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**EFFECT OF FORMATIVE EVALUATION ON
ACADEMIC PERFORMANCE IN MATHEMATICS:
A CASE OF UPPER BASIC SCHOOLS IN LUSAKA
DISTRICT**

By

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**A Dissertation Submitted to the University of Zambia in Partial Fulfillment of
the Requirements for the Degree of Master of Education in Sociology.**

The University of Zambia




2010

DECLARATION

I, Jean Bosco Ntahontuye, do here declare that this dissertation represents my own work, other sources which were consulted have been fully acknowledged and that it has not previously been submitted for a degree at the University of Zambia or any other University.

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Signed 

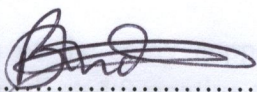
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APPROVAL

This dissertation of Jean Bosco Ntahontuye has been approved as partial fulfilling part of the requirements for the award of the degree of the Master of Education in sociology by the University of Zambia.

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ABSTRACT

This study set out to evaluate and determine the effect of formative evaluation on academic performance in Mathematics in upper basic schools of Lusaka District.

The study used a quasi-experimental non-equivalent design. Under this design, the classrooms were used as they were without any manipulation of the subjects. This design is not true experiment because no randomization was done and not all plausible extraneous and confounding factors were controlled.

The sample was composed of 138 subjects, some of whom belonged to experimental and control groups, 42 pupils for each group, 37 pupils were used for data triangulation purposes and 9 mathematics teachers in upper basic schools.

Data were collected from the pupils through pre-test, two post-tests and triangulation test. The researcher taught eighth graders for the whole term II, 2008 school year. Semi-structured interviews with mathematics teachers were also conducted. In addition, parents whose children participated in the study were given a questionnaire to fill in so as to collect information on pupils' home background factors before administering the treatment. Data analysis was done through Statistical Package for Social Sciences (SPSS).

The findings of the study supported the alternative hypothesis which stated that "Regularly conducted formative evaluation has significant statistical effect on pupils' academic performance in Mathematics". Post-test I t-value was 11.590, p-value .0001 and effect size 0.78. Post-test II t-value was 10.017, p-value .0001 and effect size 0.57. These results were obtained when experimental and control group were tested on t-test. At the level of significance 0.05, the null hypothesis was rejected. When experimental and triangulation groups were tested on t-test, t-value was 4.002, p-value .0001 and effect size 0.32, again alternative hypothesis was accepted. Qualitative data obtained from mathematics teachers, indicated that performance in Mathematics was poor in their respective schools. It was shown that teachers underwent training which included formative evaluation procedures in their pre-service training but they could not use them due to the devastating factors which undermined their efforts such as poor conditions of service and low salaries, large classes and work load.

The recommendations to key players in education were also made in line with the findings of the study. The main emphasis was laid on how schools formative evaluation can be supported in order to enhance academic performance in Mathematics.

DEDICATION

I dedicate this work to my children, Ishimwe and Mutezimana and my wife Rita, for their impeccable support.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank God Almighty for keeping me healthy and courageous enough from primary education to the university studies.

I would like to express my profound appreciation to my supervisor, Professor Vasyl S. Kostyuk for his unwavering support he gave me whenever I was in need. I also thank the co-supervisor, Dr O. C. Chakulimba for his assistance throughout the master's programme.

As a simple refugee, I wish to express my sincere thanks to the Zambian Government for providing shelter to the homeless and the University of Zambia for its non-segregationist approach to education.

I am grateful to the United Nations High Commissioner for Refugees (UNHCR) for sponsoring the research.

I also extend my sincere gratitude to the following:

- The Examinations Council of Zambia for giving me the access to their documents which contributed greatly to the existence of this study.

- The Lusaka district Education Board Secretariat for permitting me to use four schools as research sites.
- The administrations of the four basic schools for their permission to interact with the teachers and pupils during research period.
- The mathematics teachers in the four basic schools for their cooperation during interviews.

My thanks also go to those, too numerous to mention, who helped me in one way or the other. May God bless you all.

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CHAPTER ONE: INTRODUCTION

1.1 Background

In the Zambian education system, Mathematics is a compulsory subject which is taught from grade one to twelve. The importance and applicability of Mathematics in everyday life, in social and natural sciences such as education, economics, engineering, medicine, just to mention a few areas, cannot be overemphasized. Like in any other school subjects, scholastic achievement in Mathematics is evaluated in two main ways. There is summative evaluation which provides information on academic performance at the end of a given programme /course. The other one is formative evaluation which is referred to as an on-going assessment that helps teachers make decisions about individual pupil learning progress during instruction.

Summative evaluation has been regarded as not being the best way of assessing pupils' intellectual abilities. This type of evaluation does not provide an opportunity to effect a change if particular objectives have not been achieved. Winter (1999) points out that summative evaluation does not take into account how a pupil applies Mathematics to novel situations. Summative judgments are for the benefit of the people (parents, school administrators and employers) and not for the learner. UNESCO (1973) observed that summative evaluation/examinations may cause tension and fear forcing pupils into non-productive activities. Pupils may engage themselves in memorizing detailed facts, guessing the interests of the examiners and using other various illegal aids such as bringing pre-written notes into the examination room. Stiggins (1999) observed that summative evaluation encourages teachers and

school administrators to focus on narrow test content as they intend to incorporate the practice of rote memory tasks and skipping content that may be in the standards but not on the test. He further argued that the majority of tests need to provide ongoing feedback that once-a-year summative evaluation alone cannot sufficiently provide.

Many countries in the world, such as Canada, England, South Africa, United States of America and Swaziland, have embarked on the use of formative evaluation and positive results are being yielded (Gareis, 2007, Dlamini and Mhlungu, 2003). Black and William (2001) indicate that formative evaluation is a powerful means to improve pupils learning. Kaftan et al. (2006) observed that formative evaluation creates conducive platform where interactions between students, teacher and the content of the lesson provide the catalyst for deeper understanding. Cowie and Bell (2001) contends that it is through formative evaluation that teachers know how students are progressing and where students have problems. Teachers use formative evaluation information to make necessary instructional adjustments such as re-teaching or trying alternative approaches. The Ministry of Education (MOE), (1996) acknowledged that very little was being done to improve school based assessment while concerted efforts have been laid on highly formalized national examinations. These examinations evaluate how successful the school system has been in achieving specific curricular objectives, but they do not evaluate other educational objectives.

Mathematics can only be learnt in formal education (schools) and yet the failure rate has continuously been high. About 112 920 (52%) candidates (pupils) out of 217 087 failed grade nine Mathematics 2007 examination at national level. In Lusaka Province, 19 646 (49%) candidates out of 40 124 failed the very examination. In Lusaka District, out of 30 089 only 13 499 (45%) passed the 2007 grade nine Mathematics examinations and 14 442 (48%) failed it. Only 933 (3%) of those who passed got division one results. These results were described as improved compared to past performances. In 2006 examinations a high failure rate was recorded. At national level, 131 481(69%) candidates failed grade nine Mathematics examinations, for Lusaka Province 21 717 (61%) failed these examinations and 16 018 (60%) candidates failed the same grade nine Mathematics examinations in Lusaka District (Examinations Council of Zambia (ECZ), 2008a). Lusaka is the capital city of the country where most of educational parameters are found compared to other areas (MOE,2005), but academic performance in Mathematics in upper basic schools is still poor. MOE (2001c, 2003 and 2006) has consistently reported that Mathematics achievement has remained below average in basic schools: 28 percent in 2001, 34.4 percent in 2003 and 38.5 percent in 2006.

This situation raises alarming concerns. These failures have far-reaching implications in the students' future and pose serious social, economic and political problems such as: a) limitations on career choice since several institutions of higher learning require a candidate to have at least a credit in Mathematics, and b) more youth will be on the street engaging themselves in illicit activities. There is need to find out

ways of improving the situation and create a strong background in Mathematics to build on as pupils cross over to high school.

If the situation remains unchecked, the government will continue losing millions of Kwacha through preparations and printing of examination papers, payment of staff remunerations and other expenses such as transportation costs for more than 50% of candidates who are likely to fail national examinations. MOE (2008) points out that Zambia is still the lowest in sub-region as far as scholastic achievement is concerned and basic education has severely been hit with Mathematics challenges. The Ministry of Education pledged to drastically raise standards in key subject areas such as Mathematics and Science.

MOE (1995) conducted a study into factors that contributed to poor performance of pupils in schools. The study revealed that those factors were three fold. Pupil related factors (home background, lack of seriousness, physical fitness,...), teacher related factors (qualification, absenteeism, workload, too much beer drinking,...) and the Ministry of Education related ones (low salary, poor conditions of service, low funding and lack of teaching materials). However, the study did not consider the important school unit “classroom” in order to see what pupils and teachers go through so as to achieve the desired results.

According to MOE (2001b), for many children, basic education which is the first phase of formal education is also the terminal stage. The over all success of nation’s

education system is mainly dependent on the effectiveness and efficiency of its basic education. It is recommended that Mathematics should be given a considerable room for improvement if children are to appreciate and benefit from basic education. This study is set out to investigate whether formative evaluation can be used to redress poor results in Mathematics in upper basic schools.

1.2 Statement of the Problem

Since the world is becoming technologically based and Mathematics is its driving force (Rajang Teacher's College, 1999), it is imperative that schools impart mathematical knowledge into the young generation which constitutes work force for present and future scientific discoveries. The great hindrance is that Mathematics results have been unsatisfactory for many years. The national policy document "Educating our Future" (MOE 1996), points out that more than half of pupils have registered total failure in Mathematics over the years since 1987. The purpose of the study was to establish whether formative evaluation can improve pupils' academic performance in Mathematics.

1.3 Objectives of the Study

The objectives of this study were to find out :

1. if regularly conducted classroom formative evaluation can improve pupils' academic performance.
2. the extent to which regular formative evaluation is appropriate in upper basic schools.

3. if teachers were oriented to use formative evaluation in class room situation during their pre-service training.

1.4 Research Questions

1. Does regularly conducted classroom formative evaluation improve pupils academic performance?
2. To what extent is regular formative evaluation appropriate in upper basic schools?
3. Were teachers oriented to using formative evaluation during their pre-service training?

1.5 Hypothesis

1. Null hypothesis (H_0): Regularly conducted formative evaluation has no significant statistical effect on pupils' academic performance in Mathematics.
2. Alternative hypothesis (H_1): Regularly conducted formative evaluation has significant statistical effect on pupils' academic performance in Mathematics.

