Towards Effective Assessment Practices of Mathematics in Middle Schools

By

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A mini dissertation submitted in part fulfillment for the degree of Masters in Education (Mathematics Education) in the Department of Professional Studies and Internship in the Faculty of Education at the North West University (Mafikeng Campus)

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Date of submission : October 2005

DECLARATION

I declare that the dissertation for the degree of Masters of Education (Mathematics Education) at the North West University (Mafikeng Campus) hereby submitted, has not been submitted by me for a degree at this or other University, that it is my own work in design and execution and that all material contained herein has been duly acknowledged.

Seeletse Aaron Noah

CERTIFICATE OF ACCEPTANCE FOR EXAMINATION

This mini dissertation: Towards effective assessment practices of mathematics in middle schools written by Seeletse Aaron Noah of the Department of Professional Studies and Internship in the Faculty of Education is hereby recommended for acceptance for examination

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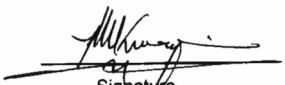

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ACKNOWLEDGEMENTS

Special word of gratitude is due to Mr. Fred N. Kwayisi for the role he played, as I was busy with this research. There were times when it was hard, but he has been there as a father to encourage and motivate me. I am indebted to you for the trust and the confidence you have in me, and all that you have done for me. I am aware that there were times when I felt like not going on with this research, through it all, you were there for me. Thank you also for those advises and endless inputs you made towards the refinement of this research report. "*Dank U wel*". May the Lord God Jehovah add your living days.

I also extend my thanks to Dr. M.A. Mokoena for the valuable inputs she made. Sometimes when I was just relaxing, feeling like not continuing with this research report, she would remind me that I should finish and submit. This research report has been refined though your valuable constructive inputs. May the Lord God Jehovah increase your knowledge.

To my sister Maria, you are a star. Thank you for your motivation and words of encouragement. You always believed that I am able. May God ever bless you.

Special thanks to God Almighty, the giver of life and knowledge for the gift of life He bestowed on me. To Him alone be all praise and honour.

DEDICATION

This research report is dedicated to my mother Malebo Seeletse. It is a token of my appreciation for being a special mother.

ABSTRACT

The primary purpose of this study was to determine the manner in which assessment in mathematics is carried out in the Middle Schools. The study further identified problems educators encountered in assessing learners in mathematics and suggested possible solutions to problems encountered by educators in assessing learners in mathematics.

Data was collected through questionnaires responded to by Middle Schools' mathematics educators and through the structured interview. Senior Phase mathematics educators responded to the questionnaire, which contained a blend of both closed and open-ended questions. Educators took part in the structured interviewed in which a tape recorder was used.

The study established that educators find it challenging to assess learners' mathematics work within the context of Outcomes Based Education and Curriculum 2005, even though the research was able to establish that in-service workshops on assessment in mathematics were conducted. Perhaps this calls for a new approach in conduction in-service workshops. Central to the recommendations of this research is a suggestion that there is a need for in-service workshops, which should focus on areas such as skills to be assessed in homework, class work, tests, examinations, projects, investigative activities and assignments. It was further recommended that educators should be trained on how to prepare rubrics for assessment of learners' mathematics work.

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LIST OF ACRONYMS

- AMESA: Association for Mathematics Education in South Africa
- CASS: Continuous Assessment
- CTA: Common Tasks for Assessment
- C2005: Curriculum 2005
- DoE: Department of Education
- NCTM: National Council of Teachers of Mathematics
- OBE: Outcomes Based Education

CHAPTER ONE: ORIENTATION

1.1 Introduction

"Teacher training courses in South Africa concentrated much on the role of the teacher in the classroom. Teachers were told about methodology, how to prepare lessons, and how to plan. As a result teachers know a lot about teaching but not many teachers understand exactly how learning happens in the classroom" (Winkler, Modise, and Dawber, 1998, p8). It is clear in South Africa that teachers were prepared in the traditional way of teaching in which they would just impart knowledge to learners without thinking that actual learning has actually taken place (sic).

There has been a change in education since South Africa became a democratic country in 1994. This could be said to be a change from education under apartheid to outcomes-based education. This change required of teachers to change their mindsets about how they used to teach mathematics and how they used to assess learners in mathematics to teaching and assessing learners according to the dictates of Outcomes-Based Education (OBE) and Curriculum 2005 (C2005). This paradigm shift needs considerable time, extensive researches and the opportunity for mathematics teachers to collaborate with other mathematics teachers.

Mathematics teachers need to read professional literature on mathematics assessment as envisaged by OBE and C2005. Time is already at the premium during school days for mathematics teachers, this is because teachers are faced with high workload, the vast amount of paper work they do and many staff meetings teachers attend during school hours, as a result of new educational policies. All these challenges do not necessarily exonerate teachers from assessing learners in mathematics in ways other than those envisaged by OBE and C2005.

Assessment as envisaged by OBE and C2005 requires teachers to re-evaluate not only the procedure used to generate information about learners' performance, but also to re-evaluate the purposes and audience for which the information is collected (Cambourne and Turbill, 1997). Assessment under OBE and C2005 aims to develop a learner's cognitive strategies for self monitoring of progress, to measure progress against the learner's own development (Boyer, 1995), to foster the learners ability for higher-order thinking skills and to provide more accurate evidence of learners abilities (Slatter, 1995).

Mathematics educators have to acknowledge the complexity and interpretative nature of learning mathematics and assessment processes as envisaged by OBE and C2005. Assessment as envisaged by OBE and C2005 offers teachers another perspective from which to understand the needs and abilities of their learners by utilising different assessment methods.

1.2 Background of the study

A former Minister of Education in South Africa, Professor Bhengu once said: "South Africa has never had a truly national system of education and training" (Department of Education, 1997a). This statement was uttered because of the previous apartheid dispensation, which promoted a racially and culturally divided philosophy of education.

Under the apartheid era, education for Blacks was under the Department of Education and Training and under the so-called independent and self-governing territories education departments (DoE, 1997a). This scenario resulted in the creation of nineteen education departments, which were highly fragmented, managed differently and not equal in standards (DoE, 1997a).

An interesting observation was made that the then government in South Africa ensured that Black Education was kept apart from the rest through the introduction of Black Education Act No. 407 of 1953 (DoE, 1997a). This Act ensured that Blacks would not be over qualified for positions not envisaged for them and that Blacks would be taught only how to write their names and to count so that they could serve their white masters. This observation was made on the fact that South Africa had serious educational problems such as the provision of equal education and access to school and educational opportunities, irrelevant curriculum, inadequate finances, shortage of educational material, enrolment explosion and inadequately qualified teaching staff (DoE, 1997a). Though there is a commitment from the South African government to address all these problems, it should be noted that this is not going to be easy.

When South Africa became a democratic country in 1994, there was a need to introduce a new system of education, which was to be a non-racial, non-sexist and which was to afford equal education and opportunities to all South Africans. The Department of Education in 1997 argued that the fragmentation within the education system under apartheid in South Africa necessitated a strong, co-ordinated structure and mechanism in a new one. The Department of Education envisaged a new system, which would be a single national system, largely organised and managed on the basis of nine provincial subsystems (DoE, 1997a).

Educational changes in South Africa according to Van der Horst and McDonald (1997) were required to provide equity in terms of educational provisions and by developing learners' critical thinking and problem solving abilities. Since learners received inadequate educational and training opportunities under the apartheid system of education, a new curriculum was needed, and in this case, C2005 was introduced. C2005 purports an OBE approach and endorses the concept of life-long learning. This means that all people who need to learn can now be given the opportunity to learn (Van der

Horst and McDonald, 1997). The introduction of the new curriculum in the country had implications for how assessment should be done in schools.

Though OBE was phased in from grade 0 to grade 9 in schools from 1996 to 2002, I have noted that educators did not receive training, which is sufficient for them to fully implement the new curriculum. Through my interaction with my colleagues at my workplace and educators from a number of schools, I have shared their frustrations about the implementation of C2005 and the practice of assessment. In addition, through my interaction with Advanced Certificate in Education students at the North West University, I realised that educators were perhaps finding it tough to operate within the context of OBE. I further noticed that the Department of Education was to phase in the Revised National Curriculum Statement (RNCS) in the Foundation phase from 2003, which is from grade R to grade 3. The Revised National Curriculum Statement is a refined version of C2005. My interest was in how the Department of Education was going to see to the re-education or retraining of teachers to cope with the new curriculum with its myriad of assessment methods to ensure how assessment may be effectively practised in schools.

The problem investigated was how assessment in mathematics was conducted in the Senior Phase, which is from grade 7 to grade 9 in selected Middle Schools in the Mafikeng District of Education.

1.3 Philosophical and theoretical background of the research

1.3.1 Philosophical background

The paradigm under which this research was conducted was on post-modernism. Prigogine (1961) as cited in Doll (1989) points out that in thermodynamics it is common to refer to systems as isolated, closed or open. Prigogine (1961) as cited in Doll (1989) further gave as an example

the universe, which was considered perfectly stable, exchanging neither energy nor matter. It was believed that isolated and closed systems moved as the universe does, and the movement was thought as purely cyclical within a set frame that did not change (Doll, 1989). Closed systems such as education prior to 1994 in South Africa were like mechanical devices such as gears, pulleys, waterwheels where there was a transference and concentration of energy but not spontaneous development of energy or transformation of matter into energy (Doll, 1989). Education was narrow and backward.

Post-modern systems are open systems predicated on Einstein's formula of energy in physics which is given as $E = mc^2$. This formula gives a deep connection Einstein discovered between energy and mass where E represents energy, m represents mass and c^2 represents a very large number, which is the square of the speed of light. In this system, there is an exchange of both energy and matter and these two quantities can be transformed into another as atomic explosions. Thus, Doll (1989) asserts that isolated systems transmit and transfer energy while open systems transform energy. Doll (1989) further argued that education and curriculum such as curriculum in South Africa prior to 1994 borrowed some concepts from stable and non-exchange concepts in that children were believed to follow patterns of their parents and IQ was considered as discovering and quantifying an innate potentiality. In South Africa before 1994, children were given education, which did not allow them to think. Mathematics was not encouraged in schools.

Doll (1989) further argued that for the most part, the modernist curriculum adopted a closed vision where through focussing on what the mathematics teachers taught, knowledge was transmitted and transferred to learners. Transmission, framed the teaching process. Under the modernist curriculum, good teaching (resulting in good learning) was defined as the transfer of knowledge (Doll, 1989).

The facets of post-modern curriculum are the nature of open (as opposed to closed) systems, the structure of complexity (as opposed to simplicity) and transformatory (as opposed to accumulative change) (Doll, 1989). Price (2003a, online) argued that moving from simple to complex, hierarchy to heterachy, mechanical to holographic, determinate to indeterminate, linear to mutual casualty, assembly to morphogenesis, and objective to perspective are the principles, which underpin post-modern philosophy. Price (2003a, online) further argued that in an open system, teaching becomes auxiliary to learning. Instead of training in pre-selected activities, which provide limited room for growth, curriculum is more of a process of experiential transformation.

Price (2003a, online) argued that post-modernism has three distinguishable features from modernism, those are that it is a transformation of the past, the best features of the old paradigm have been chosen to build the new features (Eclectic nature of post-modernism) and furthermore, Price (2003a, online) asserts that postmodernism allows a combination of traditions. C2005 can be said to be built on these principle.

Wilson (1997, online) asserted that post-modernism is an underlying philosophy about the world and that Constructivism is a general theory of cognition, suggesting how the mind works and how we know things. Thus in post-modernism, the emphasis is on contextual construction of meaning and the validity of multi-perspectives. Hence assessment in mathematics should be multi faceted and be varied to reflect how learners learn mathematics and how problem solving is used in mathematics in comprehending mathematical concepts. Wilson (1997, online) further argued that the ideas of post-modernism philosophy should include facts such as; groups and people construct knowledge, reality is multiperspectival, truth is grounded in everyday life and social relations, life is a text and thinking is an interpretative act, facts and values are inseparable and science and other human activities are value laden. Thus,

the mathematics curriculum has outcomes, which are driven by these principles of post-modernism.

At the centre of Piaget's equilibrium model is his concept of phenocopy (Price, 2003b, online). Piaget believed that an organism has a tendency of seeking to respond to the environment and simultaneously resisting any pressure to change its own patterns (Price, 2003b, online). The interaction between the organism and its environment causes a disturbance and this forms the basis for Constructivism.

1.3.2 Educational theories and principles underpinning this research

The theory, which underpins this research, is Constructivism. Brooks and Brooks (1998, online) define Constructivism as a philosophy of learning founded on the premise that by reflecting on our experiences, we construct our own understanding of the world we live in. This means that learning becomes the process of adjusting our mental modes to accommodate new experiences. In Constructivism, learners need to construct their understanding of each mathematical concept so that the primary role of the teacher is not to lecture, explain or otherwise attempt to transfer mathematical knowledge, but to create situations for learners that will foster learners to make necessary mental construction (Math Forum, 2003, online)

The challenge in teaching mathematics is to create experiences that would engage learners and to support learners' explanations, evaluations, communication and application of mathematical models needed to make sense of these experiences (Math Forum, 2003, online). According to Brooks and Brooks (1998, online) Constructivism is based on the principle that learning is a search for meaning, meaning that teaching should start with issues around which learners are actively trying to construct meaning. Meaning requires understanding whole as well as parts, which make a whole, and meaning should be understood in the context of a whole

(Brooks and Brooks, 1998, online). This suggests that the learning process should focus on primary mathematical concepts not on isolated mathematical facts.

Teachers should understand mental models that learners use to perceive the world and assumptions learners make to support those models (Brooks and Brooks, 1998, online). Thus, the purpose of learning mathematics is for the individual learner to construct his/her own learning, not to memorise steps and procedures so as to write the correct answer.

Therefore, it is important that assessment in mathematics should be conducted based on the understanding of how learning takes place because assessment within the context of C2005 is closely linked to the process of teaching and learning. It is upon these two principles, post-modernism and Constructivism that the current curriculum on mathematics education might have been based. The research is therefore based on the views that learning takes place in a multi-faceted and varied way and that the individual learner has the freedom to think, search for meaning and construct his/her own knowledge about issues. This is what C2005 refers to as life-long learning.

Cathcart, Pothier, Vance and Bezuk (2000) argued that assessment in mathematics no longer refers to a learner's score or marks on tests only; instead, assessment involves a more holistic view of each learner's understanding, skills, and attitude about mathematics. South Africa moved from a traditional education characterised by tests and examinations as primary forms of assessment to a curriculum, which is outcomes driven with different forms of assessment. This paradigm shift necessitated a shift in assessment practises.

Therefore, the purpose of the research was to find out the manner in which assessment in mathematics was carried out within the context of C2005 and OBE in the Senior Phase, in the middle schools of Mafikeng District of

Education. The research was to further identify problems teachers encountered in assessing learners in mathematics and to provide possible suggestions on how such problems would be solved and on assessment practices in general.

1.4 Statement of the problem

Traditional education was norm referenced in that learners were ranked according to their performance in the final examination. C2005 and OBE ushered formative assessment, which was intended to record learners' positive achievements and academic growth at all levels (DoE, 2001). The problem investigated therefore was to identify how assessment of mathematics under C2005 and OBE was carried out in the Middle Schools of Mafikeng District of Education.

