GUIDELINES
FOR THE EDUCATIONAL PSYCHOLOGIST
IN THE ASSESSMENT OF
MATHEMATICS IN THE FOUNDATION PHASE

by

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The aim of this study was to investigate guidelines for the educational psychologist in the assessment of foundation phase mathematics. The investigation takes place in the light of Outcomes-based education, which is a new practice of education in South Africa, within the paradigm of post-modernism. Outcomes-based education framed within the National Curriculum Statement, has necessitated far-reaching changes in education and assessment alike. Educational psychology has not been untouched and the field has had to re-look its approach to assessment. Therefore, it has been necessary for educational psychologists in South Africa to develop an approach to the assessment of foundation phase mathematics that will yield credible information in order to support the learner in the best way possible.

Educational psychologists have tended to use standardised mathematics tests and IQ tests exclusively when assessing foundation phase learners in mathematics. But, the emphasis of an educational psychological assessment is moving from, not only discovering the learner’s IQ score and the grade or age level that they function at mathematically but also, to question ‘why’ the specific learner is not making progress, ‘what’ the learner can or can’t do, and from the teacher’s point of view, ‘how’ the child can best be helped. This can be achieved by making use of the curriculum as the starting point for the assessment and then assessing each task using an approach which encompasses a dynamic and asset-based approach, where the assessor seeks to understand the learner’s areas of personal strength and assets in mathematics.

A qualitative interpretivistic design was used in this study. The research methods employed were a literature search of existing literature including mathematics documents, a focus-group interview with foundation teachers from a local primary school, an interview with a lecturer of educational psychological assessment and an incomplete-sentences questionnaire completed by second year masters’ degree students in the educational psychology programme—both at the University of Johannesburg.
A content analysis of two documents— the National Curriculum Statement (NCS) (2002) and the Principles and Standards for School Mathematics (2000), an American mathematics curriculum— revealed that the NCS (2002) seems to be based, because of the similarities and at times the exactness of content, on the Principles and Standards for School Mathematics (2000). The value of the process undertaken was that both the documents provide insight into how curriculum-based assessment could be carried out.

The constant comparative method of analysis was used to analyse the focus group interview, the individual interview and the incomplete questionnaires. The findings confirm that the changes in education have impacted on educational psychologists’ ‘medical model’ approach to assessment and on the way in which they have been used to working. Educational psychologists’ when carrying out an assessment should aim to ascertain how much an individual has learnt and whether support for learning is required. They should use a variety of assessment tools which should result in a comprehensive understanding of the learner resulting in feedback and a report that is meaningful to teachers and parents.
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CHAPTER ONE

CONTEXTUALISATION AND ORIENTATION

OF THIS STUDY

1.1 INTRODUCTION

This introductory chapter presents, firstly, the background to the study followed by the context and rationale. Thereafter, the research question is formulated and from this the aim of the study derived. This is followed by an explication of relevant terminology. The research design and methods to be used to achieve the set goals will be briefly reviewed. The chapter concludes with a review of the researcher’s personal assumptions and presuppositions and a brief overview of the structure and sequence of the study is given.
1.2 BACKGROUND TO THE STUDY

As the course of human history is followed it can be seen that societies are constantly changing (Lewis, 2004:121). Throughout time philosophers have believed that society moves according to immutable and unchanging laws, and that there is a driving force that drove society onwards (Burke, 2000:1). This has resulted in society undergoing major paradigm shifts. A paradigm, according to Gipps (1994:1) and Lincoln and Guba (2000:157) is a basic set of interrelated concepts and beliefs that guide action. Paradigms provide a framework within which individuals see and understand a particular problem or activity. The paradigm within which people work determines what they look for, the way things seen are construed and how problems are solved, and as such these paradigms are human constructions. The first paradigm shift occurred when humans changed from being nomadic hunters and gatherers to members of societies that were supported by agriculture. The second paradigm is a historical period in Western Culture described as modernity or modernism, characterised by a capitalistic, industrial-based economy that relied on science and technology (Lewis, 2004:121).

Modernism adhered to the world of science, scientific methods and the authority of the expert (Lewis, 2004:121). Psychology as a field, including educational psychology, developed within the paradigm of modernism where the psychologist was considered to be the expert. Jansen (in Eloff & Ebersohn, 2004:381) explains modernism as “an understanding of the world that privileges certainty, order, organisation, prediction, rationality, familiarity, progress, truth and freedom”. Psychological theory was seen to be scientific and because it was scientific it had to be accurate. Therefore, it was considered to be the truth. Modernism used traditional scientific methods to try and establish the truth about human behaviour. This meant that assessment was based on psychometric testing. Psychometric testing was part of the modern era because it favoured displays of knowledge and skills that were easily quantifiable, emphasised the individual and individual performance and led to comparisons between individuals, and therefore a culture of ranking (Lubbe & Eloff, 2003:81; Lubbe, 2004:319). Assessment results were thus seen to be absolute and true. The expert role assumed by the assessor extended to the authoritative style of imparting the findings and making recommendations which created
the disempowering perception that the learner and other parties were dependent on the specialist for guidance, decisions and actions (Bouwer, 2005:47).

Then, disenchantment with modernism set in and society began moving into the new paradigm namely, postmodernity. The period that marked the modern/postmodern turn was characterised by demands for revision and re-conceptualisation everywhere, as well as the deconstruction and demystification of scientific knowledge. There was the rise of alternative schooling, of woman demanding a place in the history of Western culture, of Africans demanding not simply equality but the right and power to be leaders (Longstreet, 2003:11). According to Lewis (2004:121), the postmodern period was marked by an upheaval in the ways important knowledge was conceived. There was a shift away from the dominance of scientific knowledge controlled largely by military, governmental and industrial communities. One of the many consequences of this shift was a worldwide shift in educational assessment. As a result then, South Africa too reviewed its curriculum- and assessment policy. This obviously also impacted on psychological assessment.

The shift to postmodernism has had a significant affect on psychological assessment. The emphasis has moved to collaboration, the broader ecosystem, and the dynamic nature of human learning (Lubbe, 2004:323). Postmodernism gives value to varied meanings, not only to the single authoritative voice of the scientist (Jansen in Eloff et al., 2004:382). The learner and relevant others participate in the assessment process, interpret their needs and map out an action plan for themselves. In this way the traditional assessment procedure is adapted to include parents and other significant people in the decision-making process also known as an asset-based approach to assessment, which will be discussed in more detail later in the study (Lubbe, 2004:323). This then leads into the reasons for conducting this research.

1.3 CONTEXT AND RATIONALE OF THE STUDY

The context of this study is the educational psychological mathematics assessment of foundation phase learners within outcomes-based education. I have chosen assessment of
mathematics in the foundation phase as the scope of this study as I believe, that if the correct ‘foundations’ are laid when learners are young i.e. between the ages of 5-8 years, the process of attaining mathematical knowledge should be smoother as they get older. Dednam (2005:202) substantiates this opinion by stating that many learners’ difficulties start in their first year at school (this is not to say that learners may not develop barriers at a later stage).

Mathematics learning and teaching at present takes place within outcomes-based education which is a new practice of education, framed within the National Curriculum Statement (NCS)(Department of Education, 2002), and this is the context that educational psychologists need to work within. The NCS is used because, later on, I make the recommendation that educational psychologists use the Curriculum to compile a curriculum-based mathematics assessment in conjunction with other assessment tools. I would also like to mention that at the onset of the research the new curriculum was referred to as the Revised National Curriculum Statement (RNCS) and has subsequently been changed in 2006, to the National Curriculum Statement. The NCS is read as part of the RNCS.

It is my argument that the practice of Educational Psychology should encompass the postmodern paradigm and it follows that our approach to assessment in general, and of mathematics in particular, will have to be in keeping with the philosophy of the postmodern paradigm. This means that the role of the educational psychologist should be changing too. In order to understand these changing roles it is relevant to discuss how educational psychologists, trained in the modern paradigm before the introduction of the (RNCS) in South African schools, approached an educational assessment, and specifically a mathematical assessment as part of the scholastic assessment.

The assessment of individual children has always formed a significant part of the work of educational psychologists (Freeman & Miller, 2001:3). Thus, in their training educational psychologists have been almost exclusively taught to use standardised instruments to test persons for a variety of reasons (Foxcroft & Roodt, 2004:109-110). One such reason was
to investigate why a learner might be underachieving at school. During such an assessment, an intellectual test was often done, followed by a variety of scholastic tests in which a mathematical test would usually be included. (See Appendix 6, Table 1 where some examples of mathematical tests, often used by the educational psychologist, are given.) These tests are based on the traditional psychometric testing model (Gipps, 1994:5) where interpretation of scores is done in relation to norms. Norm-referencing tests a learner’s performance in relation to that of his/her peers, they provide ‘standardised’ comparisons of individuals in terms of ‘normal’ expectations of achievement, and they compare how the learner is performing compared to other learners. The ‘norm’ will be the score achieved by half of the population (Gipps, 1994:5, Weeden, Winter & Broadfoot, 2002:141).

These standardised tests are however not normed for South Africans and are thus not reliable for the South African population (Huysamen, 2002:32). When presenting the results of the IQ and mathematics tests in a written report, educational psychologists tended to indicate current achievement only. Woods (in Elliot 2000:59) raises concerns that an educational psychologist’s report tends to be very descriptive with little insight into or diagnosis of children’s difficulty with learning, and he subsequently questions the value of such reports. According to Elliot (2000:60), it would appear then that many educational psychologists place an over-emphasis on describing curricular difficulties but not the reasons underpinning them. They tend to offer proposals for general action rather than provide guidance on how to engage the learner in more meaningful and productive learning.

It is my observation that educational psychologists are continuing to carry out and report on mathematical assessments where the test result gives an indication of the mathematical level that the learner is performing at, but does not indicate why the learner is underperforming in mathematics. Elliot (2000:59) reminds practicing educational psychologists that for many teachers a skilled assessment by an educational psychologist offers the promise of a more detailed understanding of the learner’s strengths and weaknesses that can serve as a basis for subsequent intervention. I, however, from my
own experience, believe that this is not happening with regard to the assessment of foundation phase mathematics.

My proposal therefore is that the educational psychologist needs to examine how the learner approaches the task and attains the final answer. In order to do this, levels and complexity of understanding, rather than only recognition and recall of facts should be assessed. For example, instead of marking the learner’s answer as either correct or incorrect and to work out an age equivalent or standardised score based on the number of correct items, rather assess how the learner addressed the problem and then arrived at the answer. Recognition and recall of facts is only one aspect of the learning process — that of memorisation — and although it has its place there are many more facets making up the learning process (Combrinck, 2003:59; Gipps, 1994:22; Van der Horst & McDonald, 1997:188).

In the light of the above discussion I argue that the role of the educational psychologist needs to be re-assessed in using standardised mathematics tests and an IQ test exclusively when assessing foundation phase learners in mathematics. Fortunately educational psychology has, and is, reviewing its role in the era of OBE and continuous assessment, both locally and internationally. Woolfson, Whaling, Stewart and Monsen (2003:284) indicate that in this twenty-first century, educational psychologists need to work in ways that promote accountability and transparency of procedures. Professional advice and judgements are no longer taken at face value and educational psychologists must be able to justify the decisions and recommendations to parents/care givers and schools.