1.6 Significance of the Study

It is hoped that the findings of this study would lay the basis on which the effect of formative evaluation on pupils' academic performance can be established. The findings would also create an opportunity for pupils to view assessment as supportive

rather than punitive. Such attitudes would reduce malpractices intentions among pupils, and absenteeism rate especially in mathematics national examinations which stood at 6.6 percent in 2007 (ECZ, 2008). The study would help school managers and teachers realize the meaningful value of formative evaluation in order to help their pupils learn better, especially the low achievers who are the majority of the cohort. It is also hoped that the study would demonstrate the importance of Mathematics in many careers so that stake holders in education can put together their efforts to encourage pupils take the subject seriously. The study also seeks to enlighten educational planners, policy makers and curriculum developers about the necessity and importance attached to formative evaluation. The findings would contribute to the body of knowledge and resource bank for further research.

1.7 Limitations of the Study

Due to lack of funds, the researcher was compelled to limit the sample size. Only four schools were selected. Insufficient number of Mathematics teachers in selected schools limited interviews to 9 teachers. Secondly, randomization was not possible in this study because the school had already allocated student teachers the same classes with the researcher. This means that not all plausible confounding and extraneous variables were controlled. Thirdly, aspects to do with pupils' cognitive abilities were not dealt in details because they belong to a specialized field of educational psychology. Therefore, the generalization of findings to other settings must be done with caution.

1.8 Operational Definitions of Terms

Assessment

It is a process through which various strategies are used to gather information about pupils progress.

Evaluation

It is a process of identifying what are the actual educational outcomes and comparing them with anticipated outcomes in order to make judgment about desirability of educational outcomes.

Feedback

In the context of this study, the term feedback refers to the utilization of information that classroom teacher obtains from academic and non-academic activities (tests, home-works, exercises and professional observations) in order to respond to pupils' learning needs.

Formative evaluation

It is an on-going classroom process which is used to monitor learning progress during instruction. Its purpose is to provide continuous feedback to both teachers and pupils concerning learning success and failure so that reinforcement of learning and correction of learning errors can effectively be done.

Mathematics

Mathematics is a broad ranging field of study in which the properties and interactions of idealized objects are examined..., an extremely rich and diverse set of tools, terminologies and approaches which range from the purely abstract to the utilitarian (Hare, 1999 quoted by Mulendema, 2007).

Performance

This refers to the pupil's ability levels in a particular area. In this study, the performance was measured through classroom tests.

Summative evaluation

It is an external examination, such as national examinations, which measures pupils learning outcomes at the end of an educational phase.

Upper basic school

It is the last phase of basic education in the Zambian educational system which comprises of grades eight and nine.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

To meaningfully discuss the literature obtained from different sources, the chapter has been divided into two sections:

a) the importance of formative evaluation and b) evaluation and teaching trends in Mathematics.

2.2 The Importance of Formative Evaluation

UNESCO (1975) reported that evaluation in education is centrally meant for improving learning/teaching processes and to determine the degree to which objectives of education system have been achieved. Formative evaluation helps in data collection on learning achievement of any education objectives. The results of this evaluation should be fed back immediately to those concerned. This process guides educators as to whether the academic achievement is below par or not so that other educational interventions can be employed. Black and William (2001) point out that formative evaluation is at the heart of effective teaching and it provides the first hand information for the other types of evaluation to rely on such as placement, diagnostic and summative. Formative evaluation does not only help students learn Mathematics, it can also help reduce the achievement gap between slow learners and bright ones. Improved formative evaluation helps low achievers more than other students and so reduces the range of achievement while raising achievement overall. The point that is being put across is that the scores are likely to be distributed evenly amongst pupils since the weaker ones are helped to their level best because teaching, learning and

assessment intermingle. Gronlund (1971) contends that formative evaluation is used to monitor learning progress during instruction. Its purpose is to provide continuous feedback to both pupil and teacher concerning successes and failures. Feedback to pupils provides reinforcement of successful learning and identifies the specific learning difficulties that need further attention. Feedback to the teacher provides information for modifying instruction and for prescribing group and individual remedial work. MOE (2001a) states that formative evaluation is a way of finding out how effective the teaching has been and how much learners have learnt. Formative evaluation also helps identify fast and slow learners and those with special education needs. Based on tangible assessment results, the teacher is able to make appropriate decision (remedial work or change of teaching strategies). According to Svedknskaite (2005:05) :

Formative evaluation is valuable in its intent to improve learning and to change instruction based on results. In fact, research shows that formative evaluation has one of the biggest effect on learning even equal to effect of parental influence.

Seltzer, Choi, and Thum (2002) as cited by Svedknskaite (2005) state that classroom-based assessments designed for the purpose of identifying student initial status and growth overtime can enhance teachers' ability to provide equitable opportunities to learn for students with varying instructional needs. Checking for student understanding almost always takes place in the classroom through oral and written questions that teachers use to probe for various explanations of students. Cowie and Bell (2001) discuss two models of formative assessment. The first one is planned formative evaluation. In this model the teacher prepares various strategies to elicit and in-

interpret information about pupils learning with predetermined set of criteria. The second one is interactive assessment where teacher-pupil interactions arise out of learning activity and the teacher does not plan for this. Both models are meant to improve pupils learning. Haertel and Mean (2000) cited by Svedknskaite (2005) argue that formative evaluation must be supported by all stake holders in education for better students' learning outcomes in effective thinking and reasoning, complex problem solving, higher order literacy and computation.

In most developing countries, Zambia inclusive, assessment policies (practices) focus primarily on examinations (summative evaluation) with little or no emphasis on classroom assessment (Kellaghan and Greaney, 2003). The Ministry of Education has however realized the importance of formative evaluation as ECZ (2008b) points out that there has been criticism from the community on high stake examinations which adversely affect learners. The council suggested that these sentiments can be reduced by implementing continuous assessment project which is on pilot study. It must be emphasized that formative evaluation is at the heart of a successful implementation of the mentioned project. It is therefore high time that school based assessment could be strengthened.

Winter (1999) noticed however that while the classroom formative evaluation is a powerful means to improve student learning, summative evaluation such as standardized examinations can have a harmful effect. It is important to realize that standardized examinations only measure some aspects of mathematical attainment. They do

not test such aspects as attitudes, perseverance, the ability to apply Mathematics in unfamiliar situations. Gareis (2007: 17) argues:

Our focus on summative accountability measures often has an eclipsing effect on the equally important role of formative assessment practices in the classroom. In our drive to summatively assess student, we may be forgetting why and how to formatively assess student learning in the classroom.

UNESCO (1973) points out that summative evaluation plays a role of awarding school certificates through which parents, headmasters and other interested parties are provided with information on how pupils performed in national examinations. It is further stated that formative evaluation is an integral part of the teaching process rather than an external feature of the system. Although summative evaluation plays no part in the teaching process, Svedkauskaite (2005) states that through summative examinations people who pay for their children's education are ensured that the learning and accountability have taken place.

Dembo (1994) contends that formative evaluation tests are the key to mastery learning and pupils must be helped whenever they have learning problems as soon as test results have been analyzed. Airsian (2001) cited in Gareis (2007) states that formative evaluation is the process of collecting, synthesizing and interpreting information for the purpose of improving student learning while instruction is taking place. This thought portrays a picture that formative evaluation is any means by which the teachers use to find out the extent to which pupils are understanding what is being taught to them in the classroom. Gronlund (1971) reported that, despite universities and employers using public examination results as a screening device for selection,

there is growing evidence that there is a poor correlation between performance in O- and A- levels and performance in degree course.

Though formative evaluation can be a powerful tool for raising academic performance, some times it can be misleading. Mutemeri (2003:128) argues that:

When teachers give simple work or the work that is below zone of proximal development (ZPD)¹, it would be boring to children because this work would be covering the known concepts. On the other hand, the work that is above ZPD would frustrate children as it would be beyond their grasp.

It is therefore important that, as recommended by Dembo (1994), effective and meaningful instruction should be the one which is targeting at the child's zone of proximal development.

¹ Zone of proximal development is the difference between what the child can accomplish independently and what he or she can achieve with the help of a more competent person.

2.3 Evaluation and Teaching Trends in Mathematics

Evaluation is one of the activities which has a pivotal role in the process of teaching and learning in any system of education. One essential and substantial aspect of evaluation is formative evaluation (Shirbagi, 2007). This part of the literature review is designed to consider the important linkages that Mathematics has with other school subjects in order to instill motivation in mathematics teachers as they strive to maximize their pupils' mastery levels through the use of formative evaluation. Pupils must also be aware of these linkages so as to objectively concentrate during learning sessions bearing in mind that Mathematics will have a strong impact in the choice of their future careers. Zuiker (2005) cited in Shirbagi (2007) states that formative evaluation is capable of deepening the understanding of mathematical concepts which will eventually enable the pupils to comprehend other school subjects such as Chemistry, Physics and Biology.

Mathematicians and other scholars in various fields of study describe Mathematics differently due to its various usefulness as the world becomes more sophisticated and technologically based. Howard et al. (1968) describe Mathematics as peoples' mental tool which is easy to use as their legs or arms; enabling them to pursue education of any kind throughout their lives. It enhances high level of perfection in decision making as well as in the ability to predict which has made possible many of the technological advances of recent years. UNESCO (1973) argues that Mathematics had its origin in the need for application to counting and measuring. As time went by, the subject developed into an abstract discipline. Its importance created new Ma-

thematics which is still maintained in the school curriculum as one of the most important studies.

The above descriptions of Mathematics show that the subject has the usages that are greater and more varied than ever before. This further shows that our pupils are likely to live in the world which will be even more mathematically organized. Mathematics teachers therefore have duty and responsibility to instill mathematical knowledge into their pupils using practical learning and teaching tools (strategies) such as formative evaluation. Landerl et al. cited by Kalima (2006) point out that Mathematics is a complex subject which involves among other things, language, space and quantity. It involves reasoning, developing problem solving skills and remembering facts about different concepts and theories.

Zambian education system is science biased (MoE, 1996), and Bruce and Lawrenz (1991: 02) shows how heavily such a system is bound to rely on Mathematics.

...presently science classes are intimately intertwined with Mathematics. Science educators often use Mathematics to introduce a concept, to analyze the concept and even to test for comprehension of concepts. ...if students are not facile with Mathematics, understanding the science concepts may be impossible.

Mulopo (1975) emphasizes the relationship between Science and Mathematics. He states that Science and Mathematics are almost inseparable disciplines in many aspects. All sciences use some form of Mathematics that are developed specifically to facilitate the study of some natural phenomena. The scientist uses Mathematics as a

scientific tool in investigations of various scientific aspects. He further argues that, in higher learning institutions, selection and placement of students in some science (and sometimes non-science) programmes are greatly influenced by consideration of the students' mathematical background. In this regard, many candidates have found it difficult for them to diversify their decisions on career choice. Haambokoma (2000) has reported that 56 percent of the respondents, in his study, indicated that poor performance in Mathematics greatly influenced their decision not to take up a science teaching course. This scenario is illustrated in the following verbatim of one of the respondents:

My mathematics grade at school certificate level did discourage me from pursuing science teaching courses in that training institutions wanted applicants who had grade five or better which I did not have (female, second year student teacher of English , NISTCOL) p. 66.