1.5 Research questions

This study was guided by the following research questions:

1.5.1 Do educators assess learners' mathematics work as suggested by C2005 and OBE?

1.5.2 Do educators use alternative forms of assessment in assessing learners' mathematics work?

1.5.3 Do educators follow formative assessment principles and procedures in their assessment practices?

1.6 Significance of the study

The study aimed at contributing towards the improvement of how assessment in mathematics was conducted in schools. Based on analysis of questionnaires and interviews conducted, the study aimed at challenging mathematics educators about being proactive and to form mathematics clubs or societies at circuit and regional levels and if possible at provincial level. The interaction of mathematics teachers on assessment in mathematics could help them to learn from each other so that they contribute meaningfully towards further research in mathematics assessment and

towards assessment policies in South African Education. The study also hoped to challenge educators to work towards linking assessment in mathematics to teaching and learning mathematics so that learners could be assessed according to how they learned mathematics as dictated by C2005 and OBE. It was hoped that the research would also contribute to knowledge on research in mathematics and for use by educators and other research institutions.

1.7 Limitations of the study

The research was limited by the fact that some educators considered the questionnaire as a form of self-assessment and did not give their honest opinion on assessment practices. The fact that 76.6% of educators were not qualified to teach mathematics was a major limiting factor. One wondered if these teachers were doing the right thing or not. The research was also limited by the wrong responses given by some of the respondents during interviews. I had to redirect the questions to focus on the interview. It was difficult to get some teachers in their schools and this prolonged the collection time of data. Some teachers were absent from school, others were at workshops and other teachers misplaced questionnaires and were given new copies.

1.8 Definitions of terms

1.8.1 Assessment: A process of gathering valid and reliable information about the performance (evidence) of the learner, on an on-going basis, against clearly defined criteria, using a variety of methods, tools, techniques and contexts, recording the findings, reflecting and reporting by giving positive, supportive and motivational feedback to learners, other educators, parents and other stakeholders (DoE, 2001, p12)

1.8.2 Continuous assessment (CASS): Continuous assessment is an on-going everyday process that finds out what a learner knows, understands values and can do, providing information that is used to support the learner's

development and enable improvements to be made in the learning and teaching process (DoE, 2001, p13).

1.8.3 Common Tasks for Assessment (CTA): External summative assessment for grade 9 learners designed in such a way that it is administered over a period of time (Sokopo, 2000, p16)

1.8.4 Curriculum 2005 (C2005): South African Government education plan, which promised the full-scale implementation of Outcomes-Based Education from grade 1 to grade 12 by the year 2005 (Kramer, 1999, p6).

1.8.5 Outcomes-Based Education (OBE): An approach to education that shifts the emphasis from teaching to learning, from what the teachers will do to what learners will do in learning mathematics (Kramer, 1999, p5).

1.8.6 A paradigm: A collection of major assumptions, concepts and propositions in a substantial area of work or knowledge, a coherent body of ideas. A way of thinking (Lasting Forces, 2003, online).

1.8.7 A paradigm shift: A complete change in thinking or belief system that allows the creation of new conditions previously thought impossible or unacceptable (Bridgefield ERP, 2003, online).

1.8.8 Senior Phase: Grades 7 to 9 within the South African education system (known as Middle School in the North West Province (DoE, 2001).

1.9 Outline of chapters

Chapters in this study are outlined as follows;

Chapter One: Orientation

This chapter outlined the rationale behind the study. The purpose for conducting the study was also given as establishing how assessment was conducted within the context of C2005 and OBE at the Senior Phase in the Mafikeng District of Education. The chapter gives an overview of the study.

Chapter Two: Literature study.

In this chapter an in-depth literature study on assessment in mathematics was conducted. Literature focused on a paradigm shift from assessment as practiced

under the traditional education system and assessment as envisaged by C2005 and OBE.

Chapter Three: Research design

This chapter explains the methods and strategies used in conducting the research. The population, sampling procedures and data collection techniques are also described.

Chapter Four: Data analysis

Educators' questionnaires and the interviews were analysed. Tables were used to show how the respondents responded to various questions. Questions addressing the same theme were grouped together and inferences were made from analysis of the instruments.

Chapter Five: Findings and discussions, recommendations and conclusion

A discussion of the findings was made to establish implications and recommendations were made.

CHAPTER TWO: LITERATURE REVIEW ON ASSESSMENT IN MATHEMATICS

2.1 Introduction

Short and Burke (1994a) developed paradigms of assessment with the aim of distinguishing between traditional curriculum and an inquiry curriculum which in the context of South Africa can be regarded as the period before and after the introduction of Curriculum 2005. The traditional model of curriculum development was primarily based on modernist perspective of reality (Elkind, 1997). From this perspective, knowledge is viewed as an objective commodity that can be transmitted from the teacher to learners and subsequently measured through standardised forms of assessment (Bertrand, 1991). In comparison, from a constructivist perspective, knowledge is viewed as socially and cognitively constructed by humans as they interact with their environment (Fosnot, 1996). Knowledge is further viewed as a construction, and not a commodity that exists separately from the learner.

A paradigm shift in assessment in South Africa was from a narrow view of assessment, which could be regarded as a modern paradigm to a continuous and ongoing view of assessment, which can be regarded as a post-modern paradigm of assessment. The modern paradigm of assessment was of a psychometric model of assessment based on IQ theory, which regarded IQ as innate, fixed and a quantity that could be measured. Assessment under the modern paradigm was based on tests and examinations learners write at the end of the year or term. Thus, assessment under the modern paradigm, which could be regarded as assessment prior to OBE and C2005, was summative in nature, as it did not consider different forms of assessment.

This modern paradigm of assessment was norm-referenced in that a learner's performance and scores in mathematics were compared to other

learners' performance and scores in mathematics. The teacher was the only person who could assess learners in mathematics and learners were not actively involved in assessment of their work. The purpose of assessment was primarily for selection and streaming for Universities and Technikons and for certification in which it was clearly stated whether a learner has qualified for University entrance or not. Learners, who could not pass grade 12, were regarded as 'unintelligent' and were required to repeat the same grade for the whole year. Such learners were considered not good enough for any vocations.

Assessment under OBE, which can be regarded as a post-modern paradigm assessment is ongoing and continuous in nature. OBE assessment is criterion-referenced in that it is based on a set of agreed national standards called specific outcomes where a learner is assessed against the assessment standards. Assessment under OBE is performance based in that it is based on what the learner knows and can do. Learners are supposed to demonstrate that they have achieved a specific outcome. The purposes of assessment in OBE are for monitoring learners' growth in mathematics, supporting the learning of mathematics, informing teaching of mathematics, diagnosing learning problems learners encounter in learning mathematics and providing feedback about how learners learn different mathematics topics to learners, teachers and parents.

A post-modern assessment considers different forms of assessment such as journals, where learners have to reflect on their journey of learning mathematics, portfolios in which learners display their academic growth in the learning of mathematics, and seminars in which learners make presentations orally or through models on their discoveries of different mathematical principles and theorems. Such an assessment is classroom based because the teachers can assess learners' work, a learner can assess his/her work and peer assessment is encouraged where books are exchanged and each learner marks his/her peer's mathematics work. This

form of assessment is definitely different from assessment prior to 1994 in the country.

2.2 Paradigms of assessment Mathematics

2.2.1 Assessment as measurement paradigm

In assessment as measurement paradigm, it is believed that knowledge exists separate from the learner and that the learner has to work hard to acquire that knowledge (Wineberg, 1997). Wineberg (1997) argued that the primary instruments of assessment in this paradigm are norm-reference tests, which are designed to objectively measure the amount of knowledge a learner has acquired over a given period of time. Learning in this paradigm is viewed as the transmission of knowledge from teacher to learners, while meaning is believed to reside within the text and only one interpretation or judgement is accepted in these standardised tests (Short and Burke, 1994b). Thus, learners were seen as "empty vessels" or "blank slates" ready to be filled up with knowledge. As indicated by Rothman (1996), objectivity, standardisation and reliability in measurement, assessment paradigm took priority over concerns of the teachers and learners' involvement. Therefore, there was little opportunity for self-evaluation (Rothman, 1996). The results of these tests were primarily used by school districts, Department of Education and other stakeholders to rank and compare learners and schools in the Republic of South Africa (Meier, 1994).

2.2.1.1 Assessment prior to Curriculum 2005

Assessment prior to the introduction of Curriculum 2005 in South Africa was evaluative. Worthen and Sanders (1987) defined evaluation in education as the formal determination of the quality, effectiveness, or the value of a programme, product, project, process, objective or a curriculum. Worthen and Sanders (1987) further argued that evaluation uses inquiry

and judgement methods, including determining the standards for judging quality and deciding whether those standards should be relative or absolute, collecting relevant information and applying the standard to determine quality.

Riding and Butterfield (1990) regarded evaluation as a method of acquiring and processing the evidence needed to improve the learner's learning and teaching, including a variety of evidence beyond the usual final "paper and pencil" examination, an aid in clarifying the significant goals and objectives of the curriculum and as a process for determining the extent to which learners are developing in these desired ways. Riding and Butterfield (1990) further argued that evaluation is a system of quality control in which it may be determined at each step in the teaching-learning process whether the process is effective or not, and if not, what changes must be made to ensure its effectiveness before it is too late, and a tool in education practice for ascertaining whether alternative educational procedures are effective or not in achieving a set of educational ends.

Evaluation used to be summative in the sense that learners were evaluated at the end of the course or year. Such evaluations were through tests and examinations, which covered what learners, did, for the whole period or year. Time for such examinations was limited compared with time spent studying for such a subject (Riding and Butterfield, 1990).

Evaluation was norm referenced. Riding and Butterfield (1990) argued that norm-referenced assessment gives no information about what has to be achieved but only about how the achievement or performance compares with that of other people. Because learners were evaluated on accumulation of facts, which were isolated, learners were mainly evaluated on knowledge and skills. In the South African context, grade 12 assessment was norm referenced. The subject educator was the only person allowed to evaluate learners in the subject he/she offered from

grade 1 to grade 11. Grade 12 learners wrote examination papers, which were set nationally and common to all South Africans within each educational system. Markers were selected to mark those learners' scripts.

Evaluation was carried out in a formal atmosphere and under strict controlled conditions, where a large hall with invigilators, no "cheating", examination papers, a fixed allocation of time for responding to questions and the whole exercise undertaken at the end of the course (Horton, 1990). In other subjects such as Home Economics, Music and Science, it was acknowledged that skills other than those, which can be manifest in written form, might be important and efforts were made to include practical work (Horton, 1990). However, in most South African schools this could not be realised because most schools did not have Home Economics centres and laboratories. Major emphasis of evaluation was on individual assessment where learners were assessed individually with much secrecy surrounding the tests (DoE, 1997a).

2.2.1.2 Purposes of evaluation prior to Curriculum 2005

Worthen and Sanders (1987, p5) regarded the purposes of evaluation prior to the introduction of Curriculum 2005 in South Africa as to:

- Provide a basis for decision-making and policy.
- Evaluate learners' achievement.
- Evaluate the curriculum.
- Accredit schools.
- Monitor expenditure of public funds.
- Improve educational materials and programmes.

The perception of evaluation as submitted by Worthern and Sanders (1987) above clearly suggest that assessment during apartheid era involved an element of competition. Learners' competition, rather than

diagnosis, dominated thinking about curriculum issues under apartheid. Worthen and Sanders (1987) summed up the purpose of evaluation as to determine the worth and merit of 'whatever' is being evaluated. Horton (1990) argued that evaluation was primarily used for selection of young people for such things as further study, training courses, apprenticeships and career streaming. Horton (1990) further argued that evaluation appeared to have provided an effective means of sorting out those at the 'top' the 'middle' and the 'bottom' and to redirect them towards an appropriate niche of society.

In South African schools prior to 1994, portfolios or collection of authentic writing samples were not used to evaluate learners. The major concern for classroom teachers was whether assessment as measurement provided necessary information required to make day-to-day instructional curricular decisions.

2.2.2 Assessment as inquiry paradigm

Assessment as inquiry can be viewed as a process of inquiry and interpretation used to promote reflection concerning learners' understanding, attitudes and mathematics literacy abilities (Short, Harste and Burke; 1995). In the Assessment as inquiry paradigm, assessment can also be viewed as a process of inquiry (Short, Harste and Burke; 1995), based on the constructivist theory of knowledge (Fosnot, 1996), learner-centred learning (Altwenger, Edelsky and Flores; 1995), where teachers use various assessment techniques to inquire about a particular learner and his/her learning processes and progress in mathematics.

The purposes of assessment as inquiry are deeper understanding of individual learner's in his/her specific context because assessment in this paradigm is perceived as a social, contextually specific and interpretative activity (Grafton and Burke; 1994). Instead of using tests to measure learners' abilities and comparing learners based on the results of

standardised tests, classroom-based assessments procedures are used by teachers to facilitate learning, to direct curricular decisions and to communicate with learners and parents about strengths, weakness and areas of improvements in learners' performance in mathematics (Serafini, 1995).

Assessment as inquiry is not viewed as an objective measurement process intended for comparisons and prescriptions, rather, assessment is seen as a human interaction involving the learner (Johnson; 1996). Portfolios are seen as vehicles for promoting learners' and teachers' reflection, self-evaluation and goal setting. Assessment as inquiry can be one of the assessment strategies under Curriculum 2005 because assessment as inquiry is viewed as part of the teaching and learning process.

2.2.2.1 Assessment as envisaged under Curriculum 2005

Kramer (1999) defined assessment as the way that information is gathered to gauge or decide whether outcomes have been achieved properly. Assessment in OBE consists of a task or series of tasks set in order to obtain information about learner's competence (DoE, 1997). Assessment in OBE is defined as a process of gathering valid and reliable information about the performance (evidence) of the learner on an on going basis against clearly defined criteria, using a variety of methods, tools, techniques and contexts, recording the findings, reflecting and reporting by giving positive feedback to learners, other educators, parents and other stakeholders (DoE, 2001). NCTM (1995) defined assessment in mathematics as the process of gathering evidence about a learner's knowledge of, ability to use, and disposition towards mathematics and making inferences from that evidence for a variety of purposes.

2.2.2.2 Purposes of assessment under Curriculum 2005

DoE (2001) regards assessment in OBE as important because it monitors a learner's progress through an area of learning so that decisions can be made about the best way to facilitate further learning in terms of expected knowledge, skills, attitudes and values. Assessment in OBE further provides information about learning difficulties and remedial action necessary to support learners who might in the process of learning mathematics experience learning difficulties.

Ratcliff (1998) suggested that assessment should provide information about the progress of learners in relation to skills and understanding, assessment should identify where emphasis needs to be made in relation to the next stage of learning for a group of learners (and should directly influence overall lesson planning). Additionally, assessment should identify specific issues for individual learners and be the principal aid to target setting. This is important for learners with learning difficulties, as it serves to assess needs for learners to improve and for educators to be able to draw up a plan as to how to help learners. Lastly, assessment processes should be a positive experience for learners, providing them with information about their progress to date, celebrating their achievements and helping them to identify ways to improve their work.

Barry and King (1988) regarded assessment as important for learners, educators, parents, schools and the government. Barry and King (1988) gave the following as the importance of assessment to learning; that it enhances learning especially when tasks are set such that they encourage the use of learning strategies, understanding real life application, provide feedback about progress and thereby help guide future learning, builds self-esteem and self-confidence and develops skills in evaluation through self and peer assessment.

