 mins	2	1	1. Explain the concept of fraction 2. Explain the concept of decimal 3. Express fractions as decimals	1.Listen to the explanation of the concept of fraction,		Give home work to: express: 1. fractions as decimals (correct to 2

				4. Solve problems on the chalk board e.g. express ¾ as a decimal	decimal and express fractions as decimals 2.Listen, ask questions and copy the note.		or 3 decimal places)
	15 mins		2	1. Explain the processes involve in expressing decimals as fraction. 2. Solve problems on the chalk board e.g. express 0.75 as a fraction; give answer in its lowest term 3. Explain the processes involve in ordering decimal numbers 4. Order a set of decimals in ascending and descending order of magnitude	1. Listen to the processes involve in expressing decimal as fraction. 2. Listen, ask questions and copy the note.		Give home work to: express: 1. Decimals to fractions. Give answers in the lowest term. 2. Order decimals in ascending order. 3. Order a set of decimals in descending order.
			3	1. Explain the process involve in ordering fractions 2 .Order fraction in ascending or descending order of magnitude.	1. Listen to the processes involve in ordering fractions .		Give home work to: 1.Order fractions in ascending

					2. Listen, solve examples with the teacher and copy the note.		order. 2. Order a set of fractions in descending order
	15mins		4	1. Revise the week's work. 2. Solve more examples on the week's work.	1. Listen and ask questions 2. Participate in solving the examples.		Give more exercises as home work.
	40 mins.		5	1. Give test for the weeks work 2. Mark the test and do the correction.	1. Write the test. 2. Do their corrections.		Give test to 1. Order a set of fraction in ascending or descending order. 2. Order a set of decimal in ascending or descending order. 3. Express fractions as decimals. 4. Express decimals as fractions.

							Give answers in the lowest term.
	20 mins	3		1. Give pupils problems to solve in the class. 2. Mark pupils work and do the correction. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher. 2. Do their correction. 3. Copy the home work in their notes.		Give class work covering the day's lesson.

Week 2

Lesson 2

Duration: 40 mins

Topic: Addition and Subtraction

Objectives: At the end of the lesson, pupils should be able to:

1. Add fractions and decimals
2. Subtract fractions and decimals
3. Combined addition and subtraction of fraction
4. Solve word problems on addition of fraction and decimal
5. Solve word problems on subtraction of fraction and decimal.

Topic	Duration	Steps	Day	Teacher Activities	Pupils Activities	Teaching Aids	Evaluation Guide
Addition and subtraction (sub-topic)	5 mins	1	1 to 4	Ask pupils questions on the previous lesson and introduce the new topic.	Listen and answer the questions.		
		2	1	1. Give pupils a revision of addition of whole numbers. 2. Lead pupils to solve problems on addition of fraction. 3. Lead pupils to solve problems on subtraction of fraction.	1. Participate in the revision exercise. 2. Listen, and solve examples with the teacher and copy the note on		Give home work to: 1. Add fractions only 2. Subtract fractions only.

					addition of fraction. 3. Listen and solve examples on subtraction of fraction and copy the note.		
	15 mins		2	1. Solve problems on combined addition and subtraction of fraction. 2. Solve word problems on addition and subtraction of fractions.	1. Listen and solve problems with the teacher and copy the note. 2. Listen, ask questions and copy the note.		Give home work to 1. Solve problems on combined addition and subtraction of fraction. 2. Solve problems that involve carrying. 3. Solve word problems involving addition and subtraction of fraction.
			3	1. Lead pupils to solve problems on addition of decimal.	1. Listen and solve problems with		Give home work to: 1. Solve

				2. Lead pupils to solve problems on subtraction of decimal.	the teacher and copy the note. 2. Listen, and solve the problems on subtraction of decimal with the teacher.		problems on addition of decimal. 2. Solve problems on the subtraction of decimal.
			4	1. Solve word problems on addition of decimals. 2. Solve word problems on subtraction of decimals.	Listen, ask questions and copy the note.		Give home work to: 1. Solve word problems on addition of decimal. 2. Solve word problems on subtraction of decimal. 3. Solve word problems involving addition and subtraction of decimal.
	40mins		5	1. Give test for the week's work. 2. Mark the test and do the correction.	1. Write the test. 2. Do the correction.		Give test to: 1. Add and subtract fractions.