Mathematics, world over, has contributed to the development of nations through technology. Globally, the subject of Mathematics has been and is still the main driving force to economic development (Mulendema, 2007). Struessy (1993) states that there can be no doubt as to the value of mathematical and scientific literacy in a society of citizens who make decisions with consequences of global magnitude. Lemmer (2000) cited by Mulendema (2007) notes that Mathematics, Science and Technology are strongly influenced by the global context. He further indicated that proficiency in these disciplines is a pre-requisite for economic success.

Gowers (2000) argues that students who choose to ignore Mathematics or not take it seriously in high school, forfeit many future career opportunities that they could

have. They essentially turn their backs on more than half the job market. The vast majority of university degrees require Mathematics as pre-requisite to admission. Morris (1981) cited by Rajang Teacher's College (1999) indicates that present and future careers depend heavily on Mathematics. As such, it is important to instill an interest inclination and positive attitudes towards Mathematics among students, as early as possible. Knowledge in Mathematics and Science will precede the production of a work force skilled in technology in the coming century. In this regard, teachers of mathematics must employ cost free but relevant weapon/tool (formative evaluation strategies) in order to equip pupils with necessary mathematical knowledge for the purpose of increasing confidence in school examinations. Alausa (2000) stated that for Namibian economy to grow and flourish in this competitive environment, Science and Technology must be the key change. He argues that the study of Science and Mathematics must be promoted to build up the Namibian technical competencies to teach the subject and to use Science as a development tool. He further added that proficiency in Mathematics is of basic importance to the study of subject like Physics and Chemistry. Tjipangandjara and Kiangi (1996) quoted by Alausa (2000) complain that the acute shortage of trained personnel in Mathematics and Science is due to non teaching of basic science subjects and Mathematics to black Namibian students before independence. Lack of this proficiency in these two areas has greatly contributed to high poverty levels among Namibians. It is clear that the teaching of Mathematics is of paramount importance. Mbeki (2001, 2005) quoted by Reddy (2006) states that Mathematics and Science are key areas of knowledge and competence for the development of any country in a globalizing world. He fur-

ther mentioned that Mathematics and Science play a pivotal role for the human development for South Africa.

Walter (1975) quoted by Mulendema (2007) observed that large numbers of men and women who use Mathematics in connection with their work will rightly agree in stressing the great value of the practical aspect of the subject; shopping around the corner, planning a flight to the moon, designing a bridge or evaluating the result of a piece of research in education, medicine or agriculture which all involve Mathematics. On the other hand, even those pupils who will not use technical Mathematics in their later jobs need to count, to reckon with money, to weigh and measure. Burkhardt (1987) and Burghes (1989) cited by Struessy (1993) noted that the pragmatic goals for teaching Mathematics are based on its use in daily life activities, the professional areas and its use by intelligent citizenry.

Effective formative evaluation cannot be disassociated from teaching process. The formative evaluation results are capable of informing the mathematics teacher about the appropriate teaching strategies to use in order to enhance pupils mastery levels. It is for this reason that teaching procedures have to be briefly mentioned. Nkoya (2008) states that learner-centred strategies are being advocated for in order to promote meaningful learning on the part of pupils. It is further stated that learners who take responsibility for their own learning tend to enhance their understanding and apply the same knowledge in their day-to-day life. In this regard, classroom assessment procedures must be employed so as to improve mastery levels as well as check-

ing the learning progression rate. Inskeep (1972) states that formative evaluation in mathematical knowledge lies at the heart of establishing beliefs about Mathematics. This author demonstrates some teaching techniques that encourage the mastery of and understanding the subject.

Small groups provide a forum in which students ask questions, discuss ideas, make mistakes, learn to listen to others' ideas, offer constructive criticism, and summarize their discoveries in writing. Group assignments enable learners to work together helping each other integrate new knowledge with prior knowledge and discover their own meanings as they explore, discuss, explain, relate and question new ideas and problems that arise in the group. The students within each group (of 3 to 5) should be heterogeneous in ability and personal characteristics. ... However, the teacher's role as a facilitator of students' learning and a role model for how to think mathematically remains unchanged. (p. 448)

While student participation must be observed at all time in the classroom, as a global trend which is one of formative evaluation aspects, Haambokoma et al. (2002) found that, in Zambian schools, the predominant approaches that are used in mathematics classroom were teacher centred ones. The following quote demonstrates this point.

The pupils voice is hardly ever heard in class. An analysis of verbal interaction in class of two mathematics lessons produced, in one case, 80 percent of teacher talk, 9 percent of pupil talk and 11 percent of silence or confusion; and in the second case, 12 percent of teacher talk and 88 percent of silence or confusion. (p.107)

The authors expressed concern that pupils in Zambian schools are not accorded the opportunity to discuss and talk about Mathematics in their learning sessions. Cockroft report (1982) points out that it is through discussion that students demonstrate

the ability to say what they mean and mean what they say which is a good sign of the outcome of good Mathematics teaching.

Treffers (1987), Delange (1989) and Husen (1967) cited by Njobe (1989) reported that the Mathematics teacher should be more of a facilitator and discussion leader and less of a dispenser of information. Mathematics student should be an active participant in the whole enterprise rather than a passive listener and practicer. We have to encourage group discussion and guided discovery and make students realize that their ideas are as good as any one else's, they will be more prepared to take part. Cockroft(1982) contends that Mathematics is a doorway to brain-cracking world. Mathematics does not come naturally to most people in the way which is true of native language. It has to be learned and practiced. It is from this idea that teachers are persuaded to enable each pupil to develop within his or her capabilities as they are prone to commit some mistakes in the learning processes. It is worth spending time and resources on researches aiming at providing ways of raising academic performance in Mathematics. Garrison and Ehringhaus (2008) argue that teachers ask questions to which they already know the answers and learners have to approximate the teacher's answer as closely as possible. He has further observed that genuine pupils' involvement should allow pupils to articulate their own ideas.

McCay (1990) argues that students must be taught to apply mathematical skills and concepts to novel situation, since learning to solve problems is the prime principal reason for studying Mathematics. However, Munsaka (1987) stipulates that due to

lack of firm formative evaluation, some teachers have developed a habit of preparing students for examinations purposes only. That means that pupils are being coached to answer examination questions in Mathematics. Properly conducted formative evaluation is capable of consolidating the pupils understanding of Mathematics. Black and William (2001) observed that it is through formative evaluation that teachers are able to identify the strength and weaknesses of their pupils and take measures aiming at uplifting the slow achievers. Svedkanskaite (2005) states that frequent short tests are better than infrequent long ones. New learning should be tested within about a week of first exposure in order to get students used to practicing Mathematics. Inskip (1972) believes that if we take trouble and accept certain limitations for some pupils, we can bring more understanding and greater enjoyment to pupils with respect to Mathematics. He has also observed that scores on test are deceiving as a single source of describing students' understanding of a mathematical concept. Judgment on scores should be supported by a professional interpretation of the data collected through variety of modes (oral reports, class discussions, problem solving tasks and written tasks) and must be collected frequently. Bertrand and Cebula, (1980) argue that, apart from judging pupils solely on written work, observing children in the classroom can be used to enhance learning. This observation must be systematic, objective, selective, unobtrusive and carefully recorded. It can be deduced therefore that a combination of tests, observation and discussions are capable of giving a complete picture of a pupil's academic performance and development.

Husen (1967) cited by Njobe (1989) found that achievement scores tended to be higher at the junior levels of secondary school when discovery approach was used instead of rote methods. Rote learning is also a significant factor which might hamper retention, recall and transfer of learning results to new situations. Philip (1973) quoted by Njobe (1989) confirmed that there was enough evidence to suggest that discovery method of instruction should be increasingly used in teaching Mathematics in non-western societies of developing world, which Zambia is. Formative evaluation does not take only the form of marking a written work, but also through discussions between pupils and teacher and between pupils themselves. The teacher can gain insight on how to assess the pupils in relation to familiarity with mathematical terms or language and discover whether the point has been understood. Fuchs et al. (1997) cited by Black and William (2001) point out that the collection of marks to fill up records in Mathematics has been given greater priority than the analysis of pupils' work to discern learning needs. They further noticed that the giving of marks and grading functions are over emphasized, while the giving of useful advice and the learning function are under emphasized. Teachers are the best assessors of the pupils they teach as pointed out by ECZ (2007), there is need therefore to come up with assessment policy to support teachers.

2.4 Summary of Literature Review

The reviewed literature indicates that formative evaluation is the most effective tool that, compared to other available educational interventions, could be used to raise academic standards in Mathematics in short and long terms. This type of evaluation

is the benchmark of a successful summative evaluation. Though many countries, Zambia inclusive, attach more importance and focus on summative evaluation, it is high time to re-examine potential contributions that formative evaluation can make to reverse high failure rate in Mathematics in upper basic schools. The literature has put across a lot of factors that contribute to poor performance and goes on to suggest that remedy to one factor cannot produce the desired result as a remedy to poor assessment procedures can produce. Although formative evaluation is not a panacea to poor performance in Mathematics, it may be the only educational intervention that can yield positive results in any school settings.

The literature stipulates that formative evaluation generally improves scholastic achievement. The point of departure was that this study sought to know to what extent formative evaluation could be used to improve poor performance specifically in Mathematics in upper basic schools rather than generalizing across the subjects and across all phases of education system.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter discusses the research design, study population, study sample, data collection procedures, data analysis and ethical issues.

3.2 Research Design

This study employed both quantitative and qualitative approaches. The nature of the study dictated the researcher to rely heavily on quantitative techniques. Due to its probing nature, qualitative method was also used to collect non-numerical data in order to supplement quantitative data.

The researcher employed quasi-experimental non-equivalent control design under quantitative paradigm. Quasi-experimental designs are used where true experimental designs are not applicable (Johnson and Christensen, 2004 and Muijs, 2004). In this study it was not feasible to involve random assignment of subjects to groups. The school administration, in their wisdom, thought that it was not possible to dismantle the already existing classes and the school had four student-teachers who were on teaching practice. However, Gay (1996) states that non-equivalent control group design has an advantageous aspect because the study is carried out in a natural setting. In this study, classes were used as they were. Pupils were not aware that they were involved in the study. Therefore, this entails that the treatment was administered to experimental group in a natural way rather than manipulating the subjects. The treatment was comprised of weekly and short classroom mathematics tests, the use of

oral and written feedback and re-teaching or remedial work based on raw scores analysis, and it was only given to experimental group. For each lesson, there had to be verbal expression on Mathematics especially on previous topics in order to allow pupils to express their own mathematical understanding. Both experimental and control groups were taught the same topics (Appendix G) in Mathematics by the researcher and the same teaching methods were used. Guided discovery, group work, discussion and question and answer were the most preferred teaching methods. Depending on the nature of the topic, one or two teaching methods were chosen. During re-teaching sessions, a particular teaching method which was used in the previous lesson could be changed if need arose. Similar home works were also given to both groups. The two groups also had the same number of teaching periods, 7 periods each and the researcher had a total number of 14 teaching periods per week. Re-teaching was not done within the allocated periods because not all the students needed it. Making re-teaching compulsory could have been boring to some students especially high achievers, but it was compulsory for those students who scored below 50 percent.