Assessment is important to educators because it provides information about learning of the whole class and individual learners, provides background information about learners' abilities, needs and interest, helps to diagnose strengths and shortcomings of learner to ascertain a starting (follow up) point for planning and teaching (Barry and King, 1998). For the same reason assessment is important to teachers because it enhances curriculum planning and programming where the emphasis is on what has been learned by each learner in relation to specific outcomes. Finally, assessment is important to teachers because it enables educators to report to parents, school administrators and the government about learners' progress and demonstrates that teaching profession is accountable to parents, school systems and the community for its work (Barry and King, 1998).

Barry and King (1998) continue to describe how assessment is important to parents because it provides information about learners' development, learning and effort at school and it also provides guidelines to parents for assisting their children with schoolwork at home.

For schools assessment is important because it provides valid information to evaluate the learning of an individual learner, the class, the school, the achievement of learning outcomes, the appropriateness of the curriculum and the use of resource, ant it compares learner's achievement level with the nationally agreed outcomes (Barry and King, 1998). For the government assessment is important because it demonstrates the accountability for taxpayers' money spent on education (Barry and King, 1998).

2.3 Types and methods of assessment under Curriculum 2005

DoE (2001) and Sokopo (2002) regard the following as important types of assessment under curriculum 2005. These are:

2.3.1 Baseline assessment

Baseline assessment is regarded as an assessment usually used at the beginning of teaching and learning activities in order to find out what learners already know. This is referred to as recognition of prior knowledge (DoE, 2001). Baseline assessment assists educators with the planning of learning programmes and learning activities. Since some topics in mathematics are based on learners' previous knowledge, baseline assessment is also used.

2.3.2 Diagnostic assessments

According to the Department of Education (2001) diagnostic assessment specifically should focus on the nature and cause of learning difficulty and should provide appropriate remedial help and guidance. Through this assessment it could be established when specialist services and support should be requested from Education Auxiliary Services. However, Barry and King (1998) insisted that diagnostic assessment should be an assessment designed to ascertain the starting point for teaching through examining learners' performance in the subject or administering a pre-test to find out what learners' know about a particular topic before beginning instruction. Barry and King (1998) further suggested that diagnostic assessment should be used to identify learning difficulties as a basis for follow-up teaching. In this instance, the number, type, and sources of errors should be analysed and appropriate remedial programme should be developed. In my opinion this can help mathematics teachers to identify different problems learners experience as they learn mathematics and for the teacher to give learners appropriate work to help learners to learn or to refer learners with learning difficulties to specialists. The main techniques for diagnostic assessment are observations and testing (Barry and King, 1998).

2.3.3 Formative assessment

The Department of Education (2001) suggests that formative assessment should involve developmental approaches and should be designed to monitor and support learning progress. Formative assessment should be used to inform learners and educators about the progress so as to improve teaching and learning. Formative assessment should help to determine the learner's strengths and developmental needs in relation to a particular outcome. According to Barry and King (1998), formative assessment should be used during actual teaching and feedback should be given to learners and educators about the progress of learning. Barry and King (1998) further asserted that for educators, formative assessment should provide information from which the learning task could, if necessary, be modified to meet learners' needs. For learners, formative assessment should give indication of how learning should go, what learners should do well and which areas of learning should need improvement. Formative assessment could help mathematics educators to vary their teaching methods, to use appropriate teaching methods to different lessons and topics, to inform educators about the difficulties learners experience in learning mathematics and to structure their lessons according to different learning styles (sic).

According to Barry and King (1998), some of the techniques, which could be used under formative assessment, are observations, questioning, conferencing, marking, collecting work samples, learners' presentations and demonstrations, learner's self-evaluation forms and short answer test.

2.3.4 Summative assessment

According to Worthen and Sanders (1987), summative assessment should be conducted at the end of a programme. Summative assessment should give an overall picture of learners' progress at a given time, for example at the end of a term or at the end of the year (Sokopo, 2002). Barry and King

(1998) regarded summative assessment as a product assessment, which is concerned with evaluation at the end of a learning experience.

Summative assessment should involve judgement about marks, the achievements of objectives and overall learner and educator performance (Barry and King, 1998). Summative assessment should be used to determine how well a learner has progressed towards the achievement of selected outcomes. The results of summative assessment should be used to give formative feedback to the educator and to feed into the next planning session (DoE, 2001). According to Barry and King (1998), some of the techniques, which might be used for summative assessment, include testing, learner's presentations, learner's demonstrations and marking assessments. In mathematics, this summative assessment should be used to establish whether learners have mastered set specific outcomes at a given point (sic).

2.3.5 Systematic evaluation

Systematic evaluation is regarded as an external way of monitoring the education system by comparing learners' performances against the national indicators of learners' achievement (Sokopo, 2002). The Department of Education (2001) adds that systematic evaluation compares and aggregates information about learner achievements, so that curriculum development could be done and evaluation of teaching and learning can be made. Systematic evaluation should be conducted at phase exit levels i.e. Grade 3, Grade 6 and Grade 9. In my opinion, it implies that in mathematics what a learner achieves at Ramatlabama is standardised and if such a learner can decide to continue studying mathematics in Johannesburg, his/her achievements should be recognised because it is standardised.

2.3.6 Criterion-referenced assessment

Assessment under C2005 is based on criterion-referenced assessment. Kramer (1994) described criterion-referenced assessment as an assessment, which describes a learner's progress in terms of set criteria or standards, which are independent of other learner's achievements. However Van der Host and McDonald (1997) defined criterion-referenced assessment as referring to testing in which learner's scores (results) are compared to a set of standard. For example, in order for a student to pass a course in mathematics at the University, a student needs to obtain 50% or higher in the final examination of that particular course. Thus, the minimum percentage required which is 50% is not compared to those of other students but to a given set of criterion or stipulated standards of performance. The results in the criterion-referenced assessment informs the teacher on what exactly a leaner can or cannot do under certain conditions so that if possible, a learner can be helped to achieve in that subject (Van der Horst and McDonald, 1997).

2.3.7 Portfolios

The definition of a portfolio indicates that it is merely a container for carrying documents, but in educational circles a portfolio refers to a collection of samples of a learner's work used to give evidence of progress of learning over a period of time. Portfolios are an opportunity for learners to provide documentation of their learning activities, ideas and reflections (Stevenson, 2002). Portfolios help learners take more responsibility for their own learning. By making decisions about what to include in their portfolios, learners become knowledge producers rather than knowledge receivers (Yoo, 2001). Thus, portfolios can help learners to construct their own knowledge base (Constructivism) as opposed to reacting to teaching stimulus provided by the teacher (behaviourism).

According to Laboskey (2000), educational portfolios should allow for, promote, and reveal individual meaning making; should provide an opportunity for interaction between the learner and the teacher. The developmental process should occur over an extended length of time and portfolios should be constructed and presented in a context that supports, promotes and assesses reflective thinking elsewhere (Laboskey, 2000). Portfolios should be used as a vehicle to promote reflection on learners' academic progress as well as document their growth in various subjects (Graves, 1992). Therefore, educators should use portfolios to foster reflective thinking and learners' growth in mathematics.

2.4 Assessment methods in mathematics

"Whereas a knowledge of facts and skills may be assessed through short closed questions, the existence of strategic skills can be assessed only through more open tasks that require learners to make choices, reason and explain", (Association for Mathematics Education in South Africa, 1999, p28).

Therefore, a good mathematical task according to AMESA (1999) should involve significant mathematics, be solved in a variety of ways, elicit a range of responses, require learners to communicate and should stimulate the best possible performance on the part of the learner. The following are assessment methods for mathematics as suggested by AMESA (1999) and which educators in assessing learners may use. These are:

2.4.1 Tests and Examinations

AMESA (1999) argued that tests and examinations still have a place in mathematics assessment within OBE. Reddy (1995) as cited by AMESA (1999) suggests different kind of tests might be given to learners. Short, lower tests might be used to test basic skills and recall facts and formulae. Longer tests might be given to learners to test higher-level skills such as

transfer, retention, the making of connections in problem solving and oral test might be given to test recall and the ability to communicate mathematical ideas.

Teachers should vary their approach to testing by giving multiple choice tests in mathematics, setting mathematics tests which are completed by pairs or groups, mathematics tests which are written over a long period of time like learners finishing a test given in class for homework, requesting learners to answer a few mathematics questions in their journals and allowing learners to answer mathematics tests which have been set by either individuals or groups (AMESA, 1999)

2.4.2 Daily class work / homework

According to AMESA (1999), it is important that learners should be assigned marks for a doing and submitting class work or homework. AMESA (1999) suggest that in assessing learners, mathematical content, accuracy, problem solving skills, critical thinking clarity and representation of written argument and communication skills are factors that should be considered.

Activities such as investigations, interviews, oral presentations and journal writings could be used to obtain information on the above-mentioned skills (AMESA, 1999).

2.4.3 Investigations

Investigations are also termed problem-solving activities. Structured tasks where learners are taken through different steps are encouraged for learners to solve different mathematical problems. Open-ended tasks where learners are given one or more questions on which to work are encouraged as investigating activities for mathematics (AMESA. 1999). AMESA (1999) recommend that knowledge and skill, understanding, application and creativity, methods used and application of solutions are

areas, which should be assessed when learners carry out mathematics investigations.

2.4.4 Comprehensions

According to AMESA (1999), questions can be set on passages obtained from newspapers, books and magazines. AMESA (1999, p37) suggest that the benefits of using passages from newspapers for assessment are that learners develop the ability to read numerical articles intelligently, word problems are introduced in an everyday life context and general knowledge is enhanced.

As a guideline for setting comprehensions, AMESA (1999) suggest that educators should choose up to date material, which is interesting to learners. Educators are advised to listen to what learners enjoy. Thus, AMESA (1999) recommend that when setting comprehension questions, educators should set questions about the given data and set questions that go beyond what is given and require data interpretation. Furthermore, AMESA (1999) recommend that educators should set questions, which require critical thinking on the part of the learners and set questions, which require comparisons of articles on the same topic but from different newspapers.

2.4.5 Projects

It is important that mathematical projects given to learners are not long. If possible, A4 page can be sufficient for certain tasks and can thus reduce marking loads. The scope of the projects should be focused on different areas of mathematics (AMESA, 1999). Thus scope for assessment purposes as recommended by AMESA (1999) for the development of projects in mathematics should focus on the application of mathematics learned in class in real life situations, the study of mathematical topics not covered by the school syllabus such as different geometries, graph theory

and the study of the history of mathematical topics and the people and/or cultures involved in the development of mathematics.

Therefore, learners should be assisted in developing skills to produce good mathematical projects. Educators should guide learners on how to plan a project, where to find the necessary information, how to conduct an interview, how to acknowledge sources and to give learners guides for presentation of the project (AMESA, 1999)

2.4.6 Journals

Johnson (1996) suggests that a learner's journal writing in mathematics should provide the educator with access to a learner's thinking and should also provide the opportunities for regular learner's input. Furthermore, Johnson (1996) believes that as a learner becomes more accustomed to writing in his/her journal, his/her entries could provide information such as; how he/she engages with mathematics, how he/she feels about the educator, how he/she feels about particular lessons, emotional responses to mathematics lessons, and his/her personal attributes and characteristics.

AMESA (1999) advised that the focus of a learner's journal entries should be on a learner's learning of mathematics or on the mathematics of the course. That is, a learner's reflections should be on what he/she does, feels, discovers and invents. Within this context, a learner may write on any topic or issue he/she chooses. To stimulate learners thoughts and reflection, Coombe (1996) as cited in AMESA (1999, p47) suggest that learners should ask the following questions to help them reflect on their journals:

- What did I learn from the class activity and assignment discussion?
- Do I have any questions about the work I am doing or not able to do?

- Describe any discoveries I make about mathematics such as patterns, relationships procedures and/or myself.
- Describe the process you undertook to solve a mathematical problem.
- What attributes, patterns or relationships have you found?
- How do I feel about your work, discoveries, the class or assignment?
- What confused me today, what did I especially like, what did I not especially like?
- Describe any computational procedure I invented.

It is because of the usefulness of the methods mentioned that the use of a journal in mathematics is advocated under the new dispensation.

2.5 The learning environment and assessment

The learning environment is responsible for creating and controlling the conditions under which learners are to succeed (Van der Horst and MacDonald: 1997). Jonassen (1994, online) argues that within a constructivist approach the learning environment is important for effective teaching and learning to take place. Thus, Jonassen (1994, online) argues that learning environment provides multiple realities. Multiple representation of reality avoids oversimplification and represents the complexity of the real world. The learning environment emphasises knowledge construction instead of knowledge reproduction, authentic tasks in a meaningful context rather that abstract instruction out of context and provides real world setting or case based learning instead of predetermined sequences of instruction and encourages thoughtful reflections on experiences. Furthermore, the learning environment enables context and content dependent knowledge construction and supports collaborative construction of knowledge through social negotiation, not competition among learner for recognition (Jonassen, 1994, online).

Educators must bear these factors in mind when assessing learners' work. The environment must be conducive to learning for learners to be at their best in learning and performance.

2.6 Constructivists approach to learning mathematics and assessment

Constructivists' model of learning, which sees learning as a process of personal knowledge construction, and meaning making, requires assessment to be diverse, examining in more depth the structure and quality of learners' learning and understanding. Thus, assessment should assess the process as well as the product (Lunt, 1994).

In a constructivist model, learning occurs not only by recording information, but by interpreting it, so instruction can seen not as a direct transfer of knowledge but as an intervention in an ongoing knowledge construction process (Resnick, 1989). Thus, learners, according to the constructivist theory, learn by actively making sense of new knowledge, making meaning from it and mapping it into the existing knowledge map or schema. According to Iran-Nejad and Person (1999) learning in a constructivist approach is characterised as a process of self-organisation, in which the learner reorganises his/her activity to eliminate perturbation such as those arising from new or conflicting pieces of evidence so that the learner has the knowledge that is viable in his/her experience. This can only be true provided Piaget's concepts of assimilation and accommodation are accommodated in the learning process.

Pollard (1990) suggested that the role of the educator is important because he/ she is seen as a reflective agent. This role is dependent on sensitive and accurate assessment of a learner's needs and places a premium on formative educator's assessment. Lave and Wanger (1991) argued that learning does not only take place in a learner, rather, it is distributed among co-participants. This is quite evident of OBE and C2005, which encourage collaborative learning in mathematics. Iran-Nejad and Pearson (1999) further

suggested that constructivist theory of learning has implications for assessment design.

If constructivist theory is one of the theories that underpin C2005, then educators should consider how learners learn under Constructivism and consider these in assessing learners' work. The construction of rubrics for examinations will help to assess a learner's effort in problem solving.

2.7 Specific outcomes in mathematics

Specific outcomes refer to the specification of what learners are able to do at the end of the learning experience. This includes skills, knowledge and values, which inform the demonstration of the achievement of an outcome or set of outcomes. In the mathematics learning area of C2005, there are ten (10) specific outcomes learners have to achieve. These outcomes are that learners should:

- Demonstrate understanding about ways of working with numbers. This outcome intends to enable learners to know the history of development of numbers systems and use numbers as part of their tool kids in problem solving.
- Manipulate number patterns in different ways. Through this outcome, learners should investigate relationships and make connections between phenomena because mathematics offers ways of thinking, structuring, organising and making sense of the world.
- Demonstrate understanding of the historical developments of mathematics in various social and cultural contexts. Learners should be able to understand the historical background of their communities' use of mathematics. This is because all people of the world have contributed towards the development of mathematics.