							2. Add and subtract fraction involving carrying. 3. Word problems on addition and subtraction of fraction. 4. Add and subtract decimal. 5. Word problems on addition and subtraction of decimal.
	20 mins	3		1. Give pupils problems to solve in the class 2. Mark pupils work and do the correction. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher. 2. Do their correction 3. Copy the home work in their notes.		Give class work covering the day's lesson.

Week 3

Lesson 3

Duration: 40 minutes

Topic: Fraction and Decimal

Objectives: At the end of the lesson, pupils should be able to:

1. Multiply fraction by fraction
2. Solve word problems on multiplication of fraction
3. Multiply decimal by decimal
4. Divide decimal by 2-digit and 3 digit numbers
5. Solve word problems on multiplication and division of decimal.

Topic	Duration	Steps	Day	Teacher Activities	Pupils' Activities	Teaching Aids	Evaluation Guide
Multiplication and Division (sub-topic)	5mins	1	1 to 3	Ask pupils questions on the previous lesson and introduce the new lesson.	Listen and answer the questions.		
	15mins	2	1	1. Give pupils a revision on multiplication of whole numbers. 2. Solve some examples on the multiplication of fraction by fraction. 3. Solve examples of	1. Participate in the revision of multiplication of whole numbers. 2. Listen and solve examples with the teacher and		Give home to: 1. Multiply fraction by fraction 2. Solve word problems on multiplication of fraction.

				word problems on the multiplication of fraction.	copy the note. 3. Listen, ask questions and copy the note.		
	15mins		2	1. Solve some examples on the multiplication of decimal by decimal. 2. Solve word problems on the multiplication of decimal.	1. Listen, solve examples with teacher and copy the note. 2. Listen; ask questions and copy the note.		Give home work to: 1. Multiply decimal by decimal (correct to 2 or 3 places of decimal). 2. Solve word problems on multiplication of decimal.
	15 mins		3	1. Give pupils revision on the division of whole numbers by 2-digit and 3-digit numbers. 2. Solve some examples of division of decimals by 2-digit and 3-digit numbers. 3. Solve word problems involving the division of decimals.	1. Participate in the revision on division of whole numbers. 2. Listen and solve examples with the teacher and copy the note. 3. Listen, ask questions and copy the note.		Give home work to: 1. Divide decimal by 2-digit and 3-digit numbers. 2. Solve word problems on division of decimals.

	15 mins		4	1. Give revision on the week's work. 2. Solve more problems on the week's work	1. Participate in the revision in the revision exercise 2. Listen, ask questions and copy the notes.		Give home work to: 1. Solve problems covering the week's work
40 mins			5	1. Give test for the week's work. 2. Mark the test and do the correction.	1. Write the test 2. Do the correction.		Give test to: 1. Multiply fraction by fraction 2. Solve word problems involving the multiplication of fraction. 3. Multiply decimal by decimal and solve word problems. 4. Division of decimal by 2 & 3-digit numbers. 5. Word problems on division of decimal

		3		1. Give pupils problems to solve in the class 2. Mark pupils work and do the correction for them. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher 2. Do their corrections 3. Pupils copy the home work in their notes.		Give class work covering the day's lesson.

Week 4

Lesson 4

Duration: 40 minutes

Topic: Volume

Objectives: At the end of the lesson, pupils should be able to:

1. Calculate volume of triangular prism
2. Calculate volume of cylinders
3. Calculate volume of spheres
4. Solve word problems on volume