The general design of this study can be schematized as follows:

E=====O1=====X1=====X2=====O2=====O3

C=====O1=====X2=====O2=====O3

T=====O2=====

Where:

E = experimental group

C = control group

T = triangulation group

O1= pretest

O2 = first posttest

O3 = second posttest

X1 = treatment

X2 = teaching of mathematical topics

--- = represents non-random assignment of subjects to groups.

3.3 Study Population

The target population for the study comprised of grade eight (8) pupils in upper basic schools in Lusaka District. Upper basic section is critical not only in basic education as a phase of an education system but also in a life of a Zambian pupil. If one fails to make it to grade ten, which is the first year of high school, his or her dreams of entering higher institutions of learning are shuttered.

3.4 Study Sample and Sampling Procedure

Four upper basic schools were purposefully chosen in order to give unbiased results. Lusaka District basic schools were chosen due to reports expressed in MOE (2005) and ECZ (2008a) that about 50 percent of the candidates who sat for grade nine mathematics examinations during the years 2006, 2007 and 2008 failed national examinations in Mathematics and yet urban schools such as Lusaka's have qualified teachers, teaching materials, infrastructure and pupils travel short distance from

home to school. Due to ethical considerations, the schools which were used in the study will be referred to as A, B, C and D. Schools A and B were located in low social economic areas and it was school A where both grade eight experimental and control groups were extracted from. School C was located in medium socio-economic area. School D was situated in high socio-economic location and its pupils were used for triangulation or data validation purposes. The pre-test scores were tested using Pearson Product Moment to determine whether the two groups were equivalent. Since socio-economic and other home background factors can greatly influence academic performance as Ballantine (2001), Brookover and Erickson, (1975), Kalimaposo (2002) and Kapambwe (1980) reported that what is done in the classroom can be undone at home. The researcher gave a questionnaire to 92 pupils who constituted the sample of both groups for their parents to fill in. The parents' involvement was to help check home background factors that could have caused rival explanation to the findings. For instance, if a lot of students were taking extra tuitions at home, it could be argued that the improvement recorded was not due to the weekly testing but could have been attributed to rival explanation (extra tuition) which could not have been captured by pre-test. For data triangulation purposes, 37 pupils were drawn from school D, and only nine Mathematics teachers in non experimental schools (B, C and D) were interviewed in order to avoid the Hawthorne² and Placebo³ effects. The total number of the subjects (pupils and Mathematics teachers) in the sample were 138.

² The Hawthorne effect means that the subjects are aware that they are being examined and may change their behavior not necessarily because of the treatment.

³ The Placebo effect means that the subjects know which group they belong to and behave accordingly.

Table 1 below shows the responses obtained from the parents on home background factors that may have influence on pupils' academic performance in Mathematics. It was important to explore the extent to which both groups (experimental and control groups) were different or similar on home background factors.

Table 1: Home background factors

FACTORS	EXPERIMENTAL GROUP (N= 46)		CONTROL GROUP (N= 46)	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Parents' formal occupation	10	21	13	28
Parents' qualification (diploma & above)	14	30	17	37
Parents & family members support, encouragement to- wards education	38	83	40	87
Parents' positive attitudes towards education	41	89	42	91
Parents' satisfaction towards their children's Maths per- formance	18	39	16	35
Extra tuitions in Mathematics	3	7	3	7

From Table 1, it can be assumed that experimental and control groups were almost equivalent on home background factors. Any small difference between the two groups cannot affect their performance in Mathematics because Ballantine (2001) and Ukeje (1986) pointed out that any school reflects the values and beliefs of the community in which it draws its inputs (members). In both groups more parents or guardians, 36 (78%) from experimental group and 33 (72%) from control group, are not in formal employment. The majority of parents of both groups have low levels of formal education (grade twelve certificate and below), 32 (70%) from experimental group and 29 (63%) from control group. The table shows eight (8) parents who are educated but work in informal sector or self employed. Their children remained in the sample because they shared the same school ethos with their fellow pupils in the sample. Since three members from each group were taking extra tuitions, they remained in the sample because both groups had equal chances to extra tuitions.

3.5 Research Instruments

Classroom tests and semi-structured interview schedules were used in the collection of data. The tests were divided into two parts: major and minor tests. Major tests consisted of pre-test and two post-tests (Appendix F). Major tests scores were subjected to statistical test (t-test) to determine whether the treatment yielded positive results or not. Major tests covered a number of topics of the term and included a few from the previous term since Mathematics is a building up subject. They were administered to both experimental and control groups. The minor tests were short weekly tests which were meant for checking the mathematical understanding of les-

sons taught during that particular week. Minor tests were only given to experimental group. Torrance and Pryor (2004) point out that the constant, frequent and regular tests are impeccable in enhancing pupils' understanding.

Semi-structured interview schedule solicited for qualitative information from Mathematics teachers on how they understood formative evaluation and carried out its daily practices.

Classroom observation was also considered as research instrument. Johnson and Christensen (2004) and White (2005) defined observation in research as the watching of behavioral patterns of people in certain situations to obtain information about the phenomenon of interest. They further pointed out that observation was an important way of collecting information about people because people do not always do what they say they do. In this study, the researcher took kin interest in observing the way pupils reacted to and behaved towards the mathematical instruction in experimental group. The researcher also took note of the parents' responses towards the choice of the future career for their children. These responses came out when parents were filling in questionnaires to indicate their views on home background factors which could academically affect their children positively or negatively.

3.6 Validity of Research Instruments

Test items were extracted from grade eight pupil's Mathematics books (New General Mathematics (1) and Zambia Basic Education Course (8)) and Examinations Council of Zambia past examination papers. These are authentic documents and ECZ tests

are standardized. Minor modifications were some times performed so as to meet assessment objectives and to enhance high order thinking skills. Semi-structured interviews and questionnaire items were critically analyzed by experts.

3.7 Data Collection Techniques

Data were collected through tests. Pre-test and two post-tests were given to experimental and control groups in order to collect raw scores. Semi-structured interviews with Mathematics teachers in schools B, C and D were also conducted. This type of interview helps the researcher to probe more information from the participants while sticking to the objectives of the study. The researcher taught both groups for three months which was the entire term two of 2008 school calendar. Pencil and paper and tape recorder were used to capture data obtained from interviews. Professional and systematic observations were constantly recorded. Bertrand and Cebula (1980) propounded that classroom observation is an important and useful tool that teachers can use to monitor pupil progress and identify learning errors.

3.8 Data Analysis

Quantitative data obtained from pre- and post-tests were analyzed using descriptive and inferential statistics as recommended by Aggarwal (2002). A t-test was computed using Statistical Package for Social Sciences (SPSS) to compare the two groups means on pre- and post-tests scores. The same t-test was also used to compare the means of experimental and triangulation groups. Since experimental group had more subjects (46) than triangulation group (37), probability table of numbers was

used to remove 9 subjects from experimental group in order to equalize the number of subjects. Effect size (ES) was calculated manually because SPSS does not compute ES. Qualitative data were analyzed through memoing⁴ and categorization. Category names/themes were produced so as to classify data accordingly as they emerged from the interviews.

3.9 Ethical Issues

Ethical considerations are very cardinal for any plausible research report (White, 2005). The researcher sought and was granted a permission from Lusaka District Education Board to carry out the research in four schools (Appendix I). The subjects were not harmed in any way (physically and mentally). The Mathematics teachers' names were kept confidential. No names were required during the recording of interviews. However, the subjects were not informed that they were under a study because doing so could have distorted the findings. Furthermore, the findings of this study were presented as they unfolded from raw data. Other supporting information was also recorded as it emerged from the source without any intentional manipulation. Gay (1996) states that falsifying data in order to make findings agree with a hypothesis is unprofessional, unethical, and unforgivable.

⁴Memoing is, according to Johnson and Christensen (2004), a continuous recording of insights gained from reflecting on qualitative data.

CHAPTER FOUR: STUDY FINDINGS

4.1 Introduction

The findings of this study are presented in two parts. The first part outlines the analysis of the data obtained from quantitative techniques. The main point of this part was to find out whether the statistical tests would establish sufficient evidence to reject null hypothesis. The second part of the study consists of the analysis of the data solicited from qualitative methods. Semi-structured interviews were conducted with mathematics teachers in order to establish whether they were oriented to commit themselves to formative evaluation during their pre-service training and to what extent they used it in their teaching.

4.2 Quantitative Data Analysis

In this study, quantitative techniques were employed in order to present clearly numerical data using mainly descriptive and inferential statistics.

4.2.1 Correlation Analysis

Pearson correlation analysis was used to find out whether experimental and control groups were equivalent at the beginning of the study before administering the treatment to the experimental group. Muijs (2004) stipulates that, in quasi-experiments, the researcher tries all means to match experimental and control groups as similar as possible to avoid rival explanations for causality due to non-feasibility of randomization. The pre-test scores for both groups were not significantly different. $r = 0.98$ was

obtained at the level of significance of 0.01. This indicated that the groups were strongly equivalent at the beginning of the study (Appendix A).

4.2.2 Descriptive Statistics

Descriptive statistics consist of methods for organizing and summarizing information clearly and effectively (Weiss, 1996). In this section of the study, tables and figures are used to summarize the data.

Table 2 below presents descriptive statistics for experimental group on the three tests (pre-test, post-test I and post-test II). Comparative analysis of the three tests showed that there had been meaningful mean gain from pre-test through post-test I to post-test II. This suggested that the treatment made positive impact on pupils learning achievement.

Table 2: Experimental Group Descriptive Statistics

Subjects	Pre-test	Post-test I	Post-test II
Mean	15.83	31.48	27.09
Standard deviation	12.26	17.16	15.46
Highest score	54	76	78
Lowest score	0	4	6
Range	54	72	72

From Table 2 above, it is shown that the average (mean) score of the pre-test was 15.83 with the possible score of 100. The standard deviation was 12.26, the range of the scores was 54 with the lowest score of 0 and the highest score of 54. Posttest I showed the average score of 31.48 with a total score of 100. The standard deviation was 17.16, the range was 72 with the lowest score of 4 and the highest score of 76. Post-test two showed the average score of 27.09 and the standard deviation of 15.46. The range was 72 with the lowest score of 6 and the highest score of 78.

Table 3 below presents descriptive statistics for control group on the three tests. The analysis showed that the subjects made a very small mean gain from pre-test through post-test I to post-test II. This indicated that traditional assessment strategies did not make vibrant effect on pupils' learning achievement.