- Critically analyse how mathematical relationships are used in social, political and economic relations. This outcome aims to foster critical outlook to enable learners to engage with issues that concern their lives individually, in their communities and beyond.
- Measure with competence and confidence in a variety of contexts. Through this outcome, learners should be familiarised with appropriate skills of measurement, relevant units and issues of accuracy.
- Use data from various contexts to make informed judgements. Learners should be able to manage data and information and to understand how data is processed into usable knowledge.
- Describe and represents experiences with shape, space, time and motion. This outcome can be realised when learners are able to display an understanding of spatial sense and motion in time.
- Analyse natural forms, cultural products and processes as representation of shape, space and time. Learners should be able to unravel mathematical forms and processes embedded in the natural world and in cultural representations and make sense of these forms, relationships and processes.
- Use mathematical language to communicate mathematical ideas, concepts, generalisations and thought process. Since mathematics is said to be a language that uses notations, symbols, terminology, conventions, models and expressions to process and communicate information, through Algebra, learners should be developed in the use of this language.
- Use various logical processes to formulate, test and justify conjectures. Learners should be able to evaluate arguments of other people. This is because active learners question, examine, conjecture and experiment. Therefore, mathematics programmes should provide opportunities for learners to develop and employ their reasoning skills (DoE, 1997b, p. MLMMS 1 - 31).

These specific outcomes describe what learners will be able to do at all levels of learning. These outcomes are a link between the intentions and the results of learning (DoE, 1997b). These specific outcomes are derived from twelve (12) critical outcomes. The critical outcomes are broad outcomes learners have to achieve during their formal school period. Critical outcomes can be referred to as general aims of C2005.

2.8 Assessment practice of Middle School work

Assessment especially in grade 9 consists mainly of two components, the internal component known as continuous assessment (CASS), which makes 75% of learners' final marks, and the external component known as the common task for assessment (CTA) which makes 25% of the learners' final marks (Sokopo, 2002). DoE (2001) defines continuous assessment as an ongoing everyday process that finds out what a learner knows, understands, values and can do, providing information that is used to support the learner's development and enable improvements to be made in the learning and teaching process

2.8.1 Features of continuous assessment for the Middle Schools

According to the DoE (2001), continuous assessment enables educators to use any planned learning experience to assess learner achievement and progress, is an essential aspect of the total evaluation of every learner, takes place over a long period and is virtually continuously. Continuous assessment is diagnostic; enabling the educator to provide enrichment for the fast learners sets well-defined outcomes for learners and covers a wide spectrum of learning activities and tasks (DoE, 2001)

Continuous assessment involves assessment of knowledge, which Horton (1990) defines as a prepositional knowledge, which is assessed by requiring learners to demonstrate recall and understanding of facts; which Horton (1990) regards as performance of some generalised operations

devoid of reference to specific content and context (problem solving). As part of continuous assessment, learners' attitudes, which Horton (1990) regards as the interest in, disposition towards work within the subject as demonstrated by effort, commitment and motivation are assessed, and values ensuring that content is not only the focus are also assessed.

2.8.2 The practice of CASS in Grades 7 - 9

Table 1: Prescribed mathematics assessment forms [As adopted from Sokopo (2002, p30)]

Component	Minimum requirements	Year
Tests/examinations	2 per term for the first 3 terms	6 per year
Class work/homework	2 per term	8 per year
Projects (in a group)	1 before the end of the second term	1 per year
Assignments (individually)	1 per semester	2 per year
Investigations	1 per semester	2 per year

Table 1 is adopted by the Department of Education as a standard for CASS in mathematics. All mathematics educators from grade 7 to 9 are expected to conduct assessment as per departmental standards outlined in table 1 above. Mathematics is a subject in which learners are expected to solve problems almost everyday. If the guidelines given above in table 1 are to be followed, most if not all learners are going to achieve specific outcomes in mathematics. Therefore, the number of task given should be increased in such a way that the minimum given is applicable per theme in mathematics so that learners can be assessed per theme on all the forms of assessment and assessment, which is taken in consideration, covers a broad scope of topics and themes done.

2.9 Common Task for assessment (CTA)

Common Task for Assessment is a national assessment administered in all schools in South Africa at grade 9. It is common as the name suggests. Mathematics CTA paper is divided into two sections. Section A, which is structured in the form of activities, which learners have to attempt over a period of ten (10) hours under the guidance and help of the educator. The ten hours learners have to attempt Section A is stretched over a period of three to four weeks, and this is during mathematics lessons. During this session, learners can be given homework, an assignment and investigation for this section. Learners can work individually, in pairs, in groups of four to five (Sokopo, 2002).

Section B which learners attempt individually, is structured in the form of an examination and has to be attempted under strict supervision of examination supervision rules. This section is attempted for two (2) hours only. Learners work individually (Sokopo, 2002).

For both Section A and B of the CTA, the teachers use a rubric prepared by the Department of Education to mark. For Section A in particular, some of the activities can be marked by learners; some activities are not allocated marks but serve as base for other activities. In Section B, a rubric is used to mark some of the activities.

2.10 Conclusion

South Africa has moved from an education system, which regarded learners who did well in tests and examination as motivated and those who did not do well as demotivated. Assessment under C2005 does not serve the sole purpose of selecting learners for specific programmes and degrees in Universities and Technikons. South Africa now holds a broad view of assessment.

The major shift in assessment practice in mathematics can be summarised as a move from assessing learners' knowledge of specific facts and isolated skills to assessing learners' full mathematical power, a move away from comparing learners performances with that of others to comparing learners performance with established criteria, a move form making the assessment process secret, exclusive towards making assessment process public, participatory and dynamic (National Council of Teachers of Mathematics [NCTM], 1995).

The shift in assessment practice can also be regarded as a move away from restricting learners to a single way of demonstrating their mathematical knowledge to giving learners multiple opportunities to demonstrate their full mathematical power, a shift away from using assessment to filter and select learners out of the opportunities to learn mathematics toward using assessment results to ensure that all learners have the opportunity to achieve to their potential (NCTM, 1995).

The shift of assessment can also be regarded as a move away from treating assessment as independent of curriculum and instruction to aligning assessment with curriculum and instruction, a move away from viewing learners as objects of assessment in mathematics to viewing learners as active participants in the assessment process, a move away from regarding assessment as sporadic and conclusive to regarding assessment as continual and recursive, and a move away from holding all concerned with mathematics learning accountable for assessment result (NCTM, 1995). Therefore, assessment under C2005 reflects the shift from a modernist view of assessment to a post-modernist view of assessment, which might be underpinned by Constructivism as a theory of learning.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The purpose of this chapter is to indicate the research strategy and how the research project was carried out.

3.2 Research methods

For the purpose of this research, a descriptive method was used. Cohen, Manion and Morrison (2000) suggest that a survey in a research aims to gather data at a particular point in time with the intention of describing the nature of existing conditions or identifying standards, against which existing conditions can be compared or determining the relationships that exists between specific events. The survey research method has characteristics, which helped me to find out about the current assessment practices of teachers of mathematics in Middle Schools.

3.3 Characteristics of a survey in a research

A survey was used to conduct this research because it gathers data on a one-shot basis and hence it is economical and sufficient, it represents a wide target population and it generates numerical data (Cohen *et al.*, 2000). Through a survey, descriptive, inferential and explanatory information was gathered; data, which was processed statistically, was gathered. The survey also relied on large-scale data gathered from a wide population in order to enable generalisation to be made about given factors or variables (Cohen *et al.*, 2000). The use of a survey for this research helped me to support or refute hypotheses about the target population and to make generalisation about, and observe patterns of response in the target focus (Cohen *et al.*, 2000).

Furthermore, I used a survey for the research to count the representative sample and then made inferences about the population as a whole and to

gather information on how many members of the population would have a certain opinion on mathematics assessment and the implication of such fact (Oppenheimer, 1992).

The characteristics of survey as mentioned were factors I used to conduct this research. Furthermore, as mentioned by Steyn (1981) the survey helped me to identify present conditions and needs of assessment in mathematics teaching and learning in Middle Schools.

3.4 Population and sampling

There are thirty-four schools in the Mafikeng District with Senior Phase. The Mafikeng District is made up of six circuits. In each circuit, four schools were chosen. Given that the Senior Phase is made up of three grades, that is, grade 7, 8 and 9.

3.4.1 Sampling procedure

Purposive sampling was used in selecting schools. According to Cohen *et al.* (2000) in purposive sampling, the researcher handpicks case to be included in the sample on the basis of his/her judgement of typicality. In each circuit four schools were selected. The selected schools represented rural schools, urban schools and former model C schools.

Table 2: Number of educators who responded to the questionnaire

School's name	Number of educators
1. Gakologelwang Middle School	1
2. Malefo Malea Middle School	2
3. Reeme-Batloung Middle School	2
4. Sebopiwa Molema Middle School	3
5. Mmabatho Secondary School	3
6. CN Lekalake Middle School	3
7. Lokaleng Middle School	1
8. Boingotlo Middle School	3
9. Batswana Secondary School	3
10. Boitseanape Technical School	3
11. Boitshoko Middle School	2
12. Phetlu Middle School	2
13. Montshioa Memorial Middle School	2
14. St. Mary's Secondary School	2
15. Kebonang Secondary School	2
16. Seleje Secondary School	1
17. Mogakolodi Masibi Middle School	3
18. Tlapeng Tshweu Middle School	1
19. Setlopo Secondary School	2
20. Letsogo Middle School	1
21. Saane Middle School	1
22. Jan Masibi Middle School	2
23. Molopo Middle School	1
24. Bosane Middle School	1
Total	**47**

As indicated in Table 1 above, 47 teachers responded to the questionnaire from the indicated schools.

For the interview, one educator was selected from schools which did not respond to the questionnaire. The following schools participated in the interview; Danville Secondary school, Mogosane Middle School, Lecholonyane Middle School, Mosikare Middle School and Tselakgosi Middle School.

3.4.2 Sampling fraction

3.4.2.1 Sampling fraction for schools, that responded to the questionnaire

The following is a sample fraction for schools from which educators to the questionnaire came:

- Number of schools offering Senior Phase mathematics in Mafikeng District (N) = 34
- Number of schools chosen to respond to the questionnaire (n) = 24

Therefore, sampling fraction (f) = n/N x 100%

= 24/34 x 100%

= 70%

Thus for the purpose of this research 70% of the population was chosen to respond to the questionnaire. This was a fair representation of the population.

3.4.2.2 Sampling fraction for schools, that participated in the interview

The following is a sample fraction for schools from which educators who participated in the interview came:

- Number of schools offering Senior Phase mathematics in Mafikeng District (N) = 34
- Number of schools chosen to participate in the interview (n) = 5

Therefore, sampling fraction (f) = n/N x 100%

= 5/34 x 100%

= 14.7%

Five teachers were chosen from five schools out of 34 schools with Senior Phase to respond to the structured interview. This represented 14.7% of the population.

3.5 Research instruments

A questionnaire was designed for mathematics educators. A structured interview was also conducted. Questionnaires were distributed to schools based on number of educators teaching mathematics in each school. Only one educator was interviewed in each selected school.

3.5.1 Questionnaires for the research

Wilson and McLean (1994) defined a questionnaire as a widely useful instrument for collecting survey information, providing structured, often numerical data. Borg (1987) considered a questionnaire as usually containing questions deemed at getting specific information on a variety of topics. In this case, the questionnaire was used to seek information on the current practices of assessment of mathematics in Senior Phase schools, that is, from Grade 7 to Grade 9 of the Mafikeng District.

I used a questionnaire for collecting data on assessment practices in mathematics in the Senior Phases because a questionnaire gives the opportunity of covering a huge field of investigation and it gives a reliable information about the population.

The questionnaire had a blend of both open-ended and closed questions.

3.5.1.1 Closed questions for the research

Closed questions offered the educators a choice of alternatives and replies, where the educators were asked to tick or underline answers (Oppenheimer, 1992). As indicated by Oppenheimer (1992) the advantages of closed questions include the fact that close questions offered simple answers such as 'Yes' or 'No', were easy and quicker to answer, required no writing, and as such quantification of data was straightforward. Closed questions required little time, needed no extended writing and were useful for answering research questions (Oppenheimer, 1992).

3.5.1.2 Open-ended questions for the research

Oppenheimer (1992) regarded open-ended questions as free-response questions where the educators were not restricted to any choice and had to give personal opinions on issues. The use of open-end questions as indicated by Wilson and McLean (1994) include the fact that open-ended questions enable the educators to state their case freely and possibly or give reasons as well, evoke a fuller and richer response and probably probe deeper than closed questions and go beyond statistical data or factual information into areas of hidden motives that lie behind attitudes, interests, preferences and decisions. Furthermore, open-ended questions afford the educators the freedom to respond, give the researcher the opportunity to probe and are useful for testing hypothesis about ideas or awareness (Oppenheimer, 1992).

3.5.2 The use of an interview in the research

An interview is a situation in which a conversation is initiated by the interviewer for the specific purpose of obtaining relevant information for the research and in which the interviewee is focused on the content specified

by the research objectives of systematic descriptions, predictions and explanations (Watts, 1987).

3.5.2.1 The importance of an interview in a research

According to Oppenheimer (1992) and interview is important in a research because it allows the educators to say what they think and to do so with greater richness and spontaneity and it improves the response rate. Cohen *et al.* (2000) considered an interview important in a research because it gives a prepared explanation of the purpose of the study more convincingly, is capable of reaching with ease less educated educators and helps those with reading difficulties to respond with ease without writing anything.

An interview permits the researcher to follow up leads that show up during the interview and thus obtain more data and greater clarity and enables the interviewees to discuss their interpretation of the world in which they live and to express how they regard situations from their own point of view (Borg, 1987).

I used an interview to gather data from the educators to find out how mathematics assessment is conducted in the Middle Schools of the Mafikeng District. I tried to heed the warning given by Vulliamy, Levin and Stephens (1990) that the interviewees should do most of the talking and that questions should be asked in a manner that lead to rather short responses.

3.5.2.3 Type of interview used in the research

A one to one standardised interview was used. Downey and Watts (1987) defined a one to one interview as a situation in which only one interviewee is interviewed at a time. Downey and Watts (1987) further recommended a one to one interview because it is easy to manage, issues can be kept

relatively confidential and analysis is more straightforward in that only one person's set of responses are gathered at any one time.

A standardised open-end interview was used for the research because according to Patton (1990) in a standardised open-end interview, the exact wording and sequence of questions were determined in advance and all interviewees were asked the same basic questions in the same order. This was advantageous because the educators answered the same questions thus increasing comparability, data was complete for each educator on the topic addressed in the interview and interviewer effects and bias were reduced (Patton, 1990).

3.6 Enhancing validity

To address issues of validity, a questionnaire and interview were used to study how assessment of mathematics in the Middle Schools of the Mafikeng District was conducted. Through the use of questionnaires and structured interviews, I was able to establish different educators' viewpoints, and this helped me to overcome problems of method boundedness and it promoted validity of the research (Cohen et al., 2000).

3.7 How data was collected?

3.7.1 Questionnaire

I requested permission to administer questionnaires in selected schools. Questionnaires were distributed to chosen schools through mathematics heads of departments and were collected from schools after seven days. It was noticed that in some schools only one teacher taught mathematics in the Senior Phase. Thus, under such a condition, one questionnaire was given. Questionnaires were distributed to schools according to number of mathematics teachers.

3.7.2 Interview

I secured appointments with selected educators. Some educators requested to be interviewed in their respective schools and others requested to be interviewed in the convenience of their houses, and that I did. After all interviews, I made transcriptions and translations of the interviews.