Topic	Duration	Steps	Day	Teacher Activities	Pupils Activities	Teaching Aids	Evaluation Guide
Volume	5 mins	1	1 to 3	Ask pupils questions on previous lesson and introduces the new topic.	Listen and answer questions.		
	15 mins	2	1	1. Explain the concept of volume 2. Present the formula for calculating volume of triangular prism 3. Solve two example, on volume of triangular prism 4. Solve examples of word problems on	1. Listen to the explanation of the concept of volume 2. Listen and write down the formula of volume of triangular prism.	Diagrams of triangular prism on the chalk board.	1. Give home work to: 1. Solve a problem on volume of triangular prism using the formula 2. Solve a word problem involving volume of

				triangular prism.	3. Listen and write the note 4. Listen, ask questions and write the note.		triangular prisms.
	15 mins		2	1. Present the formula for calculating the volume of cylinders 2. Solve two examples on volume of cylinders 3. Solve examples of word problems on volume of cylinder.	1. Listen and write down the formula of the volume of cylinder 2. Listen and write the note 3. Listen, ask questions and write the note.	Diagram of Cylinder on the chalk board	Give home work to: 1. Solve problems on volume of cylinders using the formula. 2. Solve word problems involving volume of Cylinder.
	15mins		3	1. Present the formula for calculating the volume of sphere 2. Solve two examples on volume of sphere 3. Solve examples of word problems on volume of sphere.	1. Listen and write down the formula of the volume of a sphere 2. Listen and write the note 3. Listen, ask questions and write the note	Diagram of sphere on the chalk board	Give home work to: 1. Solve problems on volume of sphere using the formula. 2. Solve word problems involving volume of sphere.
	15 mins		4	1. Revise the week's work 2. Solve more examples	1. Listen and ask questions 2. Participate		Give home work to: 1. Solve a word

				on the week's work.	in solving the examples.		problem each on volume of triangular prism, cylinder and sphere.
	40 mins		5	1. Give test for the week's work 2. Mark the test and do corrections	1. Write the test 2. Do the corrections		Give test to: 1. Solve a problem on volume of a triangular prism, cylinder and sphere.
	20 mins	3		1. Give pupils problems to solve 2. Mark pupils works and do the corrections for them 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher. 2. Do their corrections 3. Pupils copy the home work in their notes.		Give class work covering the day's lesson.

Week 5

Lesson 5

Duration: 40 minutes

Topic: Capacity

Objectives: At the end of the lesson, pupils should be able to

1. Explain the concept of capacity
2. Solve word problems on capacity.

Topic	Duration	Steps	Day	Teacher Activities	Pupils Activities	Teaching Aids	Evaluation Guide
Capacity	5 mins	1	1to 4	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer questions.		
	15 mins	2	1	1. Explain the concept of capacity 2. Mention various containers and ask pupils to compare their capacities.	1. Listen to the explanation of the concept of capacity 2. Compare by stating the container that has higher or lower capacity.		Give home work to: 1. Name and compare the capacities of containers in the home.
	15 mins		2	1. Revise tables of capacity	1. Listen and write down		Give Home work to:

				2. Revise conversion of units of capacity.	table of capacity. 2. Listen and copy the note.		1. Solve problems on conversion of units of capacity.
	15mins		3	1. Write word problems involving capacity on the chalk board. 2. Solve the word problems involving capacity on the chalk board.	1. Write down the word problems involving capacity on the note. 2. Listen and ask questions and write the note.		Give home work to: 1. Solve word problems involving capacity.
	15 mins		4	1. Solve more word problems involving capacity on the chalk board.	1. Listen and ask questions and write the note.		Give home work to: 1. Solve more word problems involving capacity.
	40 mins		5	1. Give test for the week's work 2. Mark pupils' work and do corrections.	1. Write the test 2. Do the corrections		Give test to: 1. Solve problems on conversion of units of capacity 2. Solve word problems involving capacity.
	20 mins	3		1. Give pupils	1. Solve		Give class work

				problems to solve 2. Mark pupils' works and do the corrections for them 3. Conclude the lesson by giving home work to pupils.	problems given by the teacher. 2. Do their corrections 3. Pupils copy the home work in their notes.		covering the day's lesson.

Week 6

Lesson 6

Duration: 40 minutes

Topic: Weight

Objectives: At the end of the lesson, pupils should be able to

1. Explain the concept of weight
2. Express the same weight in different units: grams, kilograms, and tonnes
3. Solve word problems involving weight.