Table 3: Control Group Descriptive Statistics

Subjects	Pre-test	Post-test I	Post-test II
Mean	16.70	18.04	18.28
Standard deviation	11.80	10.99	9.91
Highest score	56	52	54
Lowest score	0	0	4
Range	56	52	50

Table 3 shows that, on pre-test scores, the average was 16.70 with a total score of 100 and the standard deviation was 11.80. The range of the scores was 56 with the

lowest score of 0 and the highest score of 56. On post-test I, the average was 18.04 while 18.28 was recorded as the average on post-test two. The standard deviation for post-test I and post-test II were 10.99 and 9.91 respectively. The range was 52 on post-test I and 50 on post-test II.

Table 4 below indicates descriptive statistics for triangulation group on post-test I. Triangulation group was drawn from academically sound basic school (Examinations Council of Zambia, 2008). Its mean was slightly below to that of experimental group.

Table 4: Triangulation Group Descriptive Statistics

Subject	Post-test I
Mean	28.32
Standard deviation	18.16
Highest score	88
Lowest score	0
Range	88

From Table 4, it is shown that the average of the scores was 28.32 with total scores of 100 and the standard deviation was 18.16. The range was 88 with the lowest score of 0 and the highest score of 88.

Comparing Table 2 and Table 3, it is notable that experimental group mean has been increasing from pre-test to post-tests. On the other hand, control group mean has

lowest score of 0 and the highest score of 56. On post-test I, the average was 18.04 while 18.28 was recorded as the average on post-test two. The standard deviation for post-test I and post-test II were 10.99 and 9.91 respectively. The range was 52 on post-test I and 50 on post-test II.

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Highest score	88
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Range	88

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Comparing Table 2 and Table 3, it is notable that experimental group mean has been increasing from pre-test to post-tests. On the other hand, control group mean has

been constantly low from pre-test to post-tests. These differences can also be understood by carefully observing figure 1 and 2 below on the post-test I.

Figure1 below illustrates experimental group scores on post-test I.

Figure 1: Experimental Group Scores in Percentage on Post-test I

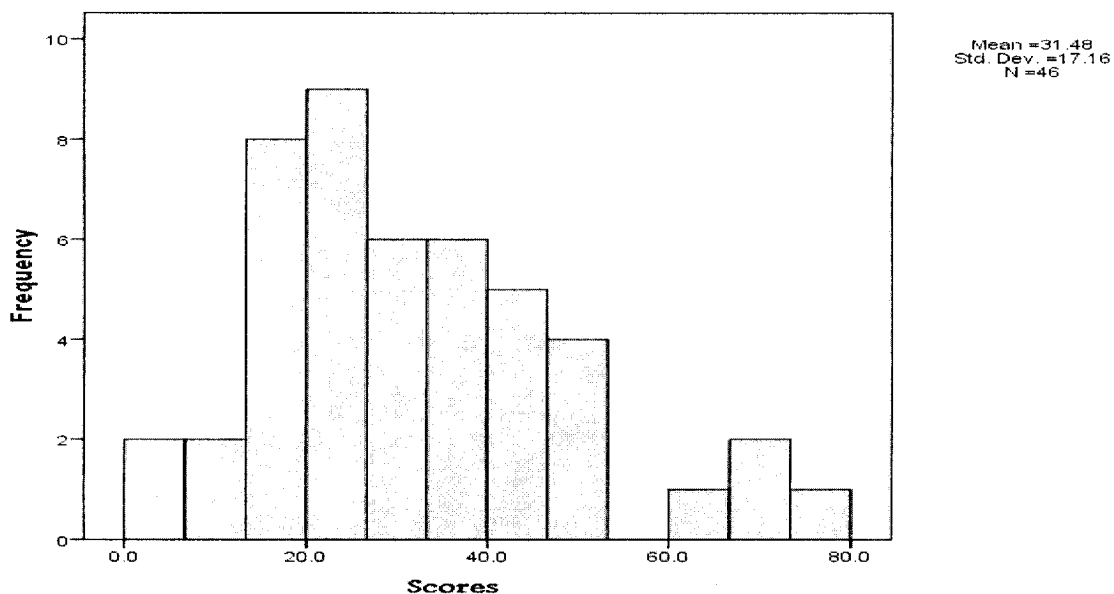


Figure 1 shows marks distribution on post-test I as scored by experimental group pupils.

Figure 2 below illustrates the scores of control group on post-test I.

Figure 2: Control Group Scores in Percentage on Post-test I

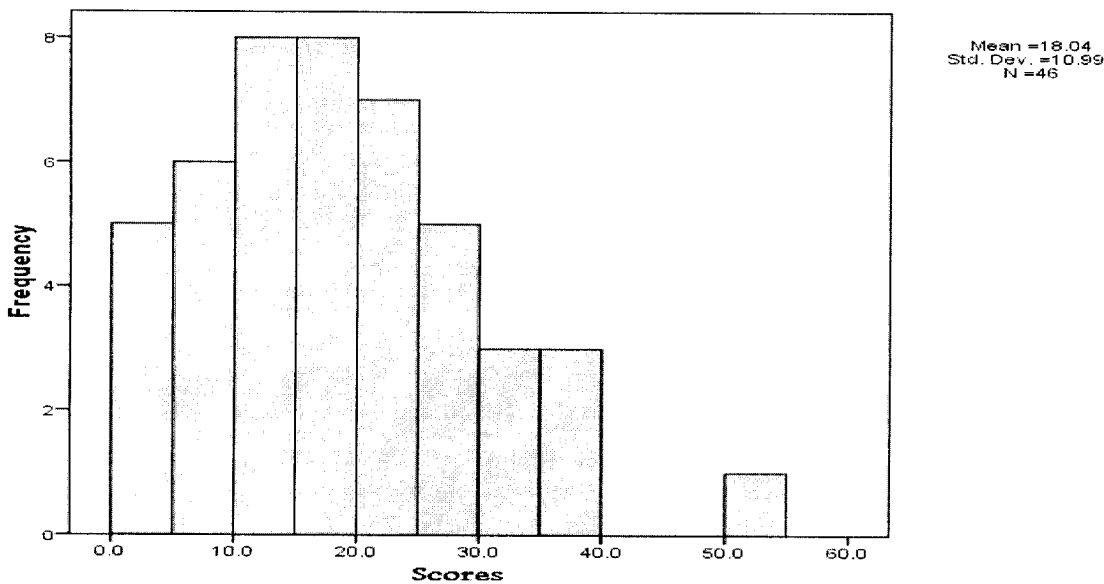


Figure 2 shows marks distribution as scored by control group pupils.

In figure 1, the scores seem to spread on the base of the histogram towards 100, while in figure 2 the scores are compressed in the first quarter of the base of the histogram. This indicates that the weekly testing and the use of the feedback helped pupils in experimental group to achieve better results in Mathematics tests. This can further mean that the pupils who were exposed to frequent testing were able to identify areas of weaknesses and worked on them accordingly. They were somehow introduced to critical thinking. However, those who were not exposed to such treatments maintained the same weaknesses without improving on them.

4.2.3 t-test on Paired Sample

The observed mean gains between experimental and control groups (Tables 2 & 3), did not indicate whether they were statistically significant or not. For this reason they were subjected to statistical test in order to know the extent to which these mean gains were significant. t-test is one of the inferential statistics tests. t-test compares the sample means of two groups. Aggarwal (2002) states that inferential statistics deals with drawing inferences about the properties of the population from sample data. In this study, experimental group mean was compared to control group mean (Tables 5 & 6) and to triangulation group mean (Table 7).

Table 5: Experimental and Control Groups on Post-test I

N	t	P	ES	DF
46	11.590	.0001	0.78	45

Table 5 shows the statistical result which was obtained when experimental and control groups' scores means were compared. t-test on paired sample had a t-value of 11.590 at 0.05 level of significance ($p < 0.05$). These results indicated that experimental and control groups were statistically different. This means that the treatment yielded positive results. The effect size (ES) of 0.78 is highly significant in education, and degree of freedom (DF) was 45. The evidence is strong enough to reject null hypothesis which stated that "regularly conducted formative evaluation has no significant statistical effect on pupils' academic performance in Mathematics".

Table 6: Experimental and Control Groups on Post-test II

N	T	P	ES	DF
46	10.017	.0001	0.57	45

From table 6, it is shown that t-test on paired sample (statistical comparison of experimental and control groups' scores means) for post-test II had a t-value of 10.017 at 0.05 as significant level ($p < 0.05$). The effect size was 0.57 which is educationally significant, and DF was 45. Therefore the null hypothesis was rejected.

Table 7: Experimental and Triangulation Groups on Post-test I

N	T	P	ES	DF
37	4.002	.0001	0.32	36

Table 7 indicates the result which was obtained when experimental and control groups means were compared for data validation purposes. It was demonstrated that t-value was 4.002 at 0.05 significant level ($p < 0.05$). The effect size was 0.32 which is small but meaningful because $p < 0.05$. This statistical evidence is good enough to reject the null hypothesis.

4.3 Qualitative Data Analysis Results

Qualitative methods were used in order to get views from upper basic mathematics teachers pertaining to formative evaluation practices in current school set up. Semi-structured interview schedule was used to elicit insightful data from the teachers. The analysis was done according to the main themes in the interview schedule. These themes included mathematics performance in upper basic schools, teachers' interpretation of formative evaluation, formative evaluation in teachers' pre-service training and teachers' usage of formative evaluation.

4.3.1 Mathematics Performance in Upper Basic Schools

The majority of teachers, 6 (67%) indicated that academic performance in Mathematics was very poor. Fewer teachers, 3 (33%) said that few pupils did extremely well while the rest of the class did extremely bad. There is a good number of factors that contribute to poor performance in Mathematics. Teachers were quick to mention factors that they felt adversely affected pupils' mathematics performance in their respective schools. Poor background in Mathematics especially in primary, contributed greatly to this poor performance. Lack of learning materials was another pertinent issue in these schools. Poor conditions of service and low salaries for the teachers seemed to gain pivotal mileage across the sample (mathematics teachers). Poor conditions and low salaries reduced, to great extent, teachers' motivation to attend to each individual pupil's problem. Pupil's home environment, lack of interest, absenteeism and attitude towards Mathematics were also mentioned.

4.3.2 Teachers' Interpretation of Formative Evaluation

The majority of teachers, 7 (78%) could not give clear meaning of formative evaluation. These teachers interpreted formative evaluation as giving tests after teaching a topic or subtopic. It was evident, from teachers' responses, that each teacher gave classroom tests, exercises and homework. Amongst interviewed teachers, 9 (100%) no one mentioned the use of the feedback. Black and William (2001), Cowie and Bell (2001) and Torrance and Pryor (2004) pointed out that feedback is the core of effective learning and teaching. The remedial work that was given to pupils was as result of revision. There was also no teacher's initiative to use the results (raw scores) obtained from tests or homework to change instructional techniques or design remedial action in order to assist weaker pupils in Mathematics. According to the Ministry of Education guide lines on formative evaluation (MOE, 2001d), pupils must be given homework and tests regularly. The word "regularly" was confusing because there was no specific interval of time to be observed. Even then many teachers, 6 (67%) complained that, due to work load (29 to 36 periods per week) and overcrowded classes of over 50 pupils, they could not manage to give weekly or semi-monthly tests.