3.7.2.1 Method of recording the interview

A tape recorder was used to record the proceedings of interviews. Borg (1987) encouraged the use of a tape recorder in an interview because it provides a complete and accurate record of the whole interview, it preserves the emotional and vocal character of the educators and it can be replayed and a written record can be made.

CHAPTER FOUR: DATA ANALYSIS

4.1 Introduction

In this chapter, an in-depth analysis is given on the teachers' questionnaire and the interviews conducted. Some items of the questionnaire have been discussed together because they address the same issue and for interviews, transcriptions are given.

4.2 Educators' questionnaire

Item 1: Educators' teaching responsibility

Table 3: Educators' teaching responsibility

Response	Number of respondents	Response percentage (%)
A: Grade 7	6	12.8 %
B: Grade 8	9	19.1 %
C: Grade 9	12	25.5 %
A & B	5	10.6 %
B & C	6	12.8 %
A, B & C	9	19.1 %
Total	**47**	**100 %**

According to Table 3 above, 6 educators (12.7%) taught mathematics in grade 7, 9 educators (19.1%) taught mathematics in grade 8 and 12 educators (25.5%) taught mathematics in grade 9. In some schools 5 educators (10.6%) indicated that they taught mathematics from grade 7 to grade 8, 6 educators, which is 12.8%, taught mathematics in both grades 8 and grade 9, 9 educators, which is 19.1% of the educators, taught mathematics in grades 7, 8 and 9 respectively.

In some schools one teacher was responsible for teaching mathematics in all three grades because there were no other teachers.

Item 2: Teaching experience of educators

Table 4: Educators' teaching experience

Response	**Number of respondents**	**Response percentage (%)**
A: Less than a year.	6	12.8%
B: Two years	8	17%
C: Three years	4	8.5%
D: Four years and more	29	61.7%
Total	**47**	**100%**

As indicated in Table 4, 6 educators (12.8%) indicated that they had less than one year mathematics teaching experience, 8 educators (17%) indicated that they had two years mathematics teaching experience, 4 educators (8.5%) % pointed out that they had three years mathematics teaching experience. Finally, 29 educators (61.7%) indicated that they had for four years and more mathematics teaching experience.

Items 3 and 4: Qualifications and subject(s) speciality

Table 5: Educators' qualifications and subject specialisation

3. Educators' qualifications		
Response	**Numbers of respondents**	**Response percentage (%)**
A: Professionally qualified	30	63.8%
B: Academically qualified	5	10.6%
C: Under qualified	3	6.4%
D: Unqualified	1	2.1%
A & B	8	17%
Total	**47**	**100%**
4. Subject specialisation		
A: Mathematics		
B: Physical Science		
C: Geography	1	2.1%
D: Agricultural Science		
E: Others	10	21.3%
A, B & C	2	4.3%
B & C	1	2.1%
A & C	2	4.3%
A & D	2	4.3%
A & B	5	10.6%
Teachers qualified to teach mathematics	11	23.4%
Non response	24	51.1%
Total	**47**	**100%**

Table 5 indicates that 30 educators, which is 63.8% indicated that they were professionally qualified. It was further observed that 5 educators, who represented 10.6% indicated that they were academically qualified, 3 educators, which is 6.4% indicated that they were under-qualified and 1 educator (2.1%)

was unqualified. 8 educators, that is, 17% indicated that they are both academically and professionally qualified.

Table 5 further indicates that 5 educators specialised with both mathematics and physical science. 1 educator, (2.1%) specialised in Geography only, 2 educators, that is 4.3% specialised in Mathematics, Physical Science and Geography in their professional qualifications, 1 educator, that is 2.1% in both Physical Science and Geography 2 educator, which is 4.3% specialised in both Mathematics and Geography and 2 educators, which is 4.3% specialised in both Mathematics and Agricultural Science.

It was further noticed that 1 educator (2.1%) specialised in Setswana only, 1 educator (2.1%) specialised in Technology only, 1 educator (2.1%) specialised in Biology only. 4 educators (8.5%) specialised in English only and 3 educators (6.4%) specialised in Psychology. 24 Educators who represented 51.1 % of the respondents did not indicate their subject specialisation.

Items 5 and 6: In-service training on assessment in mathematics

Table 6: Attendance and frequency of in-service training in mathematics assessment

5. In-service training in assessment in mathematics		
Response	**Number of respondents**	**Response percentage (%)**
A: Yes	29	61.7%
B: No	18	38.3%
Total	**47**	**100%**
6. Frequency of attending in-service training in assessment in mathematics.		
A: Once per year.	19	40.4%
B: Twice per year	6	12.8%
C: Three or more times per year.	7	14.9%
D: Never attended	15	31.9%
Total	**47**	**100%**

As per Table 6, 29 educators, which is 61.7% of the educators indicated that they received in-service training on assessment in mathematics and 18 educators who represent 38.3% did not receive in-service training on assessment in mathematics. 19 educators (40.4%) received in-service training on assessment in mathematics once a year, 6 educators (12.8%) of the educators indicated that they received in-service training on assessment in mathematics twice per year, 7 educators, which is 14.9% received in-service training on assessment in mathematics three and more times per year and 15 educators (31.9%) indicated that they never received in-service training on assessment in mathematics.

Item 7: Self-assessment for learners in mathematics

Table 7: The use of self-assessment in mathematics

Response	Number of respondents	Response percentage (%)
A: Often	10	21.3%
B: Seldom	15	31.9%
C: Not at all	22	46.8%
Total	**47**	**100%**

As in Table 7 above, 10 educators (21.3%) pointed out that they often afforded learners the opportunity to assess their mathematics work and 15 educators (31.9%) indicated that they seldom afforded learners the opportunity to assess themselves. 22 educators (46.8%) of the educators indicated that they did not afford learners the opportunity to self assess their work.

Item 8: Peer assessment in mathematics

Table 8: The use of peer assessment in mathematics

Response	Number of respondents	Response percentage (%)
A: Often	30	63.8%
B: Seldom	13	27.7%
C: Not at all	4	8.5%
Total	**47**	**100%**

According to Table 8, 30 educators (63.8%) gave an indication that they often asked learners to assess peers' mathematics work, 13 educators (27.7%) of the educators pointed out that they seldom asked learners to assess their peers' work and 4 educators (8.5%) indicated that they did not at all ask learners to assess their peers' work.

Items 9 and 10: Baseline assessment in mathematics

Table 9: The use of baseline assessment in mathematics

Response	Number of respondents	Response percentage (%)
A: Yes	40	85.1%
B: No	7	14.9%
Total	**47**	**100%**

Table 40 educators, that is 85.1% indicated that they used baseline assessment at the beginning of mathematics activities to establish what learners already know and 7 educators (14.9%) indicated that they did not use baseline assessment. 3 educators, which is 6.4% of the educators who indicated that they did not use baseline assessment could not furnish reasons why.

Item 11: Formative assessment in mathematics

Table 10: The use of formative assessment in mathematics

Response	Number of respondents	Response percentage (%)
A: To inform the teacher and learner about learner's progress.	5	10.6%
B: To determine learner's strength in learning mathematics.	4	8.5%
C: To determine learning difficulties learners experience in learning mathematics.	2	4.3%
D: As a tool to structure lessons according individual learner's learning style	2	4.3%
E: None of the above	0	0
A, B, C & D	1	2.1%
No response	33	70.2%
Total	**47**	**100%**

According to Table 10, 5 educators that is 10.6% indicated that they used formative assessment to inform learners about their progress in learning mathematics, 4 educators (8.5%) indicated that they used formative assessment in mathematics teaching to determine learners' strength in learning mathematics. 2 educators that is 4.3% used formative assessment in mathematics teaching to determine learning difficulties 2 educators (4.3%) of the educators indicated that they used formative assessment as a tool to structure lessons according to individual learners' needs.

It was further noted that though the educators were given the latitude to choose more than one option, 1 educator (2.1 %) managed to identify the correct use of formative assessment in mathematics teaching and 33 educators (70.2%) did not respond to the question. Some could not differentiate formative assessment from diagnostic assessment.

Item 12: The purpose of summative assessment in mathematics

Table 11: The use of summative assessment in mathematics

Response	**Number of respondents**	**Response percentage (%)**
A: To get the overall picture of learner's progress at a given time.	4	8.5%
B: To determine how well learners have progressed towards the achievement of selected outcomes.	13	27.7%
C: To get formative feedback about learners progress in learning mathematics	3	6.4%
D: As a tool to structure lessons according to individuals learning styles.	0	0
E: None of the above	0	0
A, B, C & D	9	19.1%
A & B	5	10.6%
A, B & C	7	14.9%
B & C	6	12.8%
Total	**47**	**100%**

From the responses as indicated in Table 11, 4 educators (8.5%) said summative assessment is used to get the overall picture of learner's progress over given length of time, 13 educators (27.7%) indicated that the use of summative assessment in mathematics is to determine how well learners have progressed towards the achievement of selected outcomes and 3 educators (6.4%) indicated that the use of summative assessment in mathematics is to get formative feedback about learner's progress in learning mathematics. None of the educators indicated the use of summative assessment in mathematics, as a tool for educators to structure mathematics lessons according to individual's learners needs.

Even though educators were told that they could choose more than one option from the given options, it was noticed that the educators chose many combinations of options. It was further noticed that 9 educators, that is 19.1% could easily identify the use of summative assessment in teaching mathematics.

Items 13 and 14: Tests in mathematics teaching and learning

Table 12: Tests as assessment forms in mathematics

13. Type of test used in mathematics assessment		
Response	**Number of respondents**	**Response percentage (%)**
A: Short test – to test basic skills, recall of facts and formulae in mathematics.	10	21.3%
B: Longer test – to test high-level skills such as transfer and retention of facts, the making of connection and problem solving skills.	6	12.8%
C: Oral test: On specific prepared questions to test recall of facts and the ability to communicate mathematical ideas	0	0
A & B	14	29.8%
A & C	10	21.3%
Non response	7	14.9%
Total	**47**	**100%**
14. How do learners respond to mathematics test?		
A: Completion pairs	10	21.3%
B: Answering few questions in their journals.	0	0
C: Allowing learners to answer questions set by peers or group.	4	8.5%
D: Following normal or routine test questions.	28	59.6%
A & C	1	2.3%
No response	4	8.5%
Total	**47**	**100%**

It became evident from Table 12 that 10 educators (21.3%) gave learners short tests to assess basic mathematical skills, recall of facts and formulae, 6 educators (12.8%) gave learners longer tests to test high level skills such as transfer, retention of facts, making of connections between facts and problem

solving skills. None of the educators gave learners oral tests to test recall of facts and the ability of learners to communicate mathematical ideas.

14 educators (29.8%) indicated that they gave learners short tests to test basic skills, recall of mathematical facts and formulae and longer tests to test high level skills such as transfer, retention of mathematics facts, the making of connections between mathematical facts and problem solving skills. 10 educators (21.3%) gave learners short tests to test basic mathematics skills such as transfer, retention of facts, making connections between mathematics facts and problem solving skills and oral tests on specific prepared questions to test recall facts and the ability of learners to communicate mathematical ideas. Furthermore, 10 educators (14.9%) did not respond to this question.

From Table 12, 10 educators (21.3%) indicated that he/she asked learners to complete tests in pairs, none of the educators indicated that learners are requested to complete tests by answering in their mathematics journals. 4 educators (8.5%) indicated that they allowed learners to answer questions set by their peers and 28 educators (59.6%) of educators indicated that when they give learners tests in mathematics, they follow normal or routine questions in giving tests.

It was also noticed that 1 educator (2.1%) allowed learners to respond to mathematics tests in pairs, to answer few test questions in their mathematics journals and answer questions set by their peers. The educators also followed normal or routine test questions. Finally, 4 educators (8.5%) did not respond to this question.

Item 15: Class work / homework in mathematics

Table 13: Aspects assessed in mathematics class work / homework

Response	Number of respondents	Response percentage (%)
A: Mathematical content	1	2.1%
B: Mathematical accuracy	1	2.1%
C: Problem solving skills	7	14.9%
D: Critical thinking skills	1	2.1%
E: Clarity and presentation of the written mathematical argument.	0	0
F: Communication skills in presenting mathematical facts	1	2.1%
A, B, C, D, E & F	8	17%
Other combinations	28	59.6%
Total	**47**	**100%**

According to Table 13, 1 educator (2.1%) indicated that only mathematical content is assessed in class work / homework given to learners, 1 educator (2.1%) indicated that mathematical accuracy is assessed in class work / homework, 7 educators (14.9%) indicated that problem solving skills are assessed class work / homework, and 1 educator (2.1%) indicated that critical thinking skills are assessed in class work / homework. None of the educators indicated that clarity and presentation of written mathematics argument are assessed in class work / homework and 1 educator (2.1%) indicated that communication skills in presenting mathematical facts are assessed in class work / homework.

It was interesting to note that educators made different combinations about what they assess in learner's class work / homework. Only 8 educators (17%) identified with accuracy that in mathematics class work / homework, content, accuracy, problem solving skills, critical thinking skills, clarity and presentation of

the written mathematical argument and communication skills in presenting mathematical facts should be assessed. Finally, 28 educators (59.6%) made different combinations of options.

Items 16 and 17: Investigative activities in mathematics

Table 14: The use of investigative activities in mathematics assessment

16. Which investigative activities do learners respond to?		
Response	**Number of respondents**	**Response percentage (%)**
A: Structured tasks – where learners solve different mathematical problems.	23	48.9%
B: Open-ended tasks	6	12.8%
A & B	18	38.3%
Total	**47**	**100%**
17. Aspects assessed in mathematics investigative activities.		
A: Knowledge and skills	7	14.8%
B: Understanding of mathematical concepts.	11	23.4%
C: Application of mathematical concepts and learner's creativity.	12	25.5%
D: Methods used and application of solution	0	0
A, B, C & D	17	36.2%
Total	**47**	**100%**

From Table 14, 23 educators (48.9%) pointed out that they gave learners only structured tasks where learners solve different mathematical problems as investigative activities, and 6 educators (12.7%) indicated that they gave learners open-ended tasks as investigative activities. It was further noticed that 18 educators (38.3%) indicated that they gave learners both structured mathematical problems and open-ended tasks as investigative activities. These are the two most important activities learners should engage in as investigative activities in mathematics.

It was further observed that 7 educators (14.8%) pointed out that whenever learners are given mathematics investigative activities, knowledge and skills are the only things assessed. 11 educator, who represented 23.4% of the educators, indicated that he/she assess learner's understanding of mathematics concepts. It was further observed that 12 educator (25.5%) assessed application of mathematical concepts and learners creativity. 9 educators, that is, 19.1% of the educators indicated that they only assessed learner's mathematics investigative activities. None of the educator indicated that they assess methods used and application of solutions in assessing learners' mathematics investigative activities.

It was noticed that only 17 educators (36.2%) of the educators, were able to identify the correct things to be assessed in mathematics investigative activities, namely, mathematical knowledge and skills, understanding of mathematical concepts, application of mathematical concepts and learner's creativity and methods learners used and application of solutions.