Elliot (2000:61) suggests that because teachers have become increasingly skilled at curriculum-based assessment, the nature of the unique contribution of the educational psychologist in undertaking assessment has been highlighted. The emphasis of an educational psychological assessment has shifted from not only discovering the learner’s IQ score and the grade or age level that they function at mathematically but instead, to question ‘why’ the specific learner is not making progress, ‘what’ the learner can or can’t do, and from the teacher’s point of view, ‘how’ the child can best be helped.
It is the researcher’s opinion that these questions can be answered if educational psychologists approach the assessment of foundation phase mathematics by making use of the curriculum as the starting point for the assessment and then assessing each task in a performance-based way. The concept of ‘performance-based assessment’ aims to capture in the test task the same demands for critical thinking and knowledge integration as is required when completing the task in the classroom in this case mathematics being the task (Department of Education, 2002:5; Gipps, 1994:11-12). While carrying out a performance-based assessment, the principles of dynamic assessment and an asset-based approach to assessment could be used. The asset-based approach is an effective assessment for learning support because not only is the learner assessed, but also collaboration with other important role players in the learner’s life-world is sought.

As a result the assessor seeks to understand the learner’s areas of personal strength and assets in mathematics, that together with dynamic assessment practices could effectively change the very acts of assessment into the first steps of learning support in mathematics (Bouwer, 2005:51). Thus, mathematical assessment would consequently be more accountable, authentic and meaningful, in terms of learning support and intervention. Both dynamic assessment and the asset-based approach to assessment of mathematics in the foundation phase will be discussed in more detail in Chapter Two.

1.4 PROBLEM STATEMENT AND RESEARCH QUESTION

Taking the above into consideration, I believe it would be of value to develop guidelines for the assessment of mathematics for educational psychologists using the National Curriculum Statement for Mathematics as the framework.

The research question can be formulated as follows:

What guidelines should the educational psychologist consider in the assessment of mathematics in the foundation phase, in the light of the revised curriculum?
1.5 THE AIM OF THE STUDY

It is the aim of this study to suggest guidelines for the educational psychologist in the assessment of mathematics in the foundation phase. One of the reasons is that there is a gap in the literature on how an educational psychologist could assess mathematics within the new paradigm of assessment without relying solely on a standardised test. The contribution that this study could make is to create awareness for educational psychologists regarding assessment within the postmodern paradigm. By following the proposed guidelines, I believe that a more in-depth approach to mathematical assessment in the foundation phase can be carried out. I further believe that the educational psychologist would have more information in order to provide guidelines to parents, teachers and learner support specialists so as to facilitate the learning process of the learners. This would ensure that the learner gets the support and mediation that will enable him/her to continue with the learning process.

After submitting the problem statement and aim of this mini-dissertation it is important to consider the definitions of some important concepts used throughout this study.

1.6 DEFINITION OF CENTRAL CONCEPTS

The following are the definitions of some key concepts that are used during this study. These definitions are presented in order to ensure that the reader of this study has the same understanding of concepts as the author.

Assessment

Assessment is the process of identifying, gathering and interpreting information for purposes of making decisions about educational policy, about curriculum and educational programmes or about individual learners’ learning (Department of Education, 2002:101; Nitko, 1995:3). Assessment traditionally has been concerned mainly with knowledge and techniques. It now includes looking at the processes, problem-solving strategies and creativity of the learner (Donald, Lazarus & Lolwana, 2002:117-118).
**Educational psychological assessment**

An educational psychological assessment is carried out in order to gain some understanding of the learner so as to make informed decisions. The purposes of assessment include screening, problem solving, diagnosis, counseling and rehabilitation and progress evaluation (Sattler, 2002:3). However, the changing trends in assessment have not left educational psychological assessment untouched. According to Lubbe and Eloff (2003:82-83) there are three major trends that influence educational psychological assessment:

“The trend away from the deficit paradigm in psychology towards a more asset based capacity focused paradigm. The trend away from isolated psychometric testing towards a more dynamic assessment culture in educational psychology. The trend in education that moves evaluation and assessment towards the centre of change processes increases collaboration and participation, systemic evaluation and coherence- making strategies and ownership”.

**Mathematics**

Mathematics is an ordered field of knowledge with many branches such as arithmetic, algebra, geometry, trigonometry, statistics and analysis that are all related and dependent on each other (Van Wyk, 1991:98). It is a *universal language* that uses carefully defined terms and symbols that enable human beings to think about, record, and communicate ideas concerning the elements and the relationship of quantity. The term mathematics encompasses more than the term arithmetic (Lerner 2003:430; Department of Education 2002:4).

**Learner**

This term refers to all learners, ranging from early childhood education through to adult education. The term ‘learners’ therefore replaces the term ‘pupil’ or ‘students’ at school and higher education levels (Department of Education, 1997e:44). In this study I will focus on learners in the foundation phase.
**Foundation phase**

The foundation phase is part of the early childhood development (EDC) phase, which applies to the processes by which children from birth to at least 9 years grow and thrive physically, mentally, emotionally, spiritually, morally and socially. The foundation phase, Grades 1-3 forms, the first part of the General Education and Training band of the National Qualification Framework, which is a nine-year long compulsory-schooling band (Department of Education, 1997a:31).

**Curriculum 2005**

Van Der Horst and McDonald (1997:5), Geyser (2000:22-23) and the Department of Education (2000:18-19) indicate that Curriculum 2005 is South Africa’s new national curriculum for the 21st century characterised by the outcomes-based philosophy of education. The principles of Curriculum 2005 are to develop learners’ critical thinking powers and their problem-solving abilities. The NCS will shift from a content-based curriculum to a curriculum which is based on outcomes.

**Outcomes-based education (OBE)**

Outcomes-based education is a design for education which is learner-centered and oriented towards successes or outcomes. It is based on the belief that all individuals can learn. In OBE the curriculum is designed to promote attitudes, values and skills that are needed by the learner and society. Van Der Horst and McDonald, (1997:6-7) describe Outcomes-based education as an approach which requires educators and learners to focus their attention on the desired results of each learning process, referred to as outcomes, where the learners have to demonstrate that they have attained them, and on the instructive and learning process that will guide the learners to these end results. Outcomes-based education is based on the following beliefs:

- That every learner must be allowed to learn to his or her full potential.
- Success breeds further success. Every success that a learner experiences will build his/her self-esteem and ensure continued motivation to strive for further successes. Positive and constructive ongoing assessment will assist in this regard.
After having defined the most relevant concepts, it is now important to consider the research design and methods as the medium through which this review is presented.

1.7 RESEARCH PARADIGM, DESIGN AND METHODS

1.7.1 Research paradigm

A research paradigm is the broad theoretical framework to which a particular research study belongs (Adams, Collair, Oswald & Perold, 2004:355; Creswell, 1994:4). This study is framed within a postmodern paradigm of social constructivism, because it is concerned with subjective knowledge that has been constructed by humans (Schwandt, 2000:189; Creswell, 2005:8). The researcher believes that the mind is active in the construction of knowledge, that knowledge is not passive but active, and as such the mind is constantly forming abstractions or concepts. Human beings do not find or discover knowledge but rather make or construct it. We do not construct our interpretations in isolation but against a backdrop of shared understandings, practices, language, etc. (Schwandt, 2000:189). Thus, in constructing this study I referred to multiple sources and using those sources constructed my guidelines. Now that the paradigm of this study has been declared it follows that the research design used will be discussed.

1.7.2 Research design

To realise the aim of this study and answer the proposed research question as comprehensively as possible, a qualitative interpretivistic design with a literature review (Mouton, 2004:179-180) was used. Mouton (2001:179-180) and Taylor & Procter (2005:1-3) describe a literature review as a study that provides “an overview of scholarship in a certain discipline, through an analysis of trends and debates”. They continue that it is an account of what has been published on a topic by accredited scholars and researchers. In this case the literature relating to education, assessment and educational psychological mathematics assessment in the modern and postmodern paradigm will be identified. A literature review is a piece of discursive prose and not a list describing or summarising one piece of literature after another. Furthermore, as indicated above, an integration of a qualitative interpretivistic design was used in
conjunction with the literature review (Denzin & Lincoln, 2005:6). This involved the “studied use and collection of a variety of empirical materials” such as interviews and visual texts. Thereafter, interpretive practices were carried out in order to get a better understanding of the subject matter at hand (Denzin & Lincoln, 2005:3-4).

1.7.3 Research methods (data collection)

The research methods focused on the research processes and the kinds of tools or procedures that were used (Mouton, 2004:56). The first tool used is a literature search, which is an essential part of every research project (Hart, 2001:2-3). Once again, I have chosen to use the word literature ‘search’ to refer to studying the existing literature. It is essential because all research needs to take into account previous work in the same area, as value is derived by how much it fits into and expands on previous work (Merriam, 1998:61). Therefore, every research project begins with a search of existing literature and forms an essential component of the study. In this study the aim is to discuss guidelines for the educational psychologist in the assessment of foundation phase mathematics, and therefore, the literature will provide the background and context for the aim as discussed.

In addition, departmental mathematics documents were analysed using content analysis. To ensure access to as much data as possible, “the use of two or more methods of data collection within a single study”, known as triangulation (Leedy, 1997:143), will be adopted as part of the methodology. At this point it is important to mention that triangulation is not a data collection method but is used to ensure trustworthiness. Gay and Airasian (2003:215) state that triangulation is where different data sources confirm one another. Trustworthiness as a result of triangulation, along with ethical conduct of the researcher, will be discussed in more detail in Chapter Three. The other methods or tools used in this study were a focus-group interview with foundation teachers from a local primary school, and an interview with a lecturer of educational psychological assessment the University of Johannesburg. One other tool used was an incomplete-sentences questionnaire completed by second year master’s degree students in the educational psychology programme.
1.7.4 Methods of data analysis

Referring to the literature review, the data from comparing the two policy documents was reduced and analysed using the content analysis where identified data and concepts are determined by their distinctive characteristics so that they can be placed in different and appropriate categories (Gay & Airasian, 2003:233). The constant comparative method of analysis was used to analyse the qualitative data gathered through the interviews and incomplete sentences (Maykut & Morehouse, 1994:126; Dana & Yendol-Silva, 2003:90). Content analysis and the constant comparative method of analysis will be discussed in more detail in Chapter 3.

The interviews were transcribed verbatim and analysed to extract common themes, which then formed the categories into which the data was sorted. The written answers to the incomplete-sentences were analysed by coding units of data into categories and then into themes, which were consolidated and verified in order to determine the internal reliability of the findings. All the data was constantly compared to the existing categories to determine similarities and differences between new and previously obtained information (DuPoy & Gitlin, 1994:143; Dana & Yendol-Silva, 2003:92-93).

The aim of these methods of analysis was to identify patterns so as to provide guidelines for the educational psychologist in the assessment of foundation phase mathematics. Triangulation, together with the declaration of any presuppositions and assumptions by the researcher ensures that this study is trustworthy.

1.8 RESEARCHER’S PRESUPPOSITIONS AND ASSUMPTIONS

Due to the nature of research it is inevitable that my values, beliefs and perspectives will influence what I read and the interpretation thereof. How I view the world will affect the entire research process, from conceptualising the problem, to collecting literature, to interpreting findings. It is therefore necessary to declare any presuppositions and assumptions in order to reduce research bias and ensure reliability and objectivity of the research (Merriam, 1998:54, 205).
As a training educational psychologist I am aware of the importance of using standardised instruments efficiently, and in so doing it is important that the tests are up-to-date and relevant. Unfortunately in my experience assessment measures often take on magical proportions for psychologists who begin to value them above professional judgement or opinion.