4.3.3 Formative Evaluation in Teachers' Pre-service Training

All the mathematics teachers (9 (100%)) in the sample accepted that they were trained on how to use formative evaluation in the classroom set up while at colleges of education. However, due to workload, large classes and poor conditions of service they felt demoralized. Here is the verbatim speech of one of the teachers.

Researcher:

Were you trained on how to use formative evaluation in day-to-day situation as a teacher in the classroom?

Teacher:

At the college I was taught how to use formative evaluation. In real life, I am not in a position to use it appropriately. We are only three Mathematics teachers in the school. Large classes, poor conditions of service and bad administration frustrate our efforts to attend to those pupils who are in need.

Since all the nine (100%) teachers admitted to have been taught formative evaluation techniques during pre-service training, it can be established that formative evaluation techniques were important components of teacher education.

4.3.4 Teachers' Usage of Formative Evaluation

Most of the teachers, 7 (78%) said that the use of formative evaluation in the classroom was cumbersome and time consuming. They also said that grades eight and nine mathematics syllabi were over-loaded in a such way that a teacher could not afford to test frequently in a term and use the raw scores results to attend to individual pupil problems. Teachers emphasized that paying attention to every detail in the classroom would delay the completion of the syllabus. Below is the verbatim speech of one of the teachers.

Researcher:

To what extent do you use formative evaluation results or the feedback from learners' raw scores?

Teacher:

I have 36 periods a week and my classes have more than 52 pupils, surely how can I appropriately use the so-called formative evaluation? In a term I give two tests, exercises and home-works. I am able to see that some pupils are really lagging behind but there is nothing I can do since I have to complete the syllabus so that grade nine pupils can seat for their examination with prepared minds.

From the above statement, it can be seen that formative evaluation is rarely used in schools.

4.4 Researcher's Naturalistic Observations

Observing pupils inside and out side classroom is one of the ways which teachers use to collect information about them. The researcher also gathered some information through observation in order to supplement other research techniques which were used in data collection.

4.4.1 Classroom Observation (experimental group)

It was observed that pupils were very timid and closed up during the first teaching sessions. As pupils got used to weekly Mathematics tests, they opened up and asked questions which established new insights in the researcher. These new insights were in the form of detecting pupils mathematical strength and weakness through the

manner in which they asked their questions, through facial expression and body language. During the teaching sessions, pupils became actively involved in their own learning in such a way that they could ask when next test was due. Pupils in experimental group could not allow the researcher to start the new lesson if they did not fully master the mathematical concepts in previous teaching encounter. This kind of pupils' reaction suggested that pupils became too inquisitive in order to make sure that they did well in the following weekly test. This attitude to learning enhanced their understanding.

4.4.2 Observation on Questionnaire Responses

Although the questionnaire was designed to capture information on home background factors of the pupils who were involved in the study, parents' responses revealed interesting points which could not be overlooked. During the coding of the data obtained from the questionnaire, the majority of parents, 68 (74%) chose future careers for their children which all required Mathematics. Parents, 24(26%) chose accountants, 14 (15%) medical doctors, 10 (11%) engineers, 10 (11%) nurses, 7 (8%) teachers, 2 (2%) pilots and 1 (1%) computer scientist. These parents' responses tend to suggest that Mathematics must be taken and taught seriously in schools if parents wishes on career choice are to be respected.

4.5 Summary of the Findings

Quantitative data analysis provided firm statistical evidence to reject null hypothesis and accept alternative hypothesis. The alternative hypothesis (regularly conducted formative evaluation has significant statistical effect on pupils academic performance in Mathematics) was accepted at the three t-test analyses. This meant that formative evaluation strategies (weekly testing, paying attention to individual slow learners through re-teaching and the use of the feedback), which were denied to control group, made positive effect on pupil's academic performance in experimental group. Qualitative data analysis showed that formative evaluation was rarely practiced in upper basic schools despite mathematics teachers having been trained to use it in their instructional delivery. The factors that contributed to non-practicing of formative evaluation, in the classroom by the teachers, were mainly in three fold: poor conditions of service and low salaries (this factor reduced teachers' motivation and commitment), large classes and work overload.

CHAPTER FIVE: DISCUSSION OF THE FINDINGS

5.1 Introduction

This chapter discusses the findings of the study. The research findings have been addressed in details. Despite the small magnitude that characterized the present study, the analysis confirmed several findings that were reported by other researchers across the globe. There are two major sections under which the discussion is done. Quantitative data analysis is discussed first, followed by qualitative one.

5.2 Quantitative Data Analysis

The t-test, which was conducted on the three sets of data at different intervals of time, provided strong grounds on which null hypothesis was rejected. H_0 stated that “regularly conducted formative evaluation has no significant statistical effect on pupils’ academic performance in Mathematics.” The t-test provided sufficient evidence which supported alternative hypothesis. H_1 stated that “regularly conducted formative evaluation has significant statistical effect on pupils’ performance in Mathematics.” On both post-tests and triangulation analysis, p-values have been less than the value of significant level, ($p < 0.05$). Addition to t-test analysis was the computation of the effect size which produced the value of 0.78 and 0.57 when experimental and control groups were compared on both post-test I and II respectively. Winter (1999) pointed out that any educational interventions that can produce such effect size numbers, are considered to be strong. These findings are consistent with Black and William (2001) who found that the effect size of 0.4 would improve performances of pupils in general certificate of secondary education (GCSE) by be-

tween one and two grades. They further argued that the effect size of 0.7 would raise England from the middle of 41 countries involved in international comparisons to being one of the top five in Mathematics.

The acceptance of alternative hypothesis by statistical tests meant that formative evaluation procedures are capable of improving academic performance. It was also shown that experimental group consistently improved their scores on post-tests after being exposed to the treatment (Table 2, p. 35). This academic improvement was associated with pupils' amelioration in mastery levels. Formative evaluation enhances mastery levels due to its prime intent of checking pupil's understanding while instruction is taking place. The evidence from t-test showed that the treatment (weekly testing, the use of the feedback and re-teaching) afforded pupils with critical minds. These findings confirmed a number of other studies such as Dembo (1994), Cowie and Bell (2001), Torrance and Pryor (2004) and Pellegrino, Chudowsky and Glaser (2001) who found that the key to formative evaluation was the role of feedback and that this feedback allowed students to correct conceptual errors, hence improvement in student understanding and progress in learning.

The rejection of null hypothesis meant that traditional ways of classroom assessments, which were used in control group, needed to be improved upon in order to meet the different needs that pupils come with into the classroom. The main focus in traditional assessments is to award grades without analyzing individual pupil's understanding. It was noticed that pupils' scores in control group remained consis-

tently low throughout post-tests (Table 3, p. 36) while experimental group improved continuously on post-tests. In experimental group, classroom assessments strategies revealed low achievers' (pupils) weaknesses which were attended to through the use of feedback and re-teaching. For the high achievers, formative evaluation strategies strengthened their intellectual abilities in Mathematics. These findings are in conformity to Dlamini and Mhlungu (2003) who found that through formative evaluation teachers come to know their pupils abilities and see regular testing in Mathematics as a learning as well as a teaching occasion.

The effect size of 0.32 is small when homogeneous groups are compared. In the case of this study, the comparisons were heterogeneous between school A and school D, hence effect size of 0.32 is meaningful. For instance, most of the pupils at school D came from affluent families. The ratio of teacher-pupil was 1:38 and infrastructure was modern. On the other hand, most of the pupils in school A came from poor families. The ratio of teacher-pupil was 1: 56 and very poor infrastructure with no electricity. Comparing their results for the 2007 grade nine Mathematics examination as ECZ (2008a) tabulated, school A had 87(37%) pupils who passed and 143(60%) who failed . On the other hand, for school D, 166 (62%) pupils passed and 96 (36%) pupils failed 2007 grade nine Mathematics examinations. The findings confirmed what Kalimaposo (2002) found. He found that socio-economic factors were significant in determining good academic performance. Furthermore, the effect size of 0.32 produced when comparing experimental and triangulation groups suggested that pupils from school A out-performed pupils from school D. In a normal circumstance, these

results would have looked strange and as a surprise, but according to Black and William (2001) and Svedkauskaite (2005), a pupil involved in an innovation, in this case formative evaluation in experimental group, would record the same or better achievement result as a pupil just in the top 35 percent of those not so involved.

5.3 Qualitative Data Analysis

The qualitative methods were mainly used to complement quantitative data in order to have a complete picture of the study. The discussion of qualitative findings is therefore done according to the main themes as they emerged from the data.

5.3.1 Mathematics Performance in Upper Basic Schools

Performance in Mathematics was described as poor by all the nine mathematics teachers in the sample. Many other researches almost found the same situation. The point of disagreement was that these researches based their conclusions on national examinations while the present study entered the actual classroom situations where the root cause for this poor performance is found. These researches included Kelly (1985), MoE (1995, 2001c, 2003 and 2006).

Teachers mentioned some factors that they felt contributed to poor performance in Mathematics. These factors included pupils' poor background in Mathematics, home background, pupils' lack of interest and absenteeism, lack of teachers commitment due to poor conditions of service and large classes. However, no single teacher men-

tioned lack of formative evaluation as adverse factor to performance. These findings are in line with what MOE (1995) found.

5.3.2 Teachers Interpretation of Formative Evaluation

It was discovered that the majority of teachers, 7 (78%) did not know the exact meaning (interpretation) of formative evaluation because, for them, giving tests, exercises and home works was good enough as far as the formative evaluation was concerned. This study argued that the paramount importance is how the feedback from these tests, exercises and home-works is used. These findings are consistent with Stiggins (1999) and Svedkauskaite (2005) who pointed out that some teachers did not understand the formative evaluation and they recommended that teachers must be given the opportunity to attend in-service training on regular basis through workshops and conferences in order to refresh their formative evaluation skills.

5.3.3 Formative Evaluation in Teachers' Pre-service Training

One of the objectives of this study was to find out whether teachers were oriented to use formative evaluation in their teaching. All the nine (100%) teachers who were interviewed accepted that they were trained to use formative evaluation techniques in the classroom situations while at the colleges of education. These findings are similar to Maliwatu (2006) and Manchishi (2002) who found that teachers from colleges of education were strong in pedagogical methodologies. It was observed however that despite having been trained, teachers did not use formative evaluation strategies in their teaching sessions.