Items 18 and 19: Mathematical projects

Table 15: The use of projects in mathematics assessment

18. Area of focus in mathematical projects		
Response	**Number of respondents**	**Response percentage (%)**
A: Application of mathematics learned in class to real-life situations	30	63.8%
B: The study of the history of mathematics topics.	0	0
C: Study of people and cultures involved in the development of mathematics.	1	2.1%
A, B & C	4	8.5%
No response	12	25.5%
Total	**47**	**100%**
19. Role of an educator when giving mathematical projects		
A: Assist learners in developing skills necessary in producing good mathematical project.	3	6.4%
B: Guide learners on how to plan a mathematics project.	5	10.6%
C: Guide learners on where to find the necessary information.	0	0
D: Guide learners on how to conduct interviews.	0	0
E: Guide learners on how to acknowledge sources used.	0	0
F: Guide learners on how to make presentations of mathematical projects.	2	4.3%
A, B, C, D, E & F	9	19.1%
No response	28	59.6%
Total	**47**	**100%**

In responding to these questions, according to Table 12, 30 educators (63.8%) indicated that they focused on the application of mathematics learned in class to real-life situation when they give learner's mathematics projects, none of the educators focused on the study of history of mathematics topics in the work they gave learners and 1 educator (2.1%) focused on the study of the people and cultures involved in the development of mathematics.

It was further noticed that 4 educators (8.5%) were able to determine the three correct things to be assessed on mathematical projects, namely, the application of classroom mathematics to real-life situations, the study of the history of mathematics topics and the study of the people and cultures involved in the development of mathematics. It was further observed that 12 educators (25.5%) did not respond to this question.

3 educators, that is, 6.4% indicated that the role they played when learners were involved in projects was to assist learners in developing skills necessary in producing good project, 5 educators (10.6%) pointed out that they guided learners to find necessary information for their projects. None indicated that they guided learners on how to conduct interviews or how to acknowledge sources used in their projects. 2 educators (4.3%) of the educators indicated that they guided learners on how to make presentations of mathematics projects.

It was established that 9 educators (19.1%) were able to identify all the roles educators should play when they give learners mathematics projects, namely, to assist learners in developing skills necessary in producing good mathematical projects, to guide learners on how to plan mathematics projects, to guide learners on where to find the necessary information, to guide learners on how to conduct interviews, to guide learners on how to acknowledge sources used and to guide learners on how to make presentations. Finally, 28 educators (59.6%) did not respond to this question.

Items 20, 21 and 22: Mathematics' Portfolio

All educators (i.e. 100%) indicated that learners were encouraged to keep mathematics portfolios.

The following are the suggestions made by the educators on how portfolios could be used in the learning of mathematics:

- For learners to be able to see how they are achieving specific outcomes.
- For learners to be able to revise for tests and examinations with ease by referring to the work they have achieved in their portfolios.
- Class work, homework and tests should be kept in the learners' portfolios to observe learners' work over a period of time.
- Learners should keep portfolios for revision purposes so that easy references could be made as learners prepare specifically for mid-year and end of the year examinations.
- Learners must collect mathematics articles from newspapers and keep such in their portfolios.
- A portfolio is a storage of learner's achievement in mathematics used specifically for continuous assessment purposes.
- Portfolios are used for record keeping.
- Learners should keep portfolios to identify their strength and weakness in learning mathematics
- Learners keep portfolios so that they should make corrections where they encounter problems in learning certain mathematical concepts.
- Portfolios are kept so that learners can find their written work with ease for assessment purposes.
- Learners keep portfolios for motivation purpose so that they can easily see their progress in learning mathematics and improve on areas in which they are not performing well.
- For learners to reflect from time to time on their performance in mathematics.

- Learners keep portfolios so that they can show their progress in learning mathematics to parents.
- Learners keep mathematics portfolios as evidence of what they have learned and achieved in mathematics at lower grades.

The indication from the educators is that portfolios are not assessed because only records are kept in such portfolios as per Department of Education's dictates.

Item 23: Improvement of educators in mathematics knowledge

Table 16: What educators should do to improve their knowledge of mathematics?

Response	Number of respondents	Response percentage (%)
A: More in-service training on assessment in mathematics.	7	14.9%
B: Enrol at higher institutions to further study mathematics education.	5	10.6%
C: Become a member of mathematics education society or club.	1	2.1%
D: You are satisfied with your current experience and qualification in mathematics.	5	10.6%
A, B & C	14	29.8%
A & B	7	14.9%
B & C	1	2.1%
No response	7	14.9%
Total	**47**	**100%**

According to Table 15, 7 educators (14.9%) indicated that they needed more in-service training on assessment to improve their knowledge in mathematics while 5 educators (10.6%) pointed out that they considered enrolling at higher institutions to further their studies in mathematics education to improve their

knowledge in mathematics. 1 educator (2.1%) considered becoming a member of mathematics education club to improve his/her knowledge in mathematics and 5 educators (10.6%) indicated that they were satisfied with their current experience and qualifications in mathematics and hence they did not need to improve their knowledge of mathematics.

14 educators (29.8%) indicated that they considered more in-service training on assessment in mathematics, enrolling in higher institutions to further their studies in mathematics education and becoming members of mathematics education society or club to improve their knowledge of mathematics. 7 educators (14.9%) indicated that they considered more in-service training on mathematics assessment and enrolling in higher institutions to further their studies to improve their knowledge of mathematics and 1 educator (2.1%) clearly indicated that he/she only needed to enrol in higher institutions to further his/her studies in mathematics education and become a member of mathematics societies or clubs to improve his/her knowledge of mathematics. Finally, 7 educators (14.9%) 7 educators (14.9%) did not respond to the question.

Items 24 and 25: Problems encountered by educators in assessing learners in mathematics and how to overcome them

The educators indicated that they experienced problems in assessing learners in mathematics. The following are some of the problems identified by the educators from the questionnaire:

- Some learners did not participate, write, or finish mathematics activities as given. This was due to the fact that learners did not seem motivated to learn mathematics. Some learners disliked solving sums with decimal fractions and they also disliked converting fractions to percentages.
- In some instances, learners could not recall mathematical formulae and principles of theorems to solve problems.

- Some learners could not apply mathematical knowledge to real life situation. They perceived mathematics as an abstract subject that cannot be applied in real life.
- Large classes and overpopulated classrooms did not allow educators to give learners more work in mathematics. As such, the educators could not cover all specific outcomes for assessment in mathematics.
- Some learners found mathematics to be a very difficult subject and they tended to have a negative attitude towards the subject
- Some learners had the tendency to depend on their teachers in learning mathematics. Learners only work when told to do so by their teachers. The educators further indicated that this was evident mostly when learners were given homework because such homework was in most instances completed in class under the supervision of teachers.
- Learners took a long time to understand mathematical principles or concepts presented in class. In most instances learners failed to solve mathematical sums especially when they worked individually.
- Some learners could not properly present their written arguments and their communication skills of mathematics concepts and principles were not acceptable. This, according to the educators, could be attributed to poor expression of learners in English as a language of learning and teaching. This, I presume can also reflect problems mathematics teachers might be facing communicating or teaching in English.
- The educators indicated that they were overloaded with too much work and find it difficult sometimes to cope. They further acknowledged that perhaps the problems learners encounter could be as a result of the fact that even educators could not teach learners mathematics effectively because of the many classes they have to teach.
- According to the educators, some schools lacked resources such as mathematical calculators and instruments. Schools, especially those in rural areas were worse off in that most parents were unemployed.

- Learners tended to forget how to calculate or solve simple problems because they practised mathematics only when they were about to write tests or examinations. Even when learners wrote examinations or tests, the educators indicated that learners could not properly comprehend questions given or interpret mathematical statements with accuracy.
- Learners lacked proper mathematical background from primary school and as such they could not comprehend mathematics principles as expected.

In response to the questionnaire, educators suggested the following towards the improvement of teaching and learning mathematics:

- There in need to plan remedial programmes to help learners to better achieve in mathematics and to understand mathematics concepts. This could only be achieved if educators' workload could be reduced to accommodate time for remedial work.
- For learners to understand mathematics better, extra lessons should be organised during school holidays and if possible on Saturdays.
- The teaching of mathematics should be fun for learners to enjoy leaning mathematics. Mathematics should be taught in contexts familiar to learners.
- Parents should encourage learners to learn mathematics and ensure that learners do homework when given. If possible, parents should help their children to do their homework and monitor what their children do everyday at school.
- Learners should be encouraged to work independently and be given investigative tasks to do.
- Homework should be given daily so that learners should practise mathematics daily.
- If possible, mathematics games should be organised to help learners understand mathematics more.

- Educators should ensure that when they give learners assignments, homework, or investigations, they give proper guidance and explanation on what learners are expected to do.
- Educators should always ensure that learners are taught different methods to solve problems in mathematics.
- Mathematics educators should not be overloaded. More educators should be employed to ease teachers' workload.
- Mathematics educators should be given in-service training on regular basis to empower them to solve problems they encounter in teaching mathematics.
- There should be proper monitoring of the teaching of mathematics from foundation phase to help learners to understand mathematics in subsequent years.

4.3 Interviews with educators

The interviews were transcribed as in Appendices 5 to 9. The following is a summary of some of the issues raised by the interviewees related to assessment in mathematics:

1. Question: How do you find assessment of learners' mathematics work as envisaged by OBE and C2005?

   Answer: Four of the five interviewees replied that assessment in mathematics as envisaged by OBE and C2005 was good. One interviewee replied that assessment as envisaged by OBE and C2005 was a waste of time.

2. Question: In your opinion, do you think learners should assess themselves in mathematics?

   Answer: Three interviewees replied that they thought learners should assess themselves. Two interviewees replied that they do not think

learners should assess themselves because it was a waste of time and learners were not honest about such assessments.

3. Question: For what purposes do you use formative assessment in mathematics?

Answer: The interviewees said they used formative assessment to check progress and problems learners might be experiencing during the lesson and to review teaching methods so to bring about effective teaching.

4. Question: Baseline assessment is encouraged by OBE and C2005. How do you use baseline assessment in mathematics?

Answer: Four of the five interviewees replied that they used baseline assessment mainly at the beginning of their lesson to identify what learners already know so that new knowledge could be based on that. One interviewee was not sure about the use of baseline assessment.

5. Question: Do your learners keep mathematics portfolios?

Answer: To this question all five interviewees replied in the affirmative.

6. Question: What do you think the advantages of mathematics assessment as envisaged by OBE and C2005 are?

Answer: Interviewees said that the advantages of mathematics assessment were to identify learning problems learners encountered so that relevant remedial work could be conducted. Alternative assessment methods practiced under C2005 offer better assessment of learners than through tests and examinations only.

7. Question: Which skills do you often assess in mathematics tests, class work and homework?

Answer: Skills such as problem solving, using correct mathematical operations, were identified by the interviewees as skills they assessed in tests, class work and homework.

8. Question: Which specific skills do you want your learners to work on in mathematics projects?

Answer: Three of the five interviewees replied that they wanted learners to work on problem solving. Two interviewees said they do not give learners mathematics projects to work on.

9. Question: Which investigative mathematics activities do you give to learners?

Answer: One of the five interviewees replied that he / she gave learners proof of Pythagorean Theorem as an investigative activity. Four other interviewees did not have an idea on what activities they could give learners.

10. Question: What are the challenges you encounter when assessing learners' mathematics work?

Answer: The interviewees indicated that problems they encountered included overcrowding, learners' lack of basic mathematical knowledge and their own limitations to construct rubrics.

11. Question: What do you think could be done to overcome such challenges?

Answer: To overcome the challenges mentioned above, the interviewees suggested that more teachers should be hired, more classrooms

should be built and workshops should be conducted on assessment for teachers.

12. Question: Which specific areas should be addressed at an in-service workshop on mathematics?

Answer: All five educators replied that assessment in mathematics should be addressed whenever in-service workshops are conducted. However, a special request was that they should be trained on how to design a rubric.

4.4 Interpretations and inferences

The following are interpretations of interviews and questionnaires.

4.4.1 Questionnaires

Responses from the questionnaire indicated that in-service workshops are organised in mathematics assessment. As analysed in items five and six, 61.7% of the educators indicated that they attended such in-service workshops. Yet it was clear that 46.8% of the educators as analysed in item 7 did not practice assessment as expected for example, they did not afford learners the opportunity to use self-assessment. It also became clear that one educator who represented 2.1% of the educators noticed that formative assessment is used to inform educators and learners about learners 'progress in learning mathematics, to determine strengths and weaknesses and as a tool for educators to structure lessons according to individual learning styles.

The analysis of item 12 of the questionnaire, indicate that nine educators who represented 19.1% were able to identify the correct uses of summative assessment in mathematics i.e. to get the overall picture of learners' progress, to determine how well learners have progressed towards the

achievement of selected mathematics outcomes and to get formative feedback about learners' progress in learning mathematics.

With reference to the analysis of item 15 of the questionnaire, 8 educators who represented 17% of the educators indicated with accuracy that in assessing mathematics tests, homework and class work they assessed mathematical content, mathematical accuracy, problem solving skills, critical thinking skills, clarity and presentation of written mathematical argument and communication skills. The analysis of items 16 and 17 of the questionnaire indicate that 13 educators (27.6%) paid attention to mathematical knowledge and skills, understanding of mathematical concepts, application of mathematical concepts, learners' creativity and methods learners used and application of solutions when assessing mathematics investigative activities.

As analysed in items 18 and 19, nine educators (19.1%) were able to identify all roles educators should play when learners were involved in mathematical projects. The roles are, to assist learners in developing skills necessary in producing good mathematical projects, to guide learners on how to plan mathematics projects, to guide learners on where to find necessary information, to guide learners on how to conduct interviews, to guide learners on how to acknowledge sources used and to guide learners on how to make presentations.

From the discussed observations, it is clear that even though 61.7% of the educators indicated that they attended in-service training in mathematics assessment, knowledge of how assessment should be conducted was still lacking. There was need for other mathematics assessment workshops with specific emphasis on different forms of assessment, e.g. class work, homework, tests and examinations, projects, investigations and assignments.

4.4.2 Interviews

All five educators said that they asked learners to keep mathematics portfolios. However, it became clear that some of the educators did not give learners investigative activities and projects. There seemed to be a gap in terms of educators understanding of the nature of assessment in mathematics, why assessment should be conducted and what kind of assessment should be practised in schools.

One interviewee was very sceptical about assessment as envisaged by OBE and C2005. He said that assessment as envisaged by OBE and C2005 is just a waste of time. Some interviewees indicated that they needed in-service workshops on how to conduct assessment in mathematics and a special request was made that a workshop should be conducted on how to design a rubric. Even though assessment workshops were conducted in mathematics, it is clear that there was still a need for more. All attempts should be made to ensure that educators understand how to assess learners' mathematics work through such workshops.

CHAPTER FIVE: FINDINGS AND DISCUSSIONS, RECOMMENDATIONS AND CONCLUSION

5.1 Discussion of the Findings

Based on the analysis of the questionnaires and the interviews, the following are discussed:

5.1.1 As per analysis of the questionnaire, items 3 and 4, 30 educators who represented 63.8% of the sample indicated that they are professionally qualified. This is an indication that the remaining 36.2% of the educators are academically qualified, under-qualified or unqualified. From the analysis of item 4, it was established that 5 educators (10.6%) specialised in both Mathematics and Physical Science, 2 educators (4.3%) specialised in Mathematics and Geography and 2 educators (4.3%) specialised in Mathematics Agricultural Science. It can therefore be said that the remaining 80.8% of the sample are not qualified to teach Mathematics.

Most of the teachers who were teaching mathematics did not specialise in mathematics. This has an impact on the learning of mathematics, such as, learners' understanding of mathematics, learners' ability to apply mathematical concepts to real life situations and poor performance in grade 12 mathematics examinations. Thus, it can be argued that learners are not taught the right mathematical procedures for solving problems. Such unqualified teachers have little or no knowledge about correct assessment methods. For example, formative assessment, according to Barry and King (1998) should be used during actual teaching and learning of mathematics to provide information from which learning tasks could, if necessary, be modified to meet learners' needs. This might not be adhered to since most educators are not professionally qualified to teach mathematics.