It is my view that when it comes to the assessment of foundation-phase mathematics, the role of the educational psychologist is to use more than just standardised measures so that an in-depth and meaningful assessment can take place. The reasons for this view is that I find reading a report from learner support specialists (remedial therapists) and educational psychologists, such as the example below, does not give me much or enough information.

![Example](image)

**Figure 1.2: Example of an excerpt of mathematical assessment results**

The information given above only refers to either the grade level and/or the mathematical age. Readers of reports such as the above do not have insight as to why the learner achieved the above scores. The test is also timed, and the question that needs to be asked in my view, is what is the value of timed tests and what information is gained? When a learner is referred for a full evaluation, the parents and teachers alike know that the learner is struggling in certain areas. They are therefore looking to find the underlying reasons why the learner is not coping.
The above report does however not give any information as to why the learner is not coping, only that he/she is not working to his potential and/or to his/her grade or chronological age level. Thus, there is a need for an approach to the assessment of mathematics in the foundation phase, which looks at more than just the score. I hope therefore, that by providing assessment guidelines, a valid contribution could be made possibly ensuring a more detailed understanding of a learner’s difficulties in mathematics. The information gained from the assessment can be used in order to assist the learner in the best possible way.

At this stage I wish to clarify that I am not against various psychometric testing as such, only against the posture of the results being the authoritative truth (Newmark, 2003:114). According to Engelbrecht, (2001:18), modern knowledge which asserts that scientific knowledge constitutes the only source of correct knowledge about reality, explains why the educational psychologist has operated from the so-called medical deficit approach. This approach involves seeing the professional’s role as the only knowledgeable one when assessing and defining the problems and needs of the clients, in treating them and evaluating the efficiency of support programmes.

It will take courage to move away from the safety and comfort of an ideology based on the assumption that the professional knows best, and adopts an approach that values different kinds of socially constructed knowledge (Engelbrecht, 2001:17-19). Taking cognisance of different kinds of socially constructed knowledge, I argue, could be an approach to the assessment of mathematics in the foundation phase. Such an assessment could include a standardised measure, use of a dynamic and an asset-based approach to the assessment of mathematics, where the educational psychologist remains aware that the framework for the assessment is the Revised National Curriculum for foundation-phase mathematics in South Africa.
1.9 CONCLUSION

Chapter One provides the reader with an overview of how the researcher intends to proceed with this study. The background to the research problem was discussed as well as the research problem itself. The research aims, design and the methodology that was used to collect and analyse the data were examined. In addition, key concepts that are important for this study were clarified and finally, the researcher’s personal presuppositions and assumptions were declared. A brief outline of the structure and format of the study is given below. Chapter Two follows with the literature search that forms the theoretical basis for this study.

1.9 COURSE OF THE STUDY

Chapter One: Explains the contextualisation and orientation of the proposed research
Chapter Two: Focuses on the literature search
Chapter Three: Focuses on the research design and methods
Chapter Four: Presents the data analysis
Chapter Five: Provides guidelines, summary and conclusion
CHAPTER TWO

LITERATURE SEARCH

Figure 2.1: Overview of Chapter Two
2.1 INTRODUCTION

It is from a search of the literature that the researcher is able to construct a theoretical framework that captures a particular broad area of interest. This leads the researcher to examine specific ideas, concepts and approaches within the designated area. This chapter then sets out a theoretical analysis of the shift from modernism to postmodernism and the resultant influences on the constructivistic theories of learning, education and assessment, and the assessment practices of the educational psychologist. Thereafter, mathematics as a learning area will be introduced. The definition of mathematics and the five learning outcomes from the National Curriculum Statement for foundation-phase mathematics will be outlined. Finally, the ways in which mathematical literacy is acquired as well as the barriers to learning mathematics in the foundation phase will be discussed.

2.2 THE PARADIGM SHIFT: MODERNISM TO POSTMODERNISM

2.2.1 Modernism described

The modern era began at the end of the 18th century. One of the defining features of this period was that the individual was considered to be more important than the community (Burke, 2000:1). Modernism was a progressive era, especially from an intellectual point of view, which had three main features. These were that there was power of reason over ignorance, of order over disorder and of science over superstition. Modernity centered on rationality that was presumed to create order. It was believed that the creation of more rationality was conducive to creating more order, with the understanding that the more ordered a society was, the more stable it would be and the better it will function (Grassie, 1997:1, Klages, 2003:3).

Reason, science, and technology therefore resulted in the improvement of knowledge, wealth and wellbeing and would therefore bring about better functioning in society (Brosio, 2000:342). The knowledge produced by science was considered to be true and eternal. This knowledge/truth produced by science would subsequently lead towards progress and perfection. This knowledge would include mathematics as it a scientific field based on reason (Jaworski 1994:2-9). Reason was seen to be the ultimate judge of
what was true, right, good, legal and ethical (Klages, 2003:3). These features of modernity were regarded as universal values (Burke, 2000:2), which were typified by logical and rational thought (Lewis, 2004:121).

However, resistance to and scepticism about modern sciences claim to objectivity, rationality, universal validity and certainty began to rise. Disillusionment with the modern notion of progress led to the demise of humanism and its faith in human power and transcendence. This dissatisfaction with and protest against the legacy of the modern era motivated the change towards postmodernism (Maree in Eloff & Ebersohn, 2004:402; Pippin 1991:4).

2.2.2 Postmodernism described

Postmodernism is an important shift in paradigm, which sparked changes, to name a few, in the areas of art, literature, politics, religion, economics, education and assessment (Brosio, 2000:343). Changes in so many areas of our existence have been the consequences of this philosophical shift, and have been subtle, gradual and have occurred over many years (Klages, 2003:4). The changes that postmodernism brought about encompass an acceptance of a variety of approaches of viewing the world, most of them valuing uncertainty, disorder, indeterminacy and integration rather than inevitable progress. During this era value has been given to multiple meanings rather than the single, authoritative voice of the expert/the scientist.

Postmodernists believe in cultural relativity, diversity of knowledge, a variety of possible interpretations of texts and the idea that knowledge is relative in specific contexts (Grassie, 1997:1-8). According to Klages (2003:4) knowledge is considered to be always incomplete and indeterminate and there are no universal standards and criteria to make absolute judgements, only differences and ambiguity, multiple paradigms and conceptual frameworks. Culture and language make up the individual’s symbolic world, who then gives it meaning and sense (Jansen, 2004:382). To the postmodernist, language and discourse constructs the conditions of human existence. Life is built around language, it is not neutral and is transparent where words serve only as representations of thoughts or
things, and thus does not have any function beyond that; (Quigley, 2001:3; Sasso, 2001:3; Scott, 2000:121).

The role of language is crucial to Vygotsky’s theory of social constructivism, which he developed from Piaget’s theory of constructivism. Postmodernists also believe that the philosophy of mathematics education is constructivism, “a mixture of Piagetian stage theory with postmodernist ideology” according to Sasso (2001:13). Children must actively construct their mathematical knowledge (Sasso, 2001:13). Thus, changes in learning theories contributed to the shift from modernism to postmodernism and will be discussed below.

2.3 PARADIGM SHIFT FROM MODERNISM TO POSTMODERNISM - IMPACT ON LEARNING THEORIES

2.3.1 An influential learning theory within modernism

Within modernism, children were viewed as ‘empty vessels’ with the assumption that at birth the mind was like a blank slate and that knowledge was something that came about by induction. The process of learning was that the individual built up a picture of reality in the mind that corresponded with the real world outside (Hobson, 2001:16). Another prominent theory which developed during the era of modernism, developed by Piaget, postulated that children learn and develop according to stages. He believed that knowledge was what one makes up in one’s mind and is not the objective observation of the individual, consequently two individuals can never have the same knowledge (Lerman, 1996:15, 140). Piaget referred to ‘making-up’ knowledge as ‘constructing knowledge’ and is therefore known as a constructivist. Piaget’s theory of learning contributed to the paradigm shift from modernism to post-modernism.

Constructivists ascribed to the philosophy and developmental theory of Piaget (Lerman, 1996:15, 140) in which the primary focus is placed on the individual, which is one of the defining features of modernism. Piaget’s theory which guided mathematics education for many years was based on his theory of learning. Piaget’s work has probably had the greatest single influence on education in general and on mathematics education in
particular. According to the Plowden report in Britain, “Piaget’s explanations appear to most educationalists in this country to fit the observed facts of children’s learning more satisfactorily than any other” (Jaworski, 1994:15). Something to consider for those of us in a third world environment, is that Piaget’s research was focused from a Western perspective. A question could be posed as to whether the educationalists in our country, South Africa, would find the same as the educators in the first world?

Despite a lack of answers to the above question, Piaget’s theory of learning mathematics continues to have a worldwide influence today. In his theory he proposed a four-stage, hierarchical theory of cognitive development as can be seen in Figure 2.2, on page 22, and believed that the child’s mind developed in a series of stages in an upward progression from newborn reflexes to adult abstract reasoning (Staves, 2001:45). Learners in the third, concrete-operational stage, are the focus of my study and therefore I will describe this stage.

**2.3.1.1 The concrete-operational stage**

The concrete-operational stage occurs between the ages of 6 or 7 and 12, where children begin to form mental pictures of objects and to think in terms of the whole rather than the parts. As mental images are moved about in children’s minds they achieve reversibility. In terms of mathematics, children now recognise the relationship between addition as a joining operation and subtraction as a separating operation.

According to Piaget children must internalise these mental operations before they can think logically. It is while children are in this stage that they develop mathematical concepts such as number, length, area, time, mass, and volume. While in both the pre-operational and concrete operational stages children do not have the mental maturity to grasp the mathematical concepts presented by words and symbols alone. They need many experiences with concrete objects and drawings to represent abstract ideas and operations involving those ideas. Children in this stage, become gradually less egocentric and perceptually dominated. An understanding of logical relationships becomes possible. They can conserve, reverse and classify objects (Maree in Eloff & Ebersohn, 2004:399;
Donald et al., 2002:63-64; Smith, 2001:16; Staves, 2001:44; Kennedy & Tipps., 2000:93-95; Louw, 1991:72-78). Piaget believed that children achieved certain skills and concepts at appropriate ages and stages, but how these skills and concepts are acquired are explained by his theory of learning.

**Figure 2.2: An individual’s hierarchical stages of development according to Piaget**

### 2.3.1.2 Piaget’s Theory of Learning

In addition to the fact that Piaget believed that children move through stages, he developed a complicated theory of learning which emphasised that the process of learning is one of continual assimilation, accommodation and equilibration. As learners have new experiences, they actively try to make sense of the new ideas in relation to old ideas and experiences, and in so doing form schemes. Schemes are segments of interrelated ideas in the child’s mind which build complex ‘maps’. Learning is thus seen as the interaction between a child’s existing schemes and new ideas. This interaction between schemas and new ideas involves assimilation and accommodation and equilibration (Eloff & Ebersohn, 2004:399; Donald et al., 2002:63-64; Smith, 2001:16; Kennedy & Tipps, 2000:93-95 and Louw, 1991:72-78).
Therefore, what is important about Piaget’s theory of learning is that children’s intellectual development is very much driven from within the individual, and that children’s capacity for understanding is determined by the ‘cognitive level’ that they have reached as an individual” (Jaworski, 1994:15, Mercer, 1995:72). The child’s activity at any point in time would therefore, be typical of its stage of development. In Piaget’s theory of constructivism the individual is primary, and learns by being active with resources (Lerman, 1994:15), just as foundation-phase learners learn by being active with concrete apparatus.