5.3.4 Teachers' Usage of Formative Evaluation

When mathematics teachers were asked how they used formative evaluation in their daily teaching, the majority of them, 7 (78%) complained that it was time consuming to evaluate formatively pupils' learning achievement. Teachers said that they had large classes coupled with rigid administration and lack of motivation. These findings are similar to Nkamba and Kangika (1996) who found that the way schools are run does influence the performance of teachers. These findings also agree with Greenberg and Baron (1997) and Riches (1997) who stated that motivation could do miracles as a motivated worker can achieve what unmotivated expert could not achieve. Mutemeri (2003), Dlamini and Mhlungu (2006) further stated that even if large classes were an issue, teachers must use formative evaluation because it was a tool to effective teaching.

5.3.5 Researcher's Naturalistic Observations

It was observed that pupils can view the testing as part of their normal learning rather than punishment, only when they are shown that their responses (correct or wrong) are important. During the teaching and feedback analysis sessions, the researcher accorded the children the opportunity to speak out their minds. They brought out some important issues that the researcher used to make his explanations more clearer. This was also found by Cockcroft (1982) and Svedkauskaite (2005), as they stated that formative evaluation was an essential part of the work of the teacher because it familiarized the pupils with the lesson content and the feedback should help pupils to identify their own strength and weaknesses in order for them to be motivated to con-

tribute in the following teaching sessions. Furthermore, it was also observed that Mathematics was likely to be a corner stone in the choice of the careers for our children. This was based on the responses obtained from the parents when they were asked to choose the future careers for their children. Most of the parents, 68 (74%) chose those careers that required good understanding of Mathematics such as accountants, medical doctors, engineers and nurses. These findings are consistent with Howard, Farmer and Blackman (1968) and Dossey (1992) who stated that mathematics skills were becoming more vital to successful learning. They also pointed out that as the world becomes more sophisticated, there would be need for a work force which was mathematically organized in order to face emerging technologies.

This study has shown that although there exist other factors that could affect academic performance in Mathematics such as teacher's qualification, pupil's home background and socio-economic status, formative evaluation is an important factor because it helps to determine whether learning and teaching have taken place. It goes further to inform the class teacher the kind of remedial action which is needed in order to assist those pupils who might have been left behind during instructional delivery. Learning and teaching are the principal aim of any viable formal education. Formative evaluation is one of educational interventions which has shown to be effective in any school settings. It is therefore important for the main stakeholders in education to support and encourage the consistent use of formative evaluation in upper basic schools.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter discusses conclusion and recommendations which were made, and based on the findings of the study. The conclusion summarizes the key findings in the study. Recommendations were also made in order to make awareness about formative evaluation contributions towards amelioration of academic performance in Mathematics for upper basic schools.

6.2 Conclusion

The t-test analysis rejected the null hypothesis at all the three tests (post-test I, post-test II and triangulation test) and supported the alternative hypothesis which stated that “ Regularly conducted formative evaluation has significant statistical effect on pupils academic performance in Mathematics”. The t-test showed that $p < 0.05$ has been recorded throughout the post-tests which meant that the treatment yielded positive results. The pupils in experimental group were exposed to weekly mathematics tests, the use of the feedback and re-teaching or remedial action which helped them to make academic improvement compared to their counter-part in control group. The study has shown that formative evaluation is capable of raising academic standards because it informs the teacher about pupils learning progress and areas of difficulty. An other essential role of formative evaluation was that pupils were also able to identify their strength and weakness and therefore responded positively to remedial action with clear conscience. The effect size of 0.78, 0.57 and 0.32 were recorded for post-test I, post-test II and triangulation test respectively. These effect size numbers

are educationally significant and any educational intervention that can raise academic standards of this kind must be supported.

Qualitative data indicated that teachers were aware of the importance of formative evaluation and they were trained to use it in the classroom while at colleges of education. Mathematics teachers pointed out essential factors that they felt prevented them from practicing formative evaluation procedures in their teaching. These factors are: lack of motivation and commitment for school work as result of poor conditions of service and low salaries, insufficiency of teaching and learning materials, large mathematics classes and work load. These factors contributed greatly to the poor academic performance in Mathematics in upper basic schools.

6.3 Recommendations

Based on the findings of the study, the following recommendations are made to various concerned stake-holders in education sector.

6.3.1 Recommendations to Teachers

- a) Teachers are encouraged to give frequent and short tests to assess learners' mastery levels and they must give oral and written feedback emanating from these tests results to their pupils.
- b) Teachers must collaborate in designing and planning their formative evaluation procedures according to their respective departments so that collective principles can be adhered to.

c) Teachers in collaboration with their school managers are advised to use formative evaluation results to take important decisions such as :

- Preparation of remedial work
- Referring a pupil to counseling and guidance classes
- Advocating for school research

6.3.2 Recommendations to the Ministry of Education

a) The Ministry of Education must formulate a policy which supports formative evaluation in schools.

b) The Ministry of Education must do away with automatic progression (from one grade to another) for the pupils to work hard academically and participate vigorously during teaching sessions in order to promote and implement formative evaluation strategies.

c) For formative evaluation to take place effectively in the classroom, the Ministry of Education must increase the teaching periods for Mathematics in upper basic schools because this phase of Zambian education system is a major determinant of one's future. This action would provide teachers with ample time to objectively use formative evaluation strategies.

d) The Ministry of Education must organize on permanent basis workshops, conferences, short courses and handbooks for teachers to refresh their pedagogical skills where formative evaluation procedures will be emphasized.

6.3.3 Recommendation for Further Research

The present study could not explore all the areas of formative evaluation due to its small magnitude and time limit of the degree programmes. It is therefore suggested that other researches would look at the following areas:

- a) To what extent can formative evaluation raise academic standards across school subjects in basic and high schools.

- b) How can teachers be helped by all the stake holders in education in order to effectively practice formative evaluation in the classroom in Mathematics.

- c) To investigate the relationship between formative evaluation and learner-centred strategies.

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APPENDIX A

PEARSON CORRELATION AND EFFECT SIZE FORMULA

a. PEARSON CORRELATION

Correlations			
		experimental pre-test group	control pre-test group
experimental pre-test group	Pearson Correlation	1.000	.984**
	Sig. (2-tailed)		.000
	N	46.000	46
control pre-test group	Pearson Correlation	.984**	1.000
	Sig. (2-tailed)	.000	
	N	46	46.000

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

b. EFFECT SIZE (ES) FORMULA

$$ES = \frac{M_1 - M_2}{\sqrt{\frac{\sum(X-M)^2}{N}}}$$

Where X is the raw score, M₁ and M₂ are the means of experimental and control groups respectively, N is the number of cases and M is the mean of either group.

APPENDIX B

t-TEST ON POST-TEST I BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	experimental group post-test I	31.478	46	17.1803	2.5302
	control group post-test I	18.043	46	10.9908	1.6205

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	experimental group post-test I & control group post-test I	46	.937	.000

Paired Samples Test

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	experimental group post-test I - control group post-test I	13.4348	7.8617	1.1591	11.1001	15.7694	11.590	45	.000

APPENDIX C

t-TEST ON POSTTEST TWO BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 experimental group post-test II	27.087	46	15.4558	2.2788
control group post-test II	18.283	46	9.9077	1.4608

Paired Samples Correlations

	N	Correlation	Sig.
Pair 1 experimental group post-test II & control group post-test II	46	.984	.000

Paired Samples Test

	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pair 1 experimental group post-test II - control group post-test II	8.8043	5.9614	.8790	7.0340	10.5747	10.017	45	.000

APPENDIX D

t-TEST ON POSTTEST II BETWEEN EXPERIMENTAL AND TRIANGULATION GROUPS

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 experimental group post-test II	21.351	37	9.7189	1.5978
triangulation group	28.324	37	18.1568	2.9850

Paired Samples Correlations

	N	Correlation	Sig.
Pair 1 experimental group post-test II & triangulation group	37	.948	.000

Paired Samples Test

	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pair 1 experimental group post-test II- triangulation group	-6.9730	9.4589	1.5550	-10.1267	-3.8192	-4.484	36	.000

APPENDIX E

SUBJECTS' RAW SCORES IN PERCENTAGE

Subjects	Pre-test		Post-test I			Post-test II	
	Exp. G	Cont. G	Exp. G	Cont. G	Tri. G	Exp. G	Cont. G
1	4	14	16	12	0	8	20
2	26	14	22	26	4	22	24
3	14	14	50	12	4	36	14
4	0	12	18	28	6	14	14
5	14	16	68	18	8	78	14
6	14	12	28	18	12	30	28
7	14	38	36	24	12	36	40
8	4	16	30	26	14	10	28
9	22	18	14	32	18	14	26
10	16	10	28	0	20	32	12
11	44	0	76	10	20	22	6
12	24	10	38	16	20	52	16
13	6	20	42	0	20	50	14
14	32	30	40	12	20	34	18
15	26	0	38	16	20	40	14
16	18	26	52	18	20	36	10
17	12	18	22	52	22	18	18
18	16	56	36	8	22	20	54
19	14	6	16	20	24	42	20
20	14	20	8	14	24	14	10
21	14	24	20	0	26	16	32
22	36	18	4	10	30	42	24
23	26	28	52	30	30	10	8
24	0	16	28	26	34	40	16
25	12	16	24	52	34	24	16
26	16	26	8	16	34	28	14
27	14	22	6	18	38	8	24
28	12	26	22	40	38	6	30
29	16	12	16	22	40	20	14
30	32	0	18	26	40	14	14
31	2	0	18	14	42	22	14
32	44	12	70	8	44	56	10
33	0	22	24	8	50	12	20
34	12	28	20	8	52	12	4
35	0	0	8	12	54	18	6
36	14	34	14	20	64	12	12
37	8	8	38	36	88	12	6

38	10	8	30	24		16	20
39	8	28	62	22		20	18
40	6	0	24	8		24	6
41	0	12	26	36		28	14
42	20	4	44	8		16	12
43	2	16	44	4		38	14
44	22	40	40	28		30	42
45	24	8	28	36		54	27
46	54	10	62	14		66	10

APPENDIX F

PRE-TEST, POST-TEST I AND POST-TEST II QUESTIONS

Mathematics Grade 8 Pre-test

Term II, 2008

Answer all the question

Duration: 1 hour 20 minutes

(1) List the following:

(a) Even numbers between 62 and 90 which are divided by 3.

(b) Odd numbers between 91 and 99

(2) Find the missing terms in the following sequences and state the rule used in each case.

(a) 324, 108, 36, _____ , _____

(b) 2500, 500, 100, _____ , _____

(3) What law is illustrated by

(a) $(3 \times 4) + (3 \times 6) = 3 \times (4 + 6)$

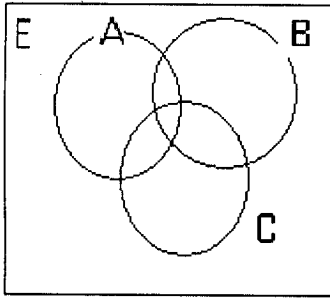
(b) Illustrate the commutative law of addition for two numbers X and Y.