5.1.2 Twenty-nine educators who represented 61.7% of the educators indicated that they attended in-service workshops on mathematics assessment. The question remains however as to whether all teachers benefit from such workshops? Another question to be answered is whether unqualified teachers are able to understand details or the importance of such in-service workshops to apply such knowledge in their teaching?

This observation indicates that teachers are exposed to proper methods of mathematics assessment. As such, learners' progress is monitored and educators are able to diagnose learning difficulties learners experience and to prescribe relevant remedial action to support learners (DoE, 2001). Are teachers able to monitor learners' progress as required?

In-service workshops are however necessary and help educators to be up to date about teaching and learning issues and should be encouraged.

5.1.3 From item 9 to 10, forty educators who represented 85.1% of the sample indicated that they use baseline assessment. This is a sign that educators use baseline assessment to assess learners as per dictates of OBE and C2005 (Sokopo, 2002).

Since the learning of mathematical principles is contingent upon what learners already know, learning is therefore concretised if learners' previous knowledge is linked to what they are about to learn or new topics. Using diverse assessment methods lead to in depth examination of the structure of the quality of learners' learning and understanding (Lunt, 1994).

Only nine educators who represented 19.1% of the educators managed to identify the correct use of baseline assessment in mathematics. This is according to analyses of the questionnaire, item 12. This is an indication that there is still a lack of knowledge about assessment in mathematics as envisaged by C2005 and OBE (Sokopo, 2002)

5.1.4 Only one educator indicated correctly the use of formative assessment in assessing learners' mathematics work. This teacher represented 2.1% of the educators. This is an indication that 97.8% of the educators did not understand what formative assessment is. This is clear indication that in-service workshops are necessary and teachers must have appropriate qualifications to teach particular subjects including mathematics.

Barry and King (1998) indicated that formative assessment should be used to monitor and support the learning process in mathematics. Formative assessment should also be used to inform learners and teachers about the progress learners are making in the attainment of specific outcomes to improve teaching and learning. Therefore, it is clear that monitoring and supporting learners' learning progress in mathematics is necessary. Teachers must use formative assessment to provide feedback to learners to aid learning.

5.1.5 According to the analyses of item 15 of the questionnaire, eight educators who represented 17%% of the educators were able to identify with accuracy aspects that should be assessed in mathematics' class work and homework. This confirms the previous observation that because most mathematics teachers are unqualified, they do not know how to correctly assess learners' work.

AMESA (1999) suggest that mathematical content, accuracy, problem solving skills, critical thinking, clarity and representation of arguments and communication skills should be assessed in mathematics class work / homework.

5.1.6 From items 16 and 17 of the questionnaire, 13 educators who represented 27.7% of the sample were able to identify correctly the necessary skills, which should be assessed in investigative activities. By inference, 72.4% of the educators failed to identify necessary skills to be assessed in investigative activities. It can be deduced that learners are not given

investigative activities to do simply because the majority of mathematics teachers do not know about the details of investigative activities.

According to AMESA (1999) knowledge and skill, understanding, application and creativity, methods and application of solutions should be assessed in investigative activities.

5.1.7 From items 18 and 19, only nine educators who represented 19.1% of the educators managed to identify all roles educators play in giving learners mathematical projects. It is therefore established that 80.9% of the educators could not identify with accuracy what they should focus on in giving projects. This is despite the fact that they indicated they attend in-service workshops in mathematics. This also indicates the need for only qualified personnel to teach mathematics.

When learners are given a project in mathematics, the focus should be on the application of mathematics learned in the classroom to real life situations. Focus should also be on the study of mathematical topics not covered by the school syllabus such as geometry, graph theory and the study of the history of mathematics and / or cultures involved in the development of mathematics (AMESA, 1999). Qualified mathematics teachers would know these.

AMESA (1999) further recommends that educators should guide learners on how to plan projects, where to find relevant information, how to conduct interviews, how to acknowledge sources and how to give learners guides for presentation of a project.

5.2 Summary of findings

It was established that 23.4% of educators who responded to the questionnaire had relevant qualification to teach mathematics. This means that 76.6% of teachers who responded to the questionnaire did not have

relevant qualifications to teach mathematics. In terms of how assessment should be conducted, it became evident that most educators did not exactly know how assessment in mathematics should be carried out. This was evident despite the fact that educators attended in-service trainings in mathematics. Therefore, reflections should be made about such in-service trainings so that educators could be better equipped to teach mathematics and to assess learners work in mathematics.

5.3 Recommendations

Based on the findings above, it is recommended that:

5.3.1 The Department of Education should retrain educators who are currently teaching mathematics but are not qualified to teach mathematics. They can be retrained through teacher upgrading programmes such as Advanced Certificate in Education courses offered by Universities so that such teachers could at least be confident to teach mathematics, study current approaches in the teaching and learning of mathematics so that they cold be able to assess learners' mathematics work properly.

5.3.2 In-service workshops on mathematics assessment should be offered on continuous basis. However, such in-service training should be as practical as possible and should be accompanied by school support. This will help educators to improve their knowledge on how assessment should be conducted. I further recommend that institutions such as universities should use their expertise to assist the Department of Education by organising workshops on assessment in mathematics for teachers.

5.3.3 Though there is an indication that assessment of learners' mathematics work is conducted, I recommend that in-service workshops proposed in 5.3.2 above, should cover topics such as, all forms of assessment and examples of assessment, rubrics and what is done after assessment. Furthermore, skills, which should be assessed in mathematics projects, investigative activities, homework / class work should be discussed in

such workshops so that teachers should be aware of how they should assess learners' mathematics work. Teachers should also be taught about their roles in assessment.

5.3.4 Furthermore they should join professional associations such as the Association for Mathematics Education in South Africa so that they could attend conferences, symposia, receive journals and articles on mathematics teaching and learning. Teachers can also form mathematics associations to discuss their problems and concerns at circuit, district, regional and provincial levels. Involvement of teachers in associations and societies for mathematics education will encourage educators to engage in action research and contribute towards formulation of policies for assessment in education and mathematics education in particular

5.4 Conclusion

"Assessment should be the servant of teaching and learning. Without information about learners' skills, understanding, and the individual approaches to mathematics, teachers have nothing to guide their work" (Mokros, Russell and Economopoulos, 1995, p.84). This statement became true to me as I was conducting this research. I noticed that the best way to practice assessment is when it is intertwined with teaching and learning of mathematics. It is also important that for South Africa to pride itself with quality education. There is also a serious need to work towards producing quality educators. Teachers should be well capacitated with all relevant information to be able to deliver in all aspects of mathematics education and in particular, in assessment in mathematics.

Cathcart (2000) argued that when planning an assessment in mathematics, teachers should interpret evidence, the criteria he/she would use to judge performance and the format he/she would use to summarize findings. Cathcart (2000) further argued that when gathering evidence that learning has taken place, teachers should consider activities, tasks and procedures

they use to involve learners. Educators should think about how they would determine understanding and the criteria they would use to analyse evidence. Teachers should also consider how results would be reported, and decide how the results would affect future instructional decisions and learners knowledge of mathematics.

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APPENDIX 1

P.O. Box 5151

Mmabatho

2735

04 August 2003

The Principal

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Sir / Madam

Re: Towards an effective assessment practices of mathematics in the Middle Schools

I am conducting a research, of which the topic is captured above, towards part fulfilment for the degree of Masters of Education (Mathematics Education) in the Department of Professional Studies and Internship in the faculty of Education at the North West University (Mafikeng Campus). The purpose of the research is to establish the manner in which assessment in mathematics is carried out in the Middle Schools, Senior Phase, in the Mafikeng District of education.

I therefore request to administer questionnaires for mathematics educators in grade 7, 8 and 9 in your school. Confidentiality is promised for responses of questionnaires.

I hope my request shall be favourably considered

Yours faithfully

_____

Seeletse Aaron Noah

APPENDIX 2

P. O. Box 4151

Mmabatho

2735

04 August 2003

The Principal

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Sir / Madam

Re: Towards an effective assessment practices of mathematics in the Middle Schools

I am conducting a research, of which the topic is captured above, towards part fulfilment for the degree of Masters of Education (Mathematics Education) in the Department of Professional Studies and Internship in the faculty of Education at the North West University (Mafikeng Campus). The purpose of the research is to establish the manner in which assessment in mathematics is carried out in the Middle Schools, Senior Phase, in the Mafikeng District of education.

I therefore request to interview one educator who is teaching mathematics in grade 7 or 8 or 9. Confidentiality is promised for responses of the interview.

I hope my request shall be favourably considered

Yours Faithfully

_____

Seeletse Aaron Noah

APPENDIX 3

EDUCATOR'S QUESTIONNAIRE

Name(Optional) : _____

School's name : _____

Circuit : _____

District : _____

N.B. Please make a tick where appropriate and give your opinion where necessary

1. Indicate the Grade(s) you teach

A. Grade 7 ☐

B. Grade 8 ☐

C. Grade 9 ☐

2. For how long have you been teaching mathematics?

A. Less than a year ☐

B. Two years ☐

C. Three years ☐

D. Four years and more ☐

3. Indicate your qualifications

A. Professionally qualified ☐

B. Academically qualified ☐

C. Under qualified ☐

D. Unqualified ☐

4. Which is/are your subject(s) of speciality?

A. Mathematics ☐

B. Physical Science ☐

C. Geography ☐

D. Agricultural Science ☐

E. Other (specify)..... ☐

5. Did you receive any in-service training in assessment in mathematics?

A. Yes ☐

B. No ☐

6. How often do you attend in-service training in assessment in mathematics?

A. Once per year ☐

B. Twice per year ☐

C. Three or more times per year ☐

D. Never attended ☐

7. Do learners assess themselves in mathematics?

A. Often ☐

B. Seldom ☐

C. Not at all ☐

8. Do you encourage learners to use peer assessment in mathematics?

A. Often ☐

B. Seldom ☐

C. Not at all ☐

9. Do you normally use baseline assessment at the beginning of your mathematics activities to establish what learners already know?

A. Yes ☐

B. No ☐

10. If answer is 'No' to 9 above, how do you use baseline assessment in mathematics?

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From 11 to 20 select more than one answer if necessary.

11. How do you use formative assessment in mathematics teaching?

A. To inform you and learners about learner's progress in learning mathematics. ☐

B. To determine learner's strength in learning mathematics. ☐

C. To determine learning difficulties learners experience in learning mathematics. ☐

D. As a tool to structure lessons according to individual learner's learning styles ☐

E. None of the above ☐

12. Indicate for which purpose(s) you use summative assessment in mathematics.

A. To get overall picture of learner's progress at a given time ☐

B. To determine how well learners have progressed towards the achievement of selected outcomes ☐

C. To get formative feedback about learners progress in learning mathematics. ☐

D. As a tool to structure lessons according to individuals learning styles. ☐

E. None of the above ☐

13. Indicate which mathematics test(s) you give to learners.

A. Short test: To test basic skills, recall of facts and formulae in mathematics. ☐

B. Longer test: To high-level skills such as transfer retention of fact, the making of connection and problem solving skills ☐

C. Oral test: On specific prepared question to test recall of fact and the ability to communicate mathematical ideas. ☐

14. How do you give mathematics test to children?

A. Completion pairs ☐

B. Answering few question in their journals ☐

C. Allowing learners to answer questions set by peers or group. ☐

D. Following normal or routine test questions. ☐

15. Which of the following aspects of class work / homework do you assess in mathematics?

A. Mathematical Content ☐

B. Mathematical accuracy ☐

C. Problem solving skills in mathematics. ☐

D. Critical thinking skills in mathematics. ☐

E. Clarity and presentation of the written mathematics argument ☐

F. Communication skills in presenting mathematical facts. ☐

G. None of the above ☐

16. Which investigative activities do you give to learners?

A. Structured tasks: Where learners solve different mathematics problems. ☐

B. Open-ended tasks. ☐

17. When assessing learners' investigation task, which of the following do you assess?

A. Knowledge and skills. ☐

B. Understanding of mathematics concepts. ☐

C. Application of mathematics concepts and learner's creativity. ☐

D. Methods used and application of solution ☐

18. What do you focus on when you give learners projects to do?

A. Application of mathematics learned in class to real-life situations. ☐

B. The study of the history of mathematics topics. ☐

C. Study of the people and cultures involved in the development of mathematics. ☐

19. Which role(s) do you play when you give learners projects to do in mathematics?

A. Assist learners in developing skills necessary in producing good mathematical project. ☐

B. Guide learners on how to plan a mathematics project. ☐

C. Guide learners on where to find the necessary information. ☐

D. Guide learners on how to conduct interviews. ☐

E. Guide learners on how to acknowledge sources used. ☐

F. Guide learners on how to make presentations of mathematical projects. ☐

20. Do you encourage learners to keep portfolios in the learning of mathematics?

A. Yes ☐

B. No ☐

21. How do you think learners can use portfolios in learning mathematics?

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22. Give a brief comment on how you assess learners' mathematics portfolios.

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23. Which of the following do you consider to improve your knowledge in mathematics?

A. More in-service training on assessment in mathematics ☐

B. Enrol at higher institution to further study mathematics education. ☐

C. Become a member of mathematics education society or club. ☐

D. You are satisfied with your current experience and qualification in mathematics. ☐

24. Identify problems you encounter when assessing learners on mathematics.

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25. What do you think should be done to overcome the problems identified in 25 above?

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APPENDIX 4

Interview Schedule for Educators

1. How do you find assessment of learners' mathematics work as envisaged by OBE and C2005?
2. In your opinion, do you think learners should assess themselves in mathematics?
3. For what purposes do you use formative assessment in mathematics?
4. Baseline assessment is encouraged by OBE and C2005. How do you use baseline assessment in mathematics?
5. Do your learners keep mathematics portfolios?
6. How do learners keep mathematics portfolios?
7. What do you think the advantages of mathematics assessment as envisaged by OBE and C2005 are?
8. Which skills do you often assess in mathematics tests, class work and homework?
9. Which specific skills do you want your learners to work on in mathematics projects?
10. Which investigative mathematics activities do you give to learners?
11. What are the challenges you encounter when assessing learners' mathematics work?
12. What do you think could be done to overcome such challenges?
13. Which specific areas should be addressed at an in-service workshop on mathematics?

APPENDIX 5

INTERVIEW TRANSCRIPTS

1. FIRST INTERVIEW

TRANSCRIPT	NOTES
1.1 **Interviewer**: Good morning **Interviewee**: Good morning, Sir	An attempt to establish a relaxed atmosphere through salutation.
1.2 **Interviewer**: I would like to ask you few questions about assessment in mathematics. I would therefore be happy if you can relax and take this conversation as an information sharing session. **Interviewee**: Thank you sir. I would do my best to relax.	Giggle
1.3 **Interviewer**: Now tell me, how do you find assessment of learners' mathematics work as envisaged by OBE and C2005? **Interviewee**: It is good because it is based on what a learner does throughout the year, not only on final examination and on tests.	Correct answer based on knowledge of assessment in mathematics.
1.4 **Interviewer**: So, do you think learners should assess themselves in mathematics? **Interviewee**: Yes, because self assessment help learners to reflect on their approaches in solving problems in mathematics	

1.5 **Interviewer**: For what purposes do you use formative assessment in mathematics? **Interviewee**: Well, I use formative assessment to check progress and problems learners might encounter during the lesson or during the learning of mathematics.	Correct answer
1.6 **Interviewer**: Baseline assessment is encouraged by OBE and C2005. How do you use baseline assessment in mathematics? **Interviewee**: I use baseline assessment to identify gaps that might exist between what learners already know on a specific topic and what learners are expected to know.	Correct answer on the use of baseline assessment in mathematics.
1.7 **Interviewer**: Do your learners keep mathematics portfolios? **Interviewee**: Yes, they do.	This is one of the expectations of OBE and C2005
1.8 **Interviewer**: How do your learners keep mathematics portfolios? **Interviewee**: As per dictates of the Department of Education	Not clear in terms of specifics.
1.9 **Interviewer**: What do you think the advantages of mathematics assessment as envisaged by OBE and C2005 are? **Interviewee**: Different forms of assessment are used to assess learners in mathematics. Learners' strengths and weaknesses can be identified and remedial action can be taken to help learners to achieve outcomes.	There is an understanding on assessment in mathematics.