According to Staves (2001:45) although Piaget in particular, has been criticised, many psychologists have refined his ideas and his framework has provided a good understanding of how children learn. Later studies, again according to Staves (2001:45) have revealed and confirmed, that human cognition does unfold in the sequence that Piaget proposed but have also revealed the beginnings of each type of thinking in children at an earlier stages, recognising a good deal of overlap. This means that progress through the stages evolves and does not occur in large leaps.

Smith (2001:16) agrees that studies have found that many children who have had an extensive pre-school education and parental teaching can perform tasks at earlier ages. I would like to refer to children in the South African context as an illustration, where they are forced through circumstances to also take on adult responsibilities an earlier age. For example, where parents, grandparents or their caregivers die of HIV/AIDS, resulting in child-headed families (Prinsloo, 2005:27). These children need to cope with shopping, use of money, preparing and sharing the food and so forth.

Nevertheless, Piaget’s general conception of learning has much validity for today’s classroom. The strength of the Piagetian approach includes a focus on the child’s thinking, or the process and not just the answer, self initiated active involvement in a rich environment and an avoidance of pushing the child to be adult like and finally viewing the role of teacher as a guide.
Because Piaget’s work presents a learner as an individual rather than as a cultural participant, Smedslund (in Jaworski, 1994:15) argues that Piaget has ignored the social and contextual implications of children’s thinking. Kamii and Ewing (1996:260) agree that mathematics is an inherently social, as well as a cognitive activity. This view then led to a turn away from an individual constructivist perspective to a socio-cultural perspective, a perspective informed by the developmental work of Vygotsky whose theory is considered to be a postmodern one, for the reasons discussed below.

2.3.2 An influential postmodern learning theory of social constructivism

Draper (2002:522) explains social constructivism as a philosophy, or belief, that learners create their own knowledge based on interactions with the environment, including interactions with other people. Social constructivists recognise that experience and environment play a large role in how well the learner learns and that language plays a key role in the acquisition of knowledge. Social constructivism is considered to be a postmodern theory because it is based on knowledge as a social construct, language as a social phenomenon and the individual as the character of the construction (Jansen, 2004:402). Natural development as a result of maturation obviously influences learning whereas cultural development results from the child’s interaction with other members of their culture, which is enhanced through the use of language (Smith, 2001:17).

According to Donald et al., (2002:99), social constructivism is a theoretical perspective that is currently of considerable importance in the entire field of psychology, including educational psychology. It is a move away from modernism, which dominated psychological thinking and research for many years. Instead of the view of human beings being influenced by nature or nurture and that development is something that happens to human beings, constructivism shifts the emphasis to the more active position that human beings are active agents in their own development. Thus, human beings are shaped by both nature and nature but also active in shaping the own development (Donald et al., 2002:99).
As language is the vehicle through which a mathematics assessment will be carried out, and as a tool for learning mathematics, the researcher believes that it is important to discuss Vygotsky’s greatest contribution, that of helping educationists understand how language, thinking and speech develops as a tool of cognitive development. Because language contains many of the cumulative meanings (social constructions) of any community of people, it is a very powerful carrier of values, information, and ways of understanding. Individuals construct knowledge and meaning and whole societies are closely tied to social, historical, and cultural contexts (Donald et al., 2002:70-71).

What is seen as truth in one context may not be seen so in another Minick (in Daniel 1996:33). Burman (in Donald et al., 2002:100) has shown how statements of ‘scientific fact’ in developmental psychology can be questioned as relative to the social and cultural contexts in which they have been constructed. Thus, language is a perfect carrier of understanding and a means for its development (Donald et al., 2002:70-71). An example follows to demonstrate the detrimental effect that forcing a language, which does not belong to a particular culture, can have.

In South Africa, an uprising of black students in the 1976 Soweto riots reminds us that when people have to learn via a language that is not theirs, cultural development and understanding could be affected, resulting in resentment and anger. As a result of our political past and the dominance of two official languages at the time, many South African learners social and cultural development was affected. Later on in this chapter under 2.7.3, a concept referred to as ‘cognitive academic language proficiency’ is discussed which explains in further detail the negative effects that forcing a language which does not belong to a particular culture can have on learning and particularly on learning mathematics.

Because language has a strong influence on the structure of thought and by talking through their actions, learners should be able to put their actions into words. Learners should be allowed to verbalise their ideas in the mathematics class (Mercer, 1995:71).
Murray (1992:3) supports the “view that discourse with peers provides a better support system or vehicle for learning than teacher support.”

An important aspect of Vygotsky’s theory is that of **scaffolding**. He believed that in the early stages of learning children need much support or scaffolding in order to grasp a task. The researcher is of the opinion that by being able to ascertain how much scaffolding a foundation phase learner needs, during a mathematical assessment, should be an important consideration in the final results of the assessment. By scaffolding (supporting), the educational psychologist in this case can help learners to construct their next level of understanding (Smith, 2001:17). These mediations challenge the learner at whatever level he/she is and to develop his/her understanding to more powerful level. In the course of scaffolding the mediator would provide help and suggestions but would gradually withdraw as the learner reaches a level of constructing his/her own internalised understanding (Donald et al., 2002:69-70; Jaworski, 1994:24-25; Kennedy et al., 2000:96, 105).

Another important tenet of Vygotsky’s theory for the educational psychologist to be aware of while assessing mathematics is the zone of proximal development. Learning happens when children are working within their zone of proximal development (ZPD) (Smith, 2001:17). The ZPD is typically thought of as each person’s range of potential for learning, where that learning results in advancement in development, through the assistance of an adult or more capable peer (Smagorinsky, 1995:192,195). Smith (2001:17) describes the ZPD as the zone in which tasks are attempted that the learner cannot yet do alone but will be able to with the help from a significant person. That significant person could be a parent, peer or teacher who activates the learner into thinking in that space (Donald et al., 2002:72). Mediation is to help the process by intervening intentionally but not by directing, and it may involve suggestion but seldom ‘telling’ (Donald et al., 2002:71).
Vygotsky (1978:86) suggests that the zone of proximal development is a clearer indication of the child’s potential than an evaluation of functions that have already matured. The learner, he says, can perform at a developmentally more advanced level when assisted than when acting alone, and this difference in level of performance suggests that a learner has a range of potential, rather than some state of ability (Smagorinsky, 1995:195). The preceding in my view, is an extremely important statement for the educational psychologist. Many of the standardised tests, measures the already matured functions, but by giving the child an opportunity to problem-solve using the concept of the zone of proximal development, the educational psychologist would have a clearer indication of the child’s potential. The concept of the zone of proximal development is an important one for my study as it forms part of the dynamic assessment process as discussed later in the chapter.

The learning theories of Piaget’s constructivism and Vygotsky’s social constructivism have both impacted on education and especially in terms of mathematics, a discussion on how, now follows.

2.4 PARADIGM SHIFT FROM MODERNISM TO POSTMODERNISM – IMPACT ON EDUCATION

2.4.1 Education in the modern era

In the modern era education was seen to be something that all individuals should strive for. Educator’s on the other hand believed that they were scientists and intellectuals who imparted correct knowledge to those individuals who knew less than they did (Brosio, 2000:5-6, 15-17; Pippin, 1991:49-50). Modern education’s methodology was to deposit knowledge in the learners through ‘direct instruction’, the so-called ‘talk and chalk’ approaches, where it was believed that it was necessary to fill up the learners with knowledge (Donald et al., 2002:99).

During the apartheid years in South Africa, the curriculum was National Christian Education and Bantu Education. The latter was based on modernism because rigid boundaries existed between subject areas, and, for the most part knowledge was imposed
on students rather than constructed by students. Schools were a place where a more knowledgeable person transmitted knowledge to those with less knowledge (Lewis, 2004:121). Addler (in Bopape, 2004) in her dealings with ‘white’ South Africans, described them as a group of students who reflected a presentation of Mathematics as “a body of knowledge that must be absorbed: questions and problems have only one answer and the object of the study is to get each answer right …”. Therefore, during the apartheid years, this approach to teaching mathematics was aimed to turn these students into the minority elite that would dominate the running of South Africa (Bopape, 2004:5).

It was during this period, mathematics was taught using direct instruction. The teacher (the expert) introduced the mathematical content of a lesson using exposition and explanation (teacher talk), usually from the front of the classroom (using the writing board and chalk). Pupils were given exercises through which they practised the topics introduced by the teacher. Mathematics was content driven: pupils did exercises, learnt definitions and followed worked examples. Concentration at the elementary level was focused on mechanical arithmetic skills and not for the development of understanding in other areas of mathematics. Children therefore ‘did’ mathematics (Jaworski 1994:2-9). It is the researcher’s understanding that the teacher as the expert taught a scientifically based mathematics programme, teaching and requiring the learners to use certain methods and processes to do the problem. However, it was during the modern period that Piaget's learning theory gained recognition where he believed that children construct their own mathematical knowledge in order to succeed in the learning of mathematics. As mentioned before the development of the constructive approach to learning mathematics was the one of the reasons the paradigm shift occurred.

Educational assessment during the modern era was results oriented (Donald et al., 2002:117) and the results from these many tests and examinations particularly at the end of a term or year, were considered absolute and used as the criteria to make a judgement or decision (Puh, 1997:2), such as passing or failing, streaming, subject choices and career directions. In the traditional school environment, according to Cress (1996:1), the skill of memorisation was the main skill exercised.
In South Africa in the 1960s an educational philosophy of Bantu Education and Christian National Education was applied to respectively educating the nations’ black, coloured and white children. This system of education did not encourage children to develop critical and creative thinking skills – skills which might have empowered the people to challenge the system (Pahad 1997:39). According to Pahad (1997:39), assessment during this time played a very important role in ‘under-educating’ people of colour as it helped in the process of selection. Regular annual examinations were used to ensure a gradual dropout from education and in the end only a small elite survived. Pahad continues that the use of assessment primarily for selection is judgmental, the result of which is that those who failed had no further recourse to higher education leaving them unskilled. Unskilled people, therefore, struggle to find employment, which then leads to poverty and hopelessness.

The paradigm shift from modernism to postmodernism influenced education and assessment practices and will be discussed in the following section.

2.4.2 Education within postmodernism

The change of paradigm and the influence of postmodernism on education in South Africa and the resultant change in the curriculum has been profound. In democratic South Africa an outcome-based curriculum known as Curriculum 2005 is being implemented through the National Curriculum Statement (NCS). Outcomes-based education (OBE) originated from the competence-based movement in education, where the emphasis falls on what learners can do as opposed to what they cannot.

This is in contrast to the teacher-centered, instruction-focused methodology that tended to dominate in most classrooms. The educational reform in South Africa proposed a paradigm shift from a teacher and content-driven curriculum to an Outcomes-based and learner-centered curriculum (Geyser, 2000:22, Department of Education, 2002:1). This is indeed a valuable shift because the accent is on active learning and on encouraging a learner-centered environment (Donald et al., 2002:24).
A postmodern perspective of the curriculum respects the whole and tries not to segment parts of the whole into closed boxes. It is therefore an open system with an integrated content (Lewis, 2004:121). Thus, the Revised National Curriculum Statement (Department of Education, 2002a:2) states that the achievement of an optimal relationship between integration across Learning Areas and conceptual progression from grade to grade are central to this curriculum.