(4) (a) The temperature in Namwala was -4°C this morning. In Luangura it was 14°C . What was the difference in temperature?

(b) (i) $\frac{(-5) \times (-4) \times 3}{-6 \times (-1)}$

(ii) $\frac{720 \times (-9) \times 16}{-8 \times (+90)}$

(5) Shade the regions stated.



$(A \cup B) \cap C$

(6) If $E = \{1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8\}$

$$F = \{1/2, 1/4, 1/6, 1/8\}$$

$$G = \{1/3, 1/5\}$$

What can you say about

(a) F in relation to E?

(b) G in relation to E?

Mathematics Grade 8 Post-test I

Answer all the questions

Duration: 75 minutes

(1) Calculate the following:

(a) $-11 - (-9) - (-3) - (+1)$

(b)
$$\frac{-3 \times (-7) \times (-2) \times (-11)}{-22 \times (-7)}$$

(2) (a) Mutinta has 6 bananas and Mwiya gives her X more. How many bananas does Mutinta have altogether?

(b) A rectangle is $(x + 3)$ cm long and y cm wide. Find the expression for:

(i) its perimeter

(ii) its area

(c) Simplify the following:

(i) $-k + 3k + 5k + 6k$

(ii) $2b + 6b + (-10b)$

(iii)
$$\frac{2x^2 \times 6xy}{4y \times 3x^2}$$

(3) (a) Expand the following:

(i) $2ab(2a - 2b + 1)$

(b) Factorize the following:

(i) $6x^2 - 15x$

(ii) $x^2y + xy^2$

(4) Work out the following:

(a) $\frac{\frac{1}{2}}{\frac{3}{4} + \frac{1}{3}} \times \frac{\frac{2}{5}}{\frac{1}{3} \square \frac{1}{4}}$

(b) $(3 - 1\frac{1}{8}) \times (\frac{1}{2} + 1\frac{1}{3})$

i. $0.025 + 0.18 + 1.245 - 0.999$

ii. 0.008×77.5

iii. $0.0396 \div 2.51$ correct to 3 decimal places

(c) What is $3\frac{2}{5}\%$ of 30?

(5) (a) Mwimbe got 54 marks out of 75 in a mathematics test. What percentage did he get? In another class Maria got 45 marks out of 60 in mathematics. Who got the higher marks?

(b) The products, of three numbers is 3.9. What is the third number if two of the numbers are 1.25 and 0.3?

(c) A tank holds 30 liters of water. The capacity of a cup is $\frac{3}{10}$ litres. How many cups can be filled from the tank?

Mathematics Grade 8 Post-test II

Answer all the questions.

Duration: 2 hours

SECTION A (10 Marks)

(1) The following set of digits defines what an integer is:

- A. -1, -3, -4, 8, 9, 4 B. 0, 1, 2, 3 4 5
C. -1, -2, -3, +4, +5, +6 D. ...-3, -2, -1, 0, +1, +2, +3...

(2) Express $\frac{7}{8}$ as a decimal number

- A. 0. 857 B. 0. 876 C. 0. 875 D. 0. 087

(3) Simplify: $\frac{128}{176}$

- A. $\frac{64}{88}$ B. $\frac{32}{44}$ C. $\frac{8}{11}$ D. $\frac{7}{9}$

(4) Evaluate $14 - (-9)$

- A. -5 B. +23 C. +5 D. -23

(5) What is the area of a rectangle whose length is $(2x + 4)$ cm and breadth is x cm?

- A. $(2x^2 + 9x) \text{ cm}^2$ B. $(x^2 + 4x) \text{ cm}^2$ C. $(2x^2 + 4) \text{ cm}^2$
D. $2x(x + 2) \text{ cm}^2$

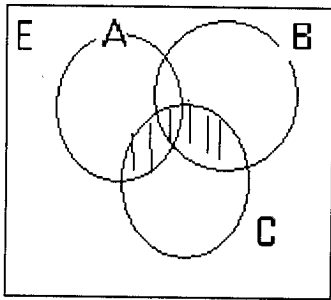
(6) Simplify $2x + 4y - 6x - 4y + 3z$

- A. $-4x + 3z$ B. $4x + 8y$ C. $8x + 8y + 3z$
D. $8x + 4y + 3z$

(7) Factorize completely $9x^3 - 3xy$

- A. $3x(3x^2 - y)$ B. $3x(3x^3 - 3y)$ C. $-27x^2y$ D. $9x^2y$

(8) Given a vein diagram, what is the shaded area?



- A. $(A \cup B) \cap C$ B. $A \cup B$ C. $(A \cap B) \cup C$ D. $(A \cup B) \cup C$

(9) Insert the symbol $>$, $<$ or $=$ between the two fractions.

A. $\frac{4}{7} > \frac{11}{15}$ B. $\frac{4}{7} = \frac{11}{15}$

B. $\frac{4}{7} < \frac{11}{15}$ D. $\frac{11}{15} \leq \frac{4}{7}$

(10) Work out $\frac{1.87 \times 0.0073}{0.010}$ and give your answer correct to three decimal places.

- A. 7.18 B. 0.0718 C. 0.718 D. 71.8

SECTION B (40 Marks)

(1) Work out the following:

(i) $(-4) + (+2)$

(ii) $(-10) + (-10)$

(iii) $(-8) - (-6) - (-4) - (-2)$ (iv) $\frac{(-5) \times (-4) \times 3}{-6 \times (-2) \times (-1)}$

(v) $\frac{49 \times (-20) \times 48 \times 24}{+14 \times (-32) \times (-10)}$

(2) Simplify the following:

(a) $3a - 4b + 2a + b$

(b) $3x + 2y - 9y - x$

(c) $24xy \div 8xy$

(c) $4(x - 3) - 2(2x - 1)$

(e) $3(2p - 4) - (4p - 8)$

(3) (a) If $a = -1$, $b = 2$, $c = 3$ and $d = 0$ evaluate the following:

(i) $ab + bc + cd$

(ii) $3a + 4b - 5c + d$

(b) Round off the following:

(i) 73.51 kg to the nearest kg

(ii) 4.728 correct to two decimal places.

(iii) 275 to the nearest 100

(iv) 24 to the nearest 10

(4) Work out the following

(a) $\frac{3}{5} + \frac{3}{4}$

(b) $2\frac{3}{4} + 4\frac{2}{3}$

(c) $\frac{7}{8} \times 3\frac{1}{2}$

(d) $2\frac{2}{3} \div \frac{13}{5}$

(e) 0.36×3.1

(f) $(\frac{1}{4} \times \frac{2}{5}) \times \frac{10}{11}$

(g) $0.00065 \div 0.0005$

(5) (a) Bwalya won K50, 000 and decided to give it to his three children, in a amount that are in the same ratio as their ages. The children were 10, 12, and 18 respectively. How much did they each get?

(b) Think of the number, multiply it by 5 and subtract two (2) from the product.

(i) Write the algebraic expression

(ii) Write the value of the expression if that number is -3.

(c) The temperature in Ndola was -2°C this morning. In Kitwe it was 18°C . what was the difference in temperature?

APPENDIX G

MATHEMATICS TOPICS

1. Integers

- addition, subtraction, multiplication and division

2. The basic processes of algebra

- the use of the four operations
- expansion and factorization of algebraic expression

3. Approximation

- rounding off

4. Fractions, percentages and ratios

- the use of the four operations
- converting decimals into fractions
- converting fractions into decimals

APPENDIX H

SEMI-STRUCTURED INTERVIEW SCHEDULE FOR TEACHERS OF MATHEMATICS IN UPPER BASIC SCHOOLS.

- How is the performance in mathematics in grade eight?
- What do you think contributes to this kind of performance in mathematics?
- How do you understand or interpret the meaning of formative evaluation?
- Were you oriented to use formative evaluation during pre-service training?
How are you using it in day-to-day situation as a teacher?
- To what extent do you use formative evaluation results or feedback from pupils' raw scores?

APPENDIX I

QUESTIONNAIRE TO THE PARENTS

Dear respondent,

I am a Master's student at the University of Zambia carrying out a research on "Effect of Formative evaluation on Academic Performance in Mathematics in Basic Schools". You are kindly requested to answer all questions as truthfully as possible. Confidentiality will be highly observed. Do not indicate your name.

INSTRUCTIONS

- a. Where options are given place a tick (✓) in the box of your answer.
- b. For the other questions where no options have given, write your answer as briefly as possible in the space provided.

1. Indicate the name of your child

.....

2. Indicate your current profession and your spouse's

.....

3. What is your level of formal education? And your spouse's

Grade Seven	<input type="checkbox"/>	<input type="checkbox"/>
Grade Nine	<input type="checkbox"/>	<input type="checkbox"/>
Grade Twelve	<input type="checkbox"/>	<input type="checkbox"/>
College Graduate	<input type="checkbox"/>	<input type="checkbox"/>
University Graduate	<input type="checkbox"/>	<input type="checkbox"/>

4. Are you affiliated to any library?

YES

NO

5. What kind of occupation/career do you have in mind for your child?

.....

6. How often do you visit the school to find out how your child is progressing academically?

Once a month

Once a term

Once a year

There is no need to do so since I trust the school

7. How often do you help your child to do the homework?

Everyday

Over the weekends

It is the teacher's responsibility

I am always busy with the work

8. How often do you discuss education matters with your child?

- Everyday
- During the weekends
- Some times
- Never

9. Are you happy with your child's performance in Mathematics?

- YES
- NO

If your answer is "NO", what do you plan to do to help your child?

.....

10. Does your child currently receive extra tuition in Mathematics?

- YES
- NO

11. Do you have other children who are in Grade 9 and above?

- YES
- NO

If your answer is "YES", do they help the one in Grade 8 to solve Mathematics questions?

- YES
- NO
- I do not know/ I am not sure

APPENDIX J

MINISTRY OF EDUCATION AUTHORIZATION LETTER

*All correspondence should be addressed
to the District Education Board Secretary
Tel: 240250 / 240249
E-mail: debzsk@yahoo.co.uk*



In reply please quote
DEB/LSK/101/1/1
No.

REPUBLIC OF ZAMBIA MINISTRY OF EDUCATION

DISTRICT EDUCATION BOARD SECRETARY
P. O. BOX 50297
LUSAKA

9th May, 2008

TO WHOM IT MAY CONCERN

RE: UNZA STUDENTS RESEARCH

This serves to introduce to you Ntahontuye Jean Bosco who is a student at UNZA. He has been given permission by District Education Board Secretary's Office to do a research in the following Schools:-

Kalingalinga Basic
Mahatma Ghandi Basic
Kabulonga Basic
Tunduya Basic

Kindly give him the support he requires.

C.K. Njekwa (Mrs)
A/Assistant Human Resources Officer
for/DISTRICT EDUCATION BOARD SECRETARY
LUSAKA DISTRICT

*Property of UNZA Library



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