Topic	Duration	Steps	Day	Teacher Activities	Pupils Activities	Teaching Aids	Evaluation Guide
Weight	5 mins	1	1to 4	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer the questions.		
	15 mins	2	1	1. Explain the concept of weight 2. Explain that the weight of small objects is expressed in grams, medium sized objects in kilograms, while heavy objects are expressed in tonnes. 3. Ask pupils to name objects and the unit of	1. Listen to the teacher's explanation of the concept of weight. 2. Listen to the explanation of objects and the unit of expression of weight. 3. Name the		Give Home work to list 5 objects each that can be expressed in: 1. in grams 2. Kilograms 3. Tonnes.

				expression of weight.	objects and the unit of expression of weight.		
	15 mins		2	1. Write tables on weight on the chalk board. 2. Explain the tables on weight 3. Express the same weight in different units, e.g. 80,000 grams = 80kg = 0.08 tonnes.	1. Copy tables on weight in the note book. 2. Listen to the explanation of the tables of weight. 3. Listen and copy the notes.		Give home work to convert weights 1. in grams to kg 2. Kg to tones 3. Grams to tones 4. Tonnes to Kg and grams.
	15mins		3	1. Write word problems involving weight on the chalk board. 2. Solve the word problems involving weight on the chalk board.	1. Copy the word problems involving weight in the note. 2. Listen, ask questions and copy the note.		Give home work to 1. Solve word problems involving weight.
	15 mins		4	1. Solve more word problems involving weight on the chalk board.	1. Listen and ask questions and write the note.		Give home work to; 1. Solve word problems involving

							weight.
	40 mins		5	1. Give test for the week's work 2. Mark pupils work and do corrections.	1. Write the test 2. Do the correction.		Give test to: 1. Convert weights to different units. 2. Solve word problems involving weight.
	20 Mins	3		1. Give pupils problems to solve in the class. 2. Mark pupils work and do the correction for them. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher 2. Do their corrections. 3. Copy the home work in their note.		Give class work covering the day's lesson.

Week 7

Lesson7

Duration: 40 minutes

Topic: 2-Dimensional figures

Objectives: At the end of the lesson, pupils should be able to

1. Explain what are 2-dimensional shapes
2. Identify 2-dimentional shapes by name
3. Identify the essential properties of 2-dimensional shapes
4. Identify polygons not exceeding the octagon
5. Solve more difficult problems on 2-dimensional shapes.

Topic	Duration	Steps	Day	Teacher Activities	Pupils Activities	Teaching Aids	Evaluation Guide
2-Dimensional Figures	5 mins	1	1 to 4	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer the questions.		
	15 mins	2	1	1. Explain what 2-dimensional shapes are. 2. List the names of 2-dimensional shapes on the chalk board. 3. Draw and label the shapes on the	1. Listen to the explanation of what 2-dimensional shapes are. 2. Copy and call the names of the shapes. 3. Draw and		Give home work to: 1. Name seven 2-dimensional shapes. 2. Name the types of triangles.

				chalk board.	label the shapes in the note.		
	15 mins		2	1. List and call the features of each 2-dimensional shape on the chalk board. 2. Draw the shapes on the chalkboard and lead pupils to see the features.	1. Copy the note, and call the features of the 2-dimensional shapes. 2. Copy the note and label the features on the shapes.	Diagrams showing the features of 2-dimensional shapes.	Give Home work to 1. Complete a chart of shapes indicating lines of symmetry, and number of sides. 2. Number of angels contained in the shape. 3. Name the types of triangles 4. Write the features of each triangle
	15 mins		3	1. Solve problems on 2-dimensional shapes.	1. Listen, ask questions and copy the note.	Draw triangles, compound shapes on the chalk board.	Give home work to: 1. Identify different shapes in a compound

							figure. 2. Find sizes of angles of triangles.
	15 mins		4	1. Explain what a polygon is. 2. List and call polygons not exceeding the octagon. 3. Solve problems on polygons	1. Listen to the explanation of what a polygon is. 2. Copy and listen to the names of the polygons. 3. Listen, ask questions and copy the note. Listen, ask questions and copy the note.	Diagram of polygons on the chalk-board.	Give home work to; 1. List the names of polygons. 2.Calculate the angle at the centre of each polygon 3. Calculate the sum of angles of each polygon. 4. Deduce the formula for the sum of angles of n-sided polygon.
	40 mins		5	1. Give a test for the week's work 2. Mark pupils work and do corrections.	1. Write the test. 2. Do the correction.		Give test to: 1. Name and identify features of 2-dimensional shapes. 2. Name types