The postmodern curriculum values the process of learning mathematics as much as it values the product. According to the National Council of Teachers of Mathematics (NCTM) simply attaining the correct answer for a mathematical problem is not the entire goal, but the process of working through the problem is also important (Lewis, 2004:122). The foundation for inquiry rests on learners and their questions. The mathematics curriculum is made meaningful when learners systematically investigate the questions they have developed. Lessons may not necessarily end with the right answer; each ending can be a new beginning as the learner extends learning and continues to ask questions (Lewis, 2004:122).

Meaning is therefore constructed by the learner and is affected by the learner’s multifaceted lived experiences, acknowledging Piaget’s and Vygotsky’s theory. The emphasis is on critical thinking and meta-cognition rather than factual knowledge or rote learning of procedures to compute a problem. There is often not one correct way to learn or one correct conclusion to a problem. Learning can proceed through multiple connections; it is the journey and not just the destination that is important (Lewis, 2004:122; Jaworski, 1994:4-5).

Outcomes-based education also ensures that all learners are equipped for lifelong learning (Department of Education, 2002a:8). According to Sarup (in Klages 2003:4) educational policy today puts emphasis on skills and training, rather than on a vague ideal of education in general. The researcher believes that the philosophy of lifelong learning, which is entrenched in outcomes-based education flows from the postmodern outlook that knowledge is incomplete. In a postmodern society knowledge becomes functional,
meaning that things are learnt not to ‘know’ them but to ‘use’ that knowledge and therefore it is characterised by its utility.

In postmodern assessment the Department of Education (2002:2) defines “assessment in Curriculum 2005 as a continuous, planned process of gathering information about the performance of learners measured against the assessment criteria of a learning area outcome. It requires clearly defined criteria and a variety of appropriate strategies for teachers to give constructive feedback to learners and to report to parents, teachers and other interested stakeholders”.

Therefore, Gipps (1994:3), Pahad (1997:39) and Van den Heuvel-Panhuizen & Becker, (2003:698) are of the opinion that the prime purpose of assessment is for learning. It also has a professional purpose and that is to support the teaching as well as the learning process. Assessment should also provide information about barriers to learning and development so as to support learners who may be experiencing learning difficulties.

The purpose of assessment in the postmodern era of education has been briefly discussed, where the most important premise is that it is ‘continuous’ and varied. Other forms of assessment may be used and is no longer only based on tests and examinations. Just as educational assessment was affected in the paradigm shift, so too was educational psychological assessment.

2.5 PARADIGM SHIFT FROM MODERNISM TO POSTMODERNISM - IMPACT ON EDUCATIONAL PSYCHOLOGISTS’ ASSESSMENT PRACTICES

2.5.1 Educational psychological assessment within modernism

Educational psychological assessment was based on psychometrics, which developed alongside the highly acclaimed and accepted procedures of modernist empirical research on the work on intelligence and intelligence testing and that the belief that something, be it intelligence, an aptitude for a particular job or scholarly accomplishment, can be measured. The underlying concept was that intelligence was innate and fixed, in the same
way as other inherited characteristics are for example, skin colour. Since intelligence was considered to be ‘observable’ like other characteristics, it could therefore be measured. On the basis of the outcome individuals could be allocated to streams, ability groups, or schools which were appropriate to their intelligence, or ability, as it came to be seen (Elliott, 2003:15; Gipps, 1994:5; Killen, 2003:2; Murphy, 1999:91).

Assessment results were also completely relied on for placement of learners with learning difficulties in specialised learning environments. These assessment results led to categorisation and labelling referred to as the medical model (Swart & Pettipher, 2005:5). Within this model, learners who struggled were labelled using key concepts associated using the medical deficit model such as pupils with ‘special educational needs’, ‘handicaps’, ‘disability’, ‘defect’, and ‘remedial’, where the problem was seen to be within the child (Swart et al., 2005:1).

Assessment practices flourished as individuals could be assessed via psychometric test batteries, ‘correctly diagnosed’ and given the relevant ‘treatment’. Conventional IQ tests were measures of achievement involving skills that are typically acquired in the home or school. However, research has shown that individuals from ethnic minorities or from socially disadvantaged communities tend to under-perform on such measures because they struggle with items that are unfamiliar and unpractised (Foxcroft, Roodt & Abrahams, 2004:26). Therefore, no test can be either completely unbiased or culture free because people of different cultural groups cannot be validly compared. Language and cultural differences complicate the issue, leading to incorrect diagnoses, placements and misunderstandings (Elliott, 2003:15, Lubbe, 2004:319). The practice of assessment within the modern paradigm reinforced segregation worldwide and especially in apartheid South Africa where it played into political suppression.

Applying standardised tests denies the multifaceted nature of learning and the multitude of possible reasons for learning failure. Standardised tests are in opposition to the cognitive multi-level approach of classroom activities as they focus on the final step rather that the learning process and in so doing may ignore higher-level cognitive skills
(Simmons, 2004:37). According to many mathematics educators, designers of standardised tests overly use items, which assess only the basic levels of mathematical content knowledge and rarely include items which assess complex levels of learners’ understanding (Van Den Heuvel-Panhuizen & Becker, 2003:691).

An important factor of psychometrics is the interpretation of scores in relation to norms where the performance of the learner is compared with the performance of a group of similar learners. Because learners are unable to control the performance of other learners, they cannot control their own grades. This is now widely considered to be an unfair approach for considering learners’ educational performance (Gipps, 1994:5).

With the psychometric model the importance of technical issues such as standardisation and reliability measures has been developed to which scientific measurement principles have been applied. If learners are going to be compared to one another then it must be certain that the tests, or assessment is carried out in the same way for all individuals, and scored and interpreted in the same way. This is to ensure that measurement is valid and reliable. (Foxcroft & Roodt, 2004:4-6, 41, 58). Such procedures allow for the comparison of an individual’s performance to that of an appropriate norm group (Sieborger & Macintosh, 1998:13).

Psychological assessment often appeared to take on mystical proportions for the layperson. Psychometric ‘theory, formulae and quantification’ tended to give such testing an aura of objectivity, because it was seen to be scientific, and therefore the figures it produced had to be meaningful and accurate (modernism has contributed to this perception). These results, such as IQ scores, reading ages, etc. have come to have a powerful labelling potential (Gipps, 1994:5). In South Africa many people have a negative perception of psychological assessment and its use, as it has been seen as a ‘clever’ way of preventing people from deprived and disadvantaged backgrounds from entering the labour market or gaining access to appropriate education or other opportunities (Foxcroft & Roodt, 2004:350).
The researcher is of the opinion that the use of norm-referenced tests is popular because of the belief that they are scientifically based and thus valid and reliable (a modern perspective). Psychometric tests and norms in South Africa are often problematic as the norms for many of these instruments are not standardised for South African children, but for children from countries abroad. Some examples of these standardised mathematic tests can be seen in Table 2.1 below.

### Table 2.1: Assessment batteries most frequently used by educational psychologists

<table>
<thead>
<tr>
<th>Assessment Battery</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old TED. one-minute test – timed; tests all four operations separately (+,-,,-,x) (SA)</td>
<td></td>
</tr>
<tr>
<td>Leicester number test- tests basic number concepts and skills (1970)</td>
<td></td>
</tr>
<tr>
<td>Vernon graded arithmetic-mathematics test (1976)</td>
<td></td>
</tr>
<tr>
<td>Young group mathematics test</td>
<td></td>
</tr>
<tr>
<td>Keymath-diagnostic arithmetic test (1971)</td>
<td></td>
</tr>
<tr>
<td>UCT Maths test -all the items are word problems (SA)</td>
<td></td>
</tr>
<tr>
<td>Milne Basic processes – all four operations tested, horizontal layout of sums</td>
<td></td>
</tr>
<tr>
<td>Intellectual quotient tests-numerical sub-tests</td>
<td></td>
</tr>
</tbody>
</table>

An additional problem in my view is that many of the test batteries were developed in the 1970’s and are thus outdated. However, a South African standardised mathematics test, called VASSI mathematics proficiency test, for foundation and intermediate phase learner’s has been developed and compiled by Dr Colleen Vassiliou (2003 & 2004).

The VASSI has been standardised for English-, Afrikaans-, and Sesotho-speaking learners and is considered to be bias free and culturally friendly. Both psychologists and educationists may administer it. The test for foundation phase learners identifies the learner’s weaknesses by categorising the questions into the five mathematics learning outcomes (Vassiliou refers to it as strands). The outcomes are from the National Curriculum Statement and are:
a) numbers and operations (includes word sums), b) patterns, c) measurement, d) fractions, and for the Grade 3 test, there is an item on e) shapes and space.

The test for the intermediate learners identifies weaknesses in cognitive processes based on the cognitive categories of Emma Holmes (1985), which are involved in learning mathematics (Vassiliou, 2004:42). These categories are: receiving, interpreting, organising, applying, remembering and problem solving. In addition to the cognitive categories the questions are categorised according to the outcomes. It is the opinion of the researcher that these tests could certainly be useful as parts of an assessment. The problem with the intermediate phase test is that the assessor needs to be well-versed in Emma Holmes’ cognitive categories. Thereafter, knowledge of the particular kind of support or intervention for learners in terms of assisting them to overcome the identified weak cognitive areas is needed.

Psychological assessment in the modern paradigm has been discussed in detail, as this was the paradigm that many of educational psychologists were trained in and worked in. With the advent of the South Africa’s Curriculum 2005, framed within the postmodern paradigm of outcomes-based education it follows that educational psychology would not remain untouched.

2.5.2 Educational psychology within postmodernism

According to Donald et al., (2002:99) the influence of postmodernism on educational psychology has been the recognition that children’s development is shaped by their social contexts. This shift has guided the changes in educational psychology’s practice towards an ecosystemic perspective, which has evolved from a blend of ecological and systems theory and shows how individuals and groups at different levels of the social context are linked in dynamic, interdependent and interacting relationships (Donald et al., 2002:99; Lewis, 2004:2).

Systems theory has its relevance in developing understanding of families, classrooms, and schools and the relationships within them, as well as between them and their social context. This theory sees different levels and groupings of the social context as ‘systems’
where the functioning of the whole is dependent on the interaction between all parts. Whatever happens in one part will therefore affect all other parts (Donald et al., 2002:44-47). According to Lubbe (2004:319), Mashile (2000:96) and Department of Education (2001:5, 11, 12), relevant contextual factors need to be incorporated for a coherent overview of the child which impacts on teaching and learning, such as socio-historic influences, and cultural and economic issues. Lubbe (2004:320), Mashile (2000:104), and Swart and Pettipher (2005:10-11) refer to the importance of the educational psychologists’ work incorporating the education system whether on a micro-, meso-, or macro level (see figure 2.3).

Bronfenbrenner’s ecological and bio-ecological model is an example of an ecological systems theory. This model reflects “the major challenge of the education system to understand the complexity of the influences, interactions and the interrelationships between the individual learner and multiple other systems that are connected to the learner” (Swart & Pettipher, 2005:9).