1.10	**Interviewer**: Which skills do you often assess in mathematics tests, class work and homework? **Interviewee**: Primarily I assess problem solving skill	Lack of understanding on different skills, which can be assessed.
1.11	**Interviewer**: When giving learners mathematics projects, which specific skills do you want your learners to work on? **Interviewee**: I also want learners to work on problem solving	Lack of understanding on different skills, which can be assessed.
1.12	**Interviewer**: Which investigative mathematics activities do you give to learners? **Interviewee**: theorems in geometry where learners discover how geometric theorems were discovered	This is correct. Though it did not indicate how the activity was to be given.
1.13	**Interviewer**: What are the challenges you encounter when assessing learners' mathematics work? **Interviewee**: well, I realized that learners learners find it difficult to comprehend mathematical concepts	Honest opinion
1.14	**Interviewer**: What do you think could be done to overcome such challenges? **Interviewee**: The Department of Education should focus on the teaching of mathematics in primary schools to ensure that learners are well grounded in mathematics.	Good point

1.15	**Interviewer**: If you were to attend an in-service training workshop in mathematics, which specific areas should be addressed? **Interviewee**: I would prefer it if the workshop an be organized on How to design a rubric	
1.16	**Interviewer:** Thank you very much for your time and your inputs, Sir. **Interviewee:** Thank you.	

APPENDIX 6

2. SECOND INTERVIEW

TRANSCRIPT	NOTES
2.1 Interviewer: Good morning **Interviewee**: Good morning, Madam	Salutation. An attempt to establish a relaxed atmosphere.
2.2 Interviewer: I would like to ask you few questions about assessment in mathematics. I would therefore appreciate if you can relax and take this conversation as an information sharing session. **Interviewee**: Ok. I will try my best.	Indication of the willingness to respond to questions
2.3 Interviewer: Now tell me, how do you find assessment of learners' mathematics work as envisaged by OBE and C2005? **Interviewee**: as opposed to assessment before OBE, it is fine. This is because it is open and learners attempt task knowing exactly what they will be assessed on.	This is an indication that she has an understanding of how assessment in mathematics is carried out.
2.4 Interviewer: So, do you think learners should assess themselves in mathematics? **Interviewee**: Yes, because self assessment help learners to identify their mistakes in solving problems and to improve on those mistakes.	Positive response

2.5 Interviewer: For what purposes do you use formative assessment in mathematics? **Interviewee**: To identify learners' strengths and weaknesses so that I can review my teaching methods so as to encourage effective learning of mathematics.	This is one reason for using formative assessment.
2.6 Interviewer: Baseline assessment is encouraged by OBE and C2005. How do you use baseline assessment in mathematics? **Interviewee**: Well, m... I use baseline assessment almost everyday during my lessons	Not sure about what baseline assessment is
2.7 Interviewer: Do your learners keep mathematics portfolios? **Interviewee**: Yes.	This is one the expectations of OBE and C2005
2.8 Interviewer: How do your learners keep mathematics portfolios? **Interviewee**: Well, their portfolio is divided into Class work or homework section, tests or examination section, assignments section, projects sections and investigation section. Each portfolio has a table of contents, which clearly indicate what is inside each portfolio.	Clear in terms of specifics.
2.9 Interviewer: What do you think the advantages of mathematics assessment as envisaged by OBE and C2005 are? **Interviewee**: I think of the of the advantages of assessment as envisaged by OBE and C2005 is to identify learning problems and to effect relevant remedial work so as to help learners in achieving specific outcomes.	There is an understanding on assessment in mathematics.

2.10	**Interviewer**: Which skills do you often assess in mathematics tests, class work and homework? **Interviewee**: I normally look at steps learners use in solving problems.	There is no diversity on what is assessed.
2.11	**Interviewer**: When giving learners mathematics projects, which specific skills do you want your learners to work on? **Interviewee**: I specifically centre projects on problem solving.	No indication of knowledge of different skills assessed in mathematics projects.
2.12	**Interviewer**: Which investigative mathematics activities do you give to learners? **Interviewee**: I give learners projects like discovering that $r^2 = x^2 + y^2$ as in the theorem of Pythagoras.	Good.
2.13	**Interviewer**: What are the challenges you encounter when assessing learners' mathematics work? **Interviewee**: Our classes are overcrowded. Sometimes you find it difficult to attend to some groups in class. Secondly, I have many periods to teach everyday and I find it difficult to assess learners as expected.	There is however an attempt to assess learners' work.
2.14	**Interviewer**: What do you think could be done to overcome such challenges? **Interviewee**: The Department of Education should hire more educators. The policy on workload on educators should be revised so that we can assess learners' work with ease.	Good point

2.15	**Interviewer**: If you were to attend an in-service training workshop in mathematics, which specific areas should be addressed? **Interviewee**: I think I need to learn more on which investigative work to give to learners.	Areas of need identified
2.16	**Interviewer:** Thank you very much for your time, Madam. **Interviewee:** It is my pleasure.	

APPENDIX 7

3. THIRD INTERVIEW

TRANSCRIPT	NOTES
3.1 Interviewer: Good morning, Madam **Interviewee**: Good morning, Sir	An attempt to establish a relaxed atmosphere through salutation.
3.2 Interviewer: I would like to ask you few questions about assessment in mathematics. I would therefore be happy if you can relax and take this conversation as an information sharing session. **Interviewee**: I will try my best to answer your questions.	Displaying a smiling face
3.3 Interviewer: Now tell me, how do you find assessment of learners' mathematics work as envisaged by OBE and C2005? **Interviewee**: It is time consuming and it involves a lot of paper work of which I do not have time for.	Critical response which is negative.
3.4 Interviewer: So, do you think learners should assess themselves in mathematics? **Interviewee**: Like I said, I find this self assessment to be a waste of time. I prefer to teach learners mathematics instead of wasting time with this self-assessment. This is because I realized that learners are not honest in assessing their work.	Negative response which is not in line with the dictates of OBE and C2005.

3.5 Interviewer: For what purposes do you use formative assessment in mathematics? **Interviewee**: I use formative assessment during my lessons to establish whether learners follow the lesson. If they do not follow, then I try to establish where the problem might be so that I can help learners to understand concepts as I present.	Good response
3.6 Interviewer: Baseline assessment is encouraged by OBE and C2005. How do you use baseline assessment in mathematics? **Interviewee**: baseline assessment is used at the beginning of the lesson to establish what learners know so that such knowledge can be linked with what they are to learn.	Correct answer on the use of baseline assessment in mathematics.
3.7 Interviewer: Do your learners keep mathematics portfolios? **Interviewee**: Yes, they do.	This is one the expectations of OBE and C2005
3.8 Interviewer: How do your learners keep mathematics portfolios? **Interviewee**: Well, I ensure that I follow the instruction as indicated in the assessment guidelines from the Department of Education	Not clear in terms of specifics.
3.9 Interviewer: What do you think the advantages of mathematics assessment as envisaged by OBE and C2005 are? **Interviewee**: all I can say is that I see learners passing on to the next grade because of group activities and so on. What I am worried about is that they do not have basics of mathematics.	Critical response.

3.10	**Interviewer**: Which skills do you often assess in mathematics tests, class work and homework? **Interviewee**: The ability to solve problems. That is the ability of learners to follow the correct procedures in solving problems.	Lack of understanding on different skills which can be assessed.
3.11	**Interviewer**: When giving learners mathematics projects, which specific skills do you want your learners to work on? **Interviewee**: it is difficult to respond to that question since I find it difficult to identify projects to work on. In short, I don't give learners projects.	Does not know which mathematics projects to give learners to work on. (Negative response)
3.12	**Interviewer**: Which investigative mathematics activities do you give to learners? **Interviewee**: I also find it difficult to give learners' investigative activities. This is because there are basically no resources for such.	Does not give learners investigative activities. (Negative response)
3.13	**Interviewer**: What are the challenges you encounter when assessing learners' mathematics work? **Interviewee**: Overcrowded classes, lack of resources, too much paper work for learners assessment.	No indications of how do mentioned factors have bearing on assessment of learners' mathematics work.

3.14	**Interviewer**: What do you think could be done to overcome such challenges? **Interviewee**: The Department of Education should increase number of teachers to ease our workload. Schools should be well resourced to enable us to assess learners effectively. Paper work should be reduced in mathematics assessment, it is too much.	Possible suggestions given
3.15	**Interviewer**: If you were to attend an in-service training workshop in mathematics, which specific areas should be addressed? **Interviewee**: I would prefer it if the workshop can be organized on How to design a rubric	Area of concern identified
3.16	**Interviewer:** It has been a pleasure interviewing you. Thank you. **Interviewee:** Thank you	

APPENDIX 8

4. FOURTH INTERVIEW

TRANSCRIPT	NOTES
4.1 Interviewer: Good morning, Madam **Interviewee**: Good morning	An attempt to establish a relaxed atmosphere through salutation.
4.2 Interviewer: I would like to ask you few questions about assessment in mathematics. I would appreciate if you can relax and please take this interview as information sharing session. **Interviewee**: Thank you.	Smiling
4.3 Interviewer: How do you find assessment of learners' mathematics work as envisaged by OBE and C2005? **Interviewee**: To be honest with you I try to assess learners' class work and homework. I believe that I have to assess learners.	Seem not to be adhering to the dictates of OBE and C2005.
4.4 Interviewer: Do you think learners should assess themselves in mathematics? **Interviewee**: No. that is basically a waste of time especially if you have cover a wide scope of work	No indication about how self-assessment wastes time.
4.5 Interviewer: For what purposes do you use formative assessment in mathematics? **Interviewee**: to diagnose learning difficulties learners might experience so that I can recommend them for remedial work.	At least formative assessment is employed.

4.6 Interviewer: Baseline assessment is encouraged by OBE and C2005. How do you use baseline assessment in mathematics? **Interviewee**: I do not know what you are talking about. I am not even sure whether I use it.	Not sure.
4.7 Interviewer: Do your learners keep mathematics portfolios? **Interviewee**: Yes.	This is one the expectations of OBE and C2005
4.8 Interviewer: How do your learners keep mathematics portfolios? **Interviewee**: Well, I follow guidelines as given by the Department of Education.	Not clear in terms of specifics.
4.9 Interviewer: What do you think the advantages of mathematics assessment as envisaged by OBE and C2005 are? **Interviewee**: All that I see is that teacher have been given more work to do. Otherwise, we are not secretaries. We have been hired to teach.	Critical about assessment as envisaged by OBE and C2005.
4.10 Interviewer: Which skills do you often assess in mathematics tests, class work and homework? **Interviewee**: Problem-solving. I believe this skill is the moist important one in mathematics learning.	Only problem solving skill is recognized.
4.11 Interviewer: When giving learners mathematics projects, which specific skills do you want your learners to work on? **Interviewee**: I do not give learners projects.	Contradiction to response on 5.8 above.

4.12	**Interviewer**: Which investigative mathematics activities do you give to learners? **Interviewee**: I also do not give learners investigative activities.	Contradiction to response on item 4.8
4.13	**Interviewer**: What are the challenges you encounter when assessing learners' mathematics work? **Interviewee**: learners are lazy to do their work. When given homework they come to school not having completed.	Area of need identified.
4.14	**Interviewer**: What do you think could be done to overcome such challenges? **Interviewee**: Parents must help us. They must ensure that their children do given mathematics work.	Workshop identified to address his challenge in mathematics assessment.
4.15	**Interviewer**: If you were to attend an in-service training workshop in mathematics, which specific areas should be addressed? **Interviewee**: Well, I want them to teach us on how to assess learners, specially if you have many children in class as in my case.	
4.16	**Interviewer:** Thank you , Madam **Interviewee:** Thank you.	

APPENDIX 9

5. FIFTH INTERVIEW

TRANSCRIPT	NOTES
5.1 Interviewer: Good morning, Madam **Interviewee**: Good morning, Sir	An attempt to establish a relaxed atmosphere through salutation.
5.2 Interviewer: I would like to ask you few questions about assessment in mathematics. I would therefore be happy if you can relax and take this conversation as an information sharing session. **Interviewee**: Ok	Displaying a smiling face
5.3 Interviewer: Now tell me, how do you find assessment of learners' mathematics work as envisaged by OBE and C2005? **Interviewee**: To be honest, in paper it is the best we ever had, but in practice it is not simple to implement.	Though no indication about problems of implementing, a positive response.
5.4 Interviewer: So, do you think learners should assess themselves in mathematics? **Interviewee**: Yes, perhaps learners will become much responsible for their learning.	Positive
5.5 Interviewer: For what purposes do you use formative assessment in mathematics? **Interviewee**: To ensure that learners are on the right path in achieving specific outcomes.	Shows understanding.

5.6 Interviewer: Baseline assessment is encouraged by OBE and C2005. How do you use baseline assessment in mathematics? **Interviewee**: To test pre-knowledge	Economic with words
5.7 Interviewer: Do your learners keep mathematics portfolios? **Interviewee**: Yes.	This is one the expectations of OBE and C2005
5.8 Interviewer: How do your learners keep mathematics portfolios? **Interviewee**: The Department of Education has issued out guidelines. I follow those guidelines	Not clear in terms of specifics.
5.9 Interviewer: What do you think the advantages of mathematics assessment as envisaged by OBE and C2005 are? **Interviewee**: Learners should be assessed on everything they do in class.	Shows some understanding of assessment.
5.10 Interviewer: Which skills do you often assess in mathematics tests, class work and homework? **Interviewee**: Problem solving and the ability to write mathematics arguments	Some knowledge on skills associated with projects.
5.11 Interviewer: When giving learners mathematics projects, which specific skills do you want your learners to work on? **Interviewee**: Oral presentation, problem solving and the correct use of different mathematical operations.	Some knowledge on skills associated with projects.
5.12 Interviewer: Which investigative mathematics activities do you give to learners? **Interviewee**: Creativity, clarity of expression, and presentation skill.	Some knowledge on skills associated with projects.

5.13	**Interviewer**: What are the challenges you encounter when assessing learners' mathematics work? **Interviewee**: Learners lack basic of mathematics, overcrowded classrooms, lack of parental help when learners are given homework.	No indication of how the do mentioned factors have bearing on assessment.
5.14	**Interviewer**: What do you think could be done to overcome such challenges? **Interviewee**: Proper monitoring of mathematics teachers in primary schools, parents should ensure that they help their children;.	Opinions
5.15	**Interviewer**: If you were to attend an in-service training workshop in mathematics, which specific areas should be addressed? **Interviewee**: Making rubrics, assessing attitude and value.	Areas of need identified.
5.16	**Interviewer:** Thank you for your time **Interviewee:** Thank you.	