							of triangles and their features. 3. Identify shapes in a given compound figure. 4. Calculate angles in a given triangle. 5. Name the types of polygons 6. Calculate the sum of angles of a given polygon.
	20 mins	3		1. Give pupils class work 2. Mark pupils work and do the correction. 3. Conclude the lesson by giving home work to pupils.	1. Solve problems given by the teacher. 2. Do their corrections 3. Copy the home work.		Give class work covering the day's lesson.

Week 8

Lesson 8

Duration: 40 minutes

Topic: 3-Dimensional shapes

Objectives: At the end of the lesson, pupils should be able to

1. Explain what are 3-dimensional shapes
2. Identify 3-dimentional shapes by name
3. Identify number of edges, faces and vertices of 3-dimensional shapes
4. Identify nets of 3-dimensional shapes
5. Measure angles of 3-dimensional shapes
6. Identify lines that are parallel and perpendicular in 3-dimensional shapes.

Topic	Duration	Steps	Day	Teacher Activities	Pupils Activities	Teaching Aids	Evaluation Guide
3-Dimensional Shapes	5 mins		1 to 3	Ask pupils questions on previous lesson and introduce the new topic.	Listen and answer the questions.		
	15 mins	2	1	1. Explain what 3-dimensional shapes are. 2. List the names of 3-dimensional shapes on the chalk board. 3. Draw and label the shapes on the chalk board.	1. Listen to the explanation of what 3-dimensional shapes are. 2. Copy and call the names of 3-dimensional shapes.	Diagrams of 3-dimensional shapes on the board.	Give home work to: 1. List 3-dimensional shapes. 2. Draw and label 3-dimensional shapes.

					3. Draw and label the shapes in the note.		
	15 mins		2	1. Explain what are edges, faces and vertices of a given 3-dimensional shape. 2. Draw and ask pupils to indicate the edges, vertices and faces of 3-D shapes. 3. Draw nets or models of 3-D shapes on the chalkboard.	1. Listen to the explanation of edges, surfaces and vertices of 3-D shapes. 2. Examine the shapes to determine the number of edges, faces and vertices. 3. Examine and determine the nets to the respective 3-dimensional shape. 4. Copy all the notes.	Diagrams showing the edges, faces and vertices of 3-dimensional shapes.	Give home work to: 1. Make 3-dimensional shapes with cardboard. 2. Complete a chart of 3-dimensional shapes indicating numbers of edges, faces and vertices. 3. Prepare nets of 3-dimensional shapes.
	15 mins		3	1. Lead pupils to measure the sizes of angles in each 3-dimensional shape. 2. Lead pupils to indicate lines that are	1. Use a protractor to determine the size of angles in a given shape. 2. Identify lines	1. Diagram of 3-dimensional shapes. 2. Diagram of parallel	Give home work to: 1. Measure sizes of angles in 3-dimensional shapes.

				parallel and perpendicular in 3-dimensional shape.	that are parallel and perpendicular in 3-dimensional shapes.	and perpendicular lines.	2. List lines that are perpendicular. 3. List lines that parallel to each other in 3-D shapes.
	15mins		4	1. Revise the week's work.	1. Listen and participate in answering and asking questions.		Give more home work.
	15 mins		5	1. Give test for the week's work 2. Mark pupils work and do corrections.	1. Write the test. 2. Do the correction.		1. List the names of 3-dimensional shapes. 2. Identify the number of edges, faces and vertices of 3-dimensional shapes. 3. Use protractor to measure the sizes of angles of 3-dimensional shapes. 4. List pair of parallel perpendicular lines in a given 3-

							dimensional shape. 5. Identify nets of 3-dimensional shapes.
	20 mins	3		1. Give pupils class work. 2. Mark pupils work and do the corrections. 3. Conclude the lesson by giving home work to pupils.	1. Solve the problems given by the teacher. 2. Do their corrections 3. Copy the home work.		Give class work covering the day's work.