Bronfenbrenner’s model reflects a “multi-dimensional model of human development which suggests that there are layers of interacting systems resulting in change, growth and development, such as physical, biological, psychological, social and cultural” (Swart & Pettipher, 2005:10). What happens in one system affects and is affected by other systems. The different systems or levels, because they are interrelated, can be thought of as a set of nested structures such as set of Russian dolls. The interrelated levels are the micro-, meso-, and macro- systems and include an exosystem, which is the environment. Swart and Pettipher (2005:10) list four interacting factors which need to be considered when understanding child development or change. The factors are listed as follows:

- **Person factors**: behaviours that would elicit either positive or negative behaviour from others.
- **Process factors**: “the patterns of interaction that occur in a system”.
- **Contexts**: families, schools, classroom and communities.
- **Time**: changes over a period of time due to maturation in the person as well as environmental changes.
2.5.2.1 Inclusion and inclusive education

The postmodern paradigm and the human rights movement not only changed the practices of the educational psychologist but also resulted in the movement towards inclusion. Within postmodernism each individual is deemed valuable and therefore human rights are adhered to, acknowledging differences in age, gender, ethnicity, class, disability, HIV, etc. (Swart in Eloff & Ebersohn, 2004:231). From this movement inclusive education developed. Inclusive education refers to an educational policy which ensures that the full variety of educational needs are optimally accommodated and included in a single education system. This was done in order to redress past imbalances and to ensure that all learners with and without disabilities, should have the same
educational rights and can reach their full learning potential, in line with the Constitution (Act 108 of 1996).

An important aspect of this paradigm shift regarding inclusive education is that the focus is not on learners’ weaknesses but on their strengths. In order to focus on these strengths an efficient support system is needed. Support has been redefined to move its focus away from supporting individual learners who are assumed to have ‘special needs’, towards addressing ‘barriers’ which prevent the system from responding to their learning and other needs (Department of Education, 2002:4 & 2001:11, Donald et al., 2002:23; Mashile, 2000:88; Swart & Pettipher, 2005:17-18).

The educational psychologist working within the postmodern paradigm needs to consider that learners identified as having learning difficulties or barriers to learning are no longer to be placed in specialised learning environments, but are to stay within mainstream education where they will receive support. This is in line with the inclusion philosophy, borne from postmodernism where all human beings are valued and respected and their rights to an education in an inclusive education system are acknowledged.

2.5.2.2 Educational psychological assessment within the postmodern paradigm

Two trends have impacted significantly on educational psychological assessment within postmodernism. The first trend is the shift away from isolated psychometric testing towards a more dynamic assessment culture. The second trend is the recognition of the necessity for collaboration, support and participation with relevant and important role-players. This is referred to as an asset-based approach to assessment (Bouwer, 2005:50). The use of a diagnostic instrument, group tests of intelligence and standardised tests, has been found to exacerbate barriers between other relevant role players and the professional. However, including the family, school-staff and peers by providing observational information has resulted in significant benefits for all involved (Lubbe, 2004:319).
The approach of assessment relevant to this study, that of the individual assessment of mathematics, focuses on obtaining a holistic view of the child in terms of competencies, assets, strengths and areas of difficulty in mathematics. Assessment can be done of different aspects of the child’s functioning in mathematics, for example memory and other cognitive abilities, emotional, language proficiency, speech, and so on (Lubbe, 2004:319; Mashile 2000:96).

Educational psychologists are reminded that assessment results represent only one source of information in the assessment process and that psychological assessment measures are simply a means of enhancing our observations and more can be accomplished with greater speed if used properly. When tests are misused as substitutes for, rather than extensions of clinical observation, the view of the learner is obscured. It is also important to remember that assessment is a process-oriented activity whereby a wide array of information is gathered by using assessment measures and information from other sources, for example interviews, an individual’s history, etc. (Foxcroft & Roodt, 2001:4,7; Neisworth & Bagnato, 2004:199).

Lubbe (2004:318) challenges educational psychologists “to use critical thinking as the compass to guide them towards establishing an assessment framework that they would feel the most comfortable in”. Because arriving at a single binding definition of assessment is almost impossible, Lubbe once again challenges educational psychologists to “decide on a definition that will fit into each individual’s framework”. I argue a decidedly postmodern view!

Due to the change in assessment practices, educational psychologists also need to consider that writing an educational psychological report should change too from listing and interpreting quantitative results to a more qualitative and dynamic asset-based approach (Sattler, 2001a:677-736). Thus, educational psychologists need to move away from a narrow classificatory function and into diagnostic, interventive and evaluative role. Furthermore they need to view assessment as a dynamic process rather than a static one (Burden, 1996:102-103).
I argue that educational psychologists need to have the view that assessment of foundation phase mathematics should be used in support of learning rather than just to indicate current or past achievement (Glaser in Gipps, 1994:10). In addition, it is the researcher’s opinion that the assessment of foundation phase mathematics by an educational psychologist should include the use of an individual and a systemic assessment. Examples of individual assessments are psychometric testing and dynamic assessment, and examples of systemic assessments are community-based assessment of which an asset-based approach to assessment forms a part. As the focus of this study is the individual assessment of mathematics by an educational psychologist, the perspective of dynamic assessment and the asset-based approach to assessment will be discussed in more detail.

### 2.5.2.3 Dynamic assessment

Dynamic assessment is the assessment of the ability to learn where actual learning is incorporated within the procedure (Lidz & Elliot, 2000:5). Lidz et al., (2000:5) and Kaniel (2000:651) suggests that what defines dynamic assessment the most, is the interactive nature of the relationship between the assessor and the assessee. The assessor is not a neutral recorder of pre-prescribed events, but works to produce change in the learner. The assessee is a learner who is capable of change, and the way the learner responds to the probes of the assessment will differ in ways characteristic of that individual.

The next defining feature of dynamic assessment is that of intervention within the procedure. The most unique information produced by dynamic assessment describes the modifiability or responsiveness of the learner to the interventions. This is what Vygotsky described as the ‘zone of actual verses proximal development’ (Smith, 2001:17).

Jepsen (2000:581) believes that the focus of dynamic assessment is on identifying and understanding how the learner thinks and applies cognitive processes through the mediation of compensatory strategies, which might enhance future learning. This provides the basis for recommendations for treatment planning, the most important aspect
of evaluation. Guthke and Beckmann (2000:17) indicate that all dynamic approaches have a requirement for incorporation of feedback and stimulation for learning into the test procedure in order to provoke a learning process for the person tested. In addition, there is an expectation that such a process will provide more adequate predictions as to the true intellectual potential of the person tested.

The concept of intellectual potential is one that educational psychologists work with all the time and it is my view that it would be useful to briefly re-look at it now. Resing’s (2000:232) definition of intelligence is “the ability to learn is profiting from incomplete instruction and the ability to apply the newly learned knowledge and processes to new situations and new tasks.” Therefore, measuring learning potential is mainly aimed at assessing how much a learner can profit from incomplete instruction and ‘inferred’ from establishing the amount of help the learner requires during the assessment procedure.

Another aspect of learning potential is the amount of transfer a child demonstrates as a result of training. According to Kaniel (2000:651) learning ability is much more important than intelligence, however both are multi-dimensional and affected by emotions, motivation and social interactions. Kaniel continues that the importance of dynamic assessment, therefore “is that it is not a type of intelligence test, but an overall approach that should evaluate the person-as-a-whole, integrating psychometric, educational and clinical frameworks”.

Finally, Lidz and Elliot (in Elliot, 2003:16) state that dynamic assessment is an inclusive term used to describe a heterogeneous range of approaches that are linked by common elements, that of instruction and feedback, which are built into the testing process. The general model of dynamic assessment can be applied to a wide variety of subjects, such as language, mathematics or other problems. Therefore, there is no one test or package that is dynamic assessment. Lidz and Elliot continue that the type, number and choice of tests are highly flexible and based on specific referral questions that lead to the assessment, and to the demonstrated level of functioning of the learner, regardless of age. Virtually any test or tasks can be adapted for use within this dynamic approach.
The assessor can also adapt a wide variety of other formal and informal tests and tasks that are more closely related to conditions the learner experiences in the educational setting (Jepsen, 2005:581). Kaniel (2000:643, 655) states that purpose of assessment is to locate the client’s difficulties, to construct an intervention plan, to direct and be part of the intervention team, to follow up, evaluate and monitor the plan. Assessment can be considered successful if it has exposed the problems and presented a relevant treatment plan. An intervention plan is therefore successful if it achieves its goals in the most efficient and effective manner. In developing a plan for intervention, identifying and harnessing the help from those in the learner’s life as well as the intrinsic strengths of the learner should be considered and introduces the topic of asset-based assessment.

2.5.2.4 Asset-based assessment

The asset-based approach as presented by Kretzmann and McKnight (in Kriek & Eloff, 2003:36, 55) focuses on what is available for intervention and moves away from an approach that focuses on problems, needs and deficiencies of the individuals involved in the assessment. Asset-based assessment addresses barriers within context. It is about enabling the “individual to actualise his personal attributes to the optimum in a self-regulating manner, to be less daunted by challenges and to accept an invitation to grow” (Kriek & Eloff, 2003:36). Asset-based assessment emphasises using resources in the environment in new and different ways and it is about “recognising and appreciating all the people surrounding one for what they know and are able to do” (Bouwer 2005:51).

The asset-based approach moves the emphasis from a services perspective to an enablement perspective. It shifts away from an over-reliance on professionals to one in which collaboration, dynamic partnerships and participation are emphasised and practiced. Every individual, family, classroom, school or learning environment has a unique combination of assets and capacities as well as deficiencies (Ebersohn & Eloff 2003:9). The asset-based approach to assessment as such focuses on assets not on deficits.
The process of gathering the information required for an asset-based assessment will be presented in the guidelines. The context of this study, the Learning Area of mathematics in the National Curriculum Statement, is presented.

2.6 INTRODUCING THE MATHEMATICS CURRICULUM I.T.O. THE NATIONAL CURRICULUM STATEMENT

2.6.1 Discovering the learning theory underlying mathematics within the context of Curriculum 2005

After careful perusal of the draft numeracy and the National Curriculum Statements, I was not able to find anything written about the theories underlying Curriculum 2005. I therefore had an informal interview with Mr. Mathume Bopape at Sol Plaatje House, Department of Education in Pretoria on the 13th of November 2002. Mr. Bopape at the time held the position of Mathematics project co-ordinator of the revised statement. I asked him what theories of learning mathematics were used in order to develop the new curriculum. He mentioned that the over-riding belief system was the social construction of knowledge. This was backed up in another informal discussion with Mrs. A. Valerie Ramsingh at Gauteng Department of Education on the 22nd of November 2002. Mrs. Ramsingh held the post of deputy chief education specialist whose area of specialisation is mathematics.

Thus, the influential learning theory, social constructivism, informs outcomes-based education expressed in Curriculum 2005. Many proponents of mathematics reform have advocated a constructivist perspective to teaching and learning (Draper, 2002:522) and the National Curriculum Statement does just that. Social constructivism places a high value on human thought where learning is seen to be a complex, social activity where learners make their own meaning as opposed to having the teacher transfer knowledge. They are taught to be active learners, high-level thinkers, problem solvers, and to question the status quo. There is room for play, chance, and the turmoil inherent in learning. Furthermore, it is recognised as essential for learners to be able to talk about their own ideas, to describe and explain their current thinking, as well as make and test predictions based on personal experience (Bruner in Lewis, 2004:122).
Teaching and learning that is informed by a constructivist philosophy requires the use of non-traditional approaches to mathematics, which emphasise doing mathematics instead of using procedures to produce correct answers (Pugalee, 2001:172). The concept of mathematics is now defined.

2.6.2 Mathematics defined

Mathematics was defined in Chapter One under definition of central concepts but it is expanded upon considering the National Curriculum Statement (Department of Education: 2002a:4). It states that “mathematics is a human activity, which involves the construction of knowledge by observing, representing and investigating patterns and quantitative relationships in physical and social phenomena and between mathematical objects themselves. Through this process, new mathematical ideas and insights are developed. Mathematics also uses its own specialised language that involves symbols and notations for describing numerical, geometric and graphical relationships” Rosner (in Dednam, 2005:194) describes mathematics as the “mapping of language onto symbols”. Thus, mathematics has its own language that requires the exact use of mathematical terms and symbols.

Mathematics then, is a study of patterns and relationships yet it can also imply the freedom of original thought and investigation to search for solutions and alternative approaches. Following on from the definition of mathematics, the Learning Outcomes for the Learning Area of Mathematics, from the National Curriculum Statement are now stated.

2.6.3 The Learning Outcomes of Mathematics

The National Curriculum Statement (2002:4) emphasises the purpose of being mathematically literate. This means that persons are enabled to contribute to and participate with confidence in society. Therefore, access to mathematics is a human right in itself. In order to attain mathematical literacy, the Mathematics Learning Area in the NCS is consolidated into five Learning Outcomes. These five Learning Outcomes encompass the entire mathematics curriculum from Grade R-9. I believe that when
assessing mathematics it is important for the educational psychologist to have an overview of the Mathematics Curriculum, therefore the five Learning Outcomes in Table 2.2 are listed below.

Table 2.2: Learning Outcomes in the Learning Area of Mathematics

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES (LO) IN THE LEARNING AREA (LA) OF MATHEMATICS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LO1 – Numbers, operations and relationships</strong></td>
</tr>
<tr>
<td>The learner will be able to recognise, describe and represent numbers and their relationships, and to count, estimate, calculate and check with competence and confidence in solving problems.</td>
</tr>
<tr>
<td><strong>LO2 – Patterns, functions and algebra</strong></td>
</tr>
<tr>
<td>The learner will be able to recognise, describe and represent patterns and relationships, as well as to solve problems using algebraic language and skills.</td>
</tr>
<tr>
<td><strong>LO3 – Space and shape</strong></td>
</tr>
<tr>
<td>The learner will be able to describe and represent characteristics and relationships between two-dimensional shapes and three-dimensional objects in a variety of orientations and positions.</td>
</tr>
<tr>
<td><strong>LO4 – Measurement</strong></td>
</tr>
<tr>
<td>The learner will be able to use appropriate measuring units, instruments, and formulae in a variety of contexts.</td>
</tr>
<tr>
<td><strong>LO5 – Data handling</strong></td>
</tr>
<tr>
<td>The learner will be able to collect, summarise, display and critically analyse data to draw conclusions and make predictions, and to interpret and determine chance variation.</td>
</tr>
</tbody>
</table>

(Department of Education, 2002:6)

In order for learners to optimally acquire mathematical literacy, prerequisites for mastering mathematical concepts have to be in place.

2.7 PREREQUISITES FOR MASTERING MATHEMATICAL CONCEPTS AND PROCESSES

As the focus of this study is the foundation-phase learner, the prerequisites for mastering mathematical concepts and processes will be discussed at the elementary level. Staves (2001:7) refers to a readiness for mathematical learning as tools, in other words, a child needs certain physical and mental tools to be in place so that mathematical learning can occur successfully. Therefore when an educational psychologist assesses, the levels of
readiness of these tools need to be taken into consideration. Some of the mental tools that Staves refers to are shown in Figure 2.4.

![Mental tools diagram](image)

**Figure 2.4: Mental tools (Staves, 2001:7)**

As indicated above in the graphic representation, these are the areas that an educational psychologist would target in order to assess a child with a barrier to learning mathematics (a mathematical difficulty).

### 2.7.1 Cognitive development

Mathematics demands from the learner both the ability to concentrate and the ability to think and reason abstractly (Malmer, 2004:3). The preconditions for mastering mathematics are based on two levels of cognitive development. The first level is the attainment of elementary theoretical concepts. On the higher level the learner should be able to work with advanced mathematical concepts. The two levels of cognitive development do not necessarily develop consecutively but gradually develop together (Dedman, 2005:197).
2.7.2 Elementary cognitive skills

According to Dedman (2005:197) cognitive skills needed for mastering the lower level mathematical concepts and processes is the ability to: remember arbitrary associations (5 stars are the same as 5 sweets), understand basic relationships (😊😊 equals 2 boys), and make low level generalisations, such as 2 sweets plus 1 sweet equals 3 sweets. For elementary cognitive skills to develop the following mathematical perceptual abilities need to be intact:

- ability to classify and seriate
- understanding of relations between mathematical units
- awareness of temporality, spatial relations, conservation of form, liquids and numbers.

The cognitive skills necessary for mastering the more advanced mathematical concepts and processes are known as meta-cognition and only develop when the child has moved out of the foundation phase.

As discussed, it is imperative that cognitively learners are in a state of readiness to learn mathematics. Another very important factor to consider, because mathematics is transmitted via ‘language’ and is a ‘language’ is language proficiency.

2.7.3 Language proficiency

Language proficiency can be described “as the degree to which the learner’s exhibit control over the use of language” (Naude, 2004:122). Cummins (in Naude 2004:123) has conceptualised two aspects of language proficiency. Basic interpersonal communicative skills (BICS) and cognitive academic language proficiency (CALP). BICS refers to those language skills that are needed in daily personal and social situations. These are the language skills that the learner learns when he interacts with peers and adults and is regarded as a social language. Cummins describes it is a type of ‘surface fluency’.

Cognitive academic language proficiency (CALP) are those “aspects of language such as vocabulary, concept knowledge, meta-linguistic insights, and a knowledge of how to processes decontextualised academic language” (Cummins). The concept encompasses
the use of language skills that are essential to transcending ordinary social language. The concept includes reasoning, problem solving and other cognitive processes required for academic achievement as language and thinking are closely intertwined. The fact that these learners have acquired communicative proficiency does not mean that they have an ability to handle tasks that require CALP. Expressive and receptive language competency is essential for successful performance in mathematics. According to Naude (2004:124), essential skills that make up cognitive academic language proficiency are vocabulary, ready knowledge, memory, associative ability, conceptual thinking and relational thinking skills, and the ability to integrate graphic/pictorial information with verbal descriptions. Linguistically diverse learners require approximately five to seven years to attain cognitive academic language proficiency foundation (Naude, 2004:124).

Many South African learners have a dominant language for communication (mother tongue) that differs from the language of instruction, also referred to as the language of learning and teaching (LoLT) (Prinsloo, 2005:37). However, these learners are expected to perform academically on par with learners whose mother tongue is also their language of instruction. These linguistically diverse learners may develop learning and academic difficulties as a result of their limited language proficiency. When learning a language other than mother tongue, there is an increased likelihood of the linguistically diverse learner making errors in production and/or comprehension and having difficulty in processing information in the non-proficient language (Naude, 2004:122). Those who work with foundation phase learners, and educational psychologists in particular, should keep a close eye on the linguistically diverse learner as this may lead to learning problems and under-achievement (Prinsloo, 2005:37).

If the prerequisites for learning mathematics are not established learners’ would experience difficulties in acquiring mathematics literacy and mathematical skills.

2.8 ACQUISITION OF MATHEMATICAL LITERACY

According to Naude (in Eloff et al., 2004:121), “the learners mode of interaction with the mathematical learning experience, and the way in which they construct and deconstruct
mathematical concepts, play a significant role in acquisition and mastering of mathematical skills”. Learners need to act on and manipulate objects in the environment resulting in *concrete experience*, thereafter the learner develops *mental imagery*, and finally they *associate labels* or names with the objects, resulting in a symbolic form of language. Simply put, Dednam (in Landsberg 2005:194) and Lerner (2003:480, 493) explain that mathematical knowledge begins on a *concrete level* and advances through a *semi-concrete level* to an *abstract level*. Once learners have reached the abstract level it is no longer necessary for them to use concrete apparatus when solving mathematical problems. At a South African University an approach was developed where the learning of mathematics moved through the above three levels.

In the early 1990s’ the Research Unit for Mathematics Education at the University of Stellenbosch, headed up by Murray, Olivier and Human developed and introduced an alternative approach to teaching Junior Primary mathematics (foundation phase) in South African schools (Murray, 1991:2-5). After conducting interviews, the research unit found that learners preferred to construct their own methods of solving mathematical problems – rather than follow a formula given to them by their teacher – and did so with a great deal of success.

This information dovetailed with the most recent views at the time, which was that learners’ had to construct their own mathematical knowledge. The ability to do so developed gradually over a period of time, depending on the type of experiences the learners had. Teachers were required to implement a teaching practice reflecting a constructivist viewpoint of learning, in the acceptance that conceptual knowledge cannot be transferred ready-made from one person to another, but must be actively built up by every learner on the basis of his own experience.

Teachers implementing this approach are no longer dispensers of knowledge, but rather facilitators of learning, supporting and guiding learners to construct their own knowledge, rather than just showing them how to compute. Teachers however, need to create and sustain situations in which learners will develop computational skills. Learner’s ideas are
respected and valued, and they are therefore seen as an active participant in the learning situation and not a passive receiver of knowledge. For this developmental process to succeed three crucial factors need to be attended to (Murray, 1991:2-5; Olivier, Murray, & Human, 1990:297).

1. The development of learners’ understanding of number by means of counting, measuring, number games, etc.
2. The use of suitable realistic word problems to give meanings to operations and to suggest methods to children.
3. Discussion and comparison among children about different methods used and advice and help freely given.

Baroody (1987:179-180) explains that number concept and meaningful counting develop gradually, step by step, as a result of applying increasingly sophisticated counting skills and concepts (concrete through to semi-concrete). Initially preschoolers use numbers mechanically, and then discover or construct deeper and deeper meanings of number and counting. As their understanding of number and counting increases, learners apply number and counting procedures in increasingly sophisticated ways. More sophisticated procedures and applications, in turn, lead to further insights and so forth.

In the light of Murray’s explanation on the development of number, it is her view, as it is Baroody’s (from the discussion above), that the first skills an educator must enable the learners to acquire is counting and counting out. By using counting skills, Murray (1991:4-7) explains that learners’ number development progresses through different levels (Table 2.3). The method of computation and the counting ability of the learner, after posing a word-problem, reflects the maturity of the learner’s number sense and as such may be a gauge as to the particular level that the learner is on.
Table 2.3: A learner’s number development (Murray, 1991:4-7)

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (pre-numerical)</td>
<td><em>Counting all (concrete)</em> – the learner at this level can count out correctly and recognise the number symbols, but does not understand the number representation. In order to compute the learner physically counts all the apparatus, or fully represents each number by means of pictures.</td>
</tr>
<tr>
<td>Level 2 (numerical)</td>
<td><em>Counting on (semi-concrete)</em> – the learner can now operate on numbers as abstract wholes without having to recreate them by counting from one. He does not need to count the first number that can ‘count on’.</td>
</tr>
<tr>
<td>Level 3 (numerical)</td>
<td><em>Decomposition and recomposition of numbers (abstract)</em> – the learner is able to decompose a number into smaller parts are and then to recompose. This is more convenient for computation and provides the learner with the conceptual basis to use thinking strategies. For example, 34 as 30 + 4 (not as 3 tens and 4 ones).</td>
</tr>
<tr>
<td>Level 4 (groups)</td>
<td>On this level the learner has the ability to interpret a two-digit number as consisting of groups of tens and some ones, without losing the meaning of the number as a number. For example, 34 as 3 tens and 4 ones. Level 4 understanding of number is a prerequisite for the meaningful execution of the standard written algorithms in its most sophisticated form.</td>
</tr>
</tbody>
</table>

Murray (1991:5) emphasises that these levels cannot be taught; at best it is a waste of time and usually an unsuccessful to attempt to do so. The learner will develop/construct this understanding in his own time, by just working with numbers in the natural way: counting, playing games with dice and money.

Gifford (in Thompson 1998:76-77) refers to beginning mathematics as emergent mathematics. She concisely summarises, into four themes, that which has been discussed above by Murray, Baroody, Naude and Dednam, within the constructivistic framework.

1. Tasks should be placed in meaningful context.
2. Learners are required to make their own representations.
3. Learner strategies are encouraged and developed.
4. Teaching styles are focused on processes rather than products.
Based on the above themes it is my opinion that the educational psychologist must keep these approaches in mind when assessing foundation phase mathematics. When presenting an assessment task it should be placed in meaningful context, thereafter the learners should be allowed to make their own representations which will give the assessor an idea of the level of understanding of the child being assessed. Vygotsky’s concept of scaffolding and zone of proximal development can be implemented by using a dynamic assessment approach which will give the educational psychologist an indication of the learner’s intellectual ability based on the strategies that the child develops. During the assessment the focus will be continuously on the learner’s processes and not only on the final answer.

In conclusion learners acquire mathematical literacy by progressing through hierarchical levels, namely concrete, semi-concrete and abstract levels. Learners progress through these levels at their own pace. Learners should experience a wide range of problems and thus be allowed to meaningfully construct their own mathematical understanding at the emergent mathematics level. If the prerequisites for learning mathematics are not established, the learners would experience difficulties in acquiring mathematical literacy and mathematical skills. These difficulties are referred to as barriers to learning and may be internal or external.

2.9 CAUSES FOR BARRIERS RESULTING IN MATHEMATICAL DIFFICULTIES

Causes for barriers to learning can be viewed on a continuum from internal to external factors. All barriers, according to Dednam (2005:199), that influence the learner’s ability to master mathematical concepts and processes are linked, and because all barriers affect each other they may be difficult to highlight. Internal factors causing barriers to learning are situated within the individual and can be organic in nature, for example visual or hearing impairment. External factors are factors within systems that are in the environment and outside the individual, for example a young learner whose parents both suffer from HIV/AIDS.
Such a learner may need to take increasing responsibility at home, for himself, his parents and his younger siblings. As a consequence his schooling is constantly interrupted and there is often not enough time to do homework. A learning difficulty may then develop, as important scholastic activities are missed and therefore basic concepts are not established. (Department of Education, 2002:4 & 2004:11; Donald et al., 2002:23; Mashile, 2000:88; & Landsberg, 2005:17-18).

Poverty in South Africa, which may be considered an external barrier to learning, can cause internal barriers such as ill health, which is as a result of under-nourishment and poor health care. This may result in a low immune system which can ultimately affect vision, hearing and perceptual skills (Prinsloo, 2005:28). When a learner has a barrier to learning, difficulties with mathematics can be ascertained by careful and thorough assessment, firstly by foundation phase teachers and then by an educational psychologist.

### 2.10. ASSESSMENT OF MATHEMATICS

Continuous assessment is the chief method by which assessment take place according to the National Curriculum Statement for Mathematics (Department of Education, 2002). Assessment planning begins with the Assessment Standards in the National Curriculum statement of Mathematics relating to mathematical understanding, skills and attitudes. Kennedy and Tipps (2002:148) recommend four stages, which should guide the assessment process by educational psychologists and teachers alike, as indicated in Figure 2.5. on the following page.
Educational psychologists need to make important decisions during the planning of a foundation phase mathematics assessment, such as the kind of performance tasks to be chosen. These relate to the concepts, skills and attitudes being assessed, the kind of data-collection tools and how the learner’s data will be interpreted. Examples of data-collection tools include observation, interviews with the learners, anecdotal records kept by the teacher, learner’s books including self-assessment and portfolios (Kennedy & Tipps, 2002:150; Smith, 2001:220).

The educational psychologist’s main assessment tools are curriculum-based assessment, observation, interviews with the parents, teachers and the learners and error analysis of their work. We are reminded that mathematical assessment is not about how many answers are correct, but the problem solving procedures the learner followed (Dednam, 2005:204).

2.11. SUMMARY

Chapter Two provides the background to the study regarding the paradigm shift from modernism to postmodernism. Changing learning theories, acknowledgement of human rights as well as the fact that absolute truth was questioned resulted in the paradigm changes. The way in which education and psychology was affected was highlighted. This in turn influenced assessment, especially the assessment practices of educational
psychologists. The Mathematics Learning Area, the Learning Outcomes of the National Curriculum Statement and constructivism as the learning theory informing the Curriculum were discussed.

Cognitive prerequisites and a certain level of language proficiency are needed before learners are able to work with mathematics concepts, and these were considered. Thereafter, how learners acquire mathematical knowledge – which starts off on a concrete level and proceeds to the abstract level – was analysed. For many reasons learners may have barriers to learning and it is important that these barriers are considered when carrying out an assessment and then considering learner support. Finally, general assessment of mathematics was discussed followed by a discussion on educational psychological assessment. Chapter Three will outline the research paradigm, design and methods.
CHAPTER THREE
RESEARCH PARADIGM, DESIGN AND METHODS

3.1 INTRODUCTION

The late twentieth century has been described as an exciting time in which to do a social inquiry. It was a time of openness and questioning established paradigms through intellectual thought, such as quantitative research and because of the paradigm shift and its resultant changes, social sciences became more interpretive, postmodern, and made use of criticalist practices (Lather in Adams, Collair, Oswald & Perold, 2004:355; Lincoln & Guba, 2000:163). Padgett (2004:3) states that during this time a sound
alternative to the “seemingly unassailable truth that science and technology had all the answers and that quantitative methods and measurements were the superior routes to finding these answers” had been provided. As can be seen the movement from modernism to postmodernism has impacted on social research and an important change has been the refusal to privilege any method or theory (Denzin & Lincoln, 2003:3). This will be reflected in the research paradigm and design.

In this chapter the research paradigm and then design used in this social inquiry will be presented. Thereafter, the method of research and means of gathering data will be discussed, followed by a description of how the researcher analysed the data, showing how the main themes and categories emerged. Finally, the way that precision was built into the design and the ethical considerations will be explained.

3.2 RESEARCH PARADIGM

As discussed in Chapter One, the research paradigm and design of this study falls into a social constructivist paradigm (Schwandt, 2000:189, Creswell, 2005:8), which assumes that people seek to understand the world in which they live and work by developing subjective meanings of their experiences. These meanings are varied and multiple (Creswell, 2005:8). Construction of our interpretations are made against a backdrop of shared understandings, practices, language, etc. (Schwandt, 2000:189). Thus, in constructing this work I referred to multiple sources, and using those sources constructed my guidelines. Having outlined a brief revision of the paradigm of this study, the research design will be discussed in detail.

3.3 RESEARCH DESIGN

Research is defined as the “process through which we attempt to achieve systematically and with the support of data the answer to a question, the resolution of a problem, or greater understanding of a phenomenon” (Leedy in Adams et al., 2004:355). The research method of a qualitative interpretivistic design which included a literature review, questionnaires and focus group interviews were used in this study.
At this point, I would like to remind the reader that the term, literature review (Mouton), rather than literature study, was used. A literature review (Mouton, 2004:56) was conducted, supported by secondary data so that best practice for educational psychologists and others in the field of education could be captured and analysed (Adams et al., 2004:355).

For those of us in such practice-based professions, the need for relevance means that we direct our efforts towards studies that build knowledge for improving practice (Padgett, 2004:3).

The research design started off as a non-empirical one using secondary data, where the sources of information were indirect, i.e. written by other authors, and where it is not an experimental design. The literature review, as a piece of writing, is defined by a guiding concept, which is the problem or issue under discussion. From the problem the key research question is formulated. Besides enlarging one’s knowledge about the domain of scholarship, a literature review demonstrates an author’s skill in information-seeking and selection of sources.

The selection of sources (articles, texts, documents, web-sites) is dependent on the aim of the study and research question. Thus, the representativeness of sources used, is an important criterion of the final quality of the literature review. Once a sample of texts has been read to gain a clear understanding of the area of the study, the author needs to undertake an “exercise in inductive reasoning” (Mouton, 2001:180). The purpose is to convey to the reader what knowledge and ideas have been established on a topic and to synthesise results into a summary of what is and is not known.

The strength of the literature review is that a comprehensive and well-integrated literature search (Hart, 2001:2-3) is an important aspect to any study. It provides one with a good understanding of the issues in the area that one is working in, as well as current theoretical thinking and definitions. The literature review however, has its limitations, which are that it can, at best, only summarise and organise the existing scholarship. A
critical review of the literature cannot produce new information or validate existing empirical insights. However, a literature review can lead to theoretical insights, although it is acknowledged that an empirical study is still needed to test these new insights (Mouton, 2001:180).

Based on the findings from the literature, I was interested in how it would correlate to the experience of teachers and practitioners in the field, those studying at universities and the lecturers who teach them. It was for this reason that I decided to interview teachers, master degree students in educational psychology and a lecturer. This then explains the reasons as to why in this design, I not only consulted the literature but also used additional methods to gather data.

3.4 RESEARCH METHODS AND DATA GATHERING

The research method of a qualitative interpretivist design which included a literature review, questionnaires and focus group interviews were used in this study. One of my first aims was to find out what has been done in the field of study regarding educational psychological assessment of mathematics. I therefore searched the existing scholarship or available body of knowledge to see how other scholars had investigated the research problem. The second aim was to avoid duplication and ensure that this topic has not already been investigated (Mouton, 2001:86-87). I then began a literature search. A literature search is a crucial part of any research dissertation, so that the researcher is able to find out “where things are at” (Potter, 2002:181)

Once my literature search was completed the literature was organised around themes or key constructs, which became evident from the background and the research problem (Mouton, 2001:93) These themes or important constructs guided Chapter Two.

To organise the literature into themes I printed out grids and wrote the emerging themes on the top and then within the grids indicated the title of the book the author and page number. A photograph of one of the grids, dealing with assessment, can be seen on the next page (figure 3.2). The main themes or key constructs in this study are the shift from
modernism to postmodernism as a worldview, how it affected learning theories and education and the assessment practices of the educational psychologist. Constructivism as the learning theory informing the National Curriculum and the process of learning mathematics were therefore viewed as important key constructs.
The major sources of information in the relevant areas were books, Department of Education publications and journal articles, both South African and international, as well as online journals from the Internet. The two documents chosen for analysis were the National Curriculum Statement for Mathematics (Department of Education, 2002) and the Principles and Standards for school Mathematics (National Council for Teachers of Mathematics, 2000). These two documents were analysed using content analysis. Conference proceedings, an unpublished paper presented at a conference and a research unit’s communiqué were also referred to. Two specialists from the department of education were also approached for information as part of the topic review and an informal telephonic interview was held with the compiler of a South African Mathematics proficiency test (Mouton, 2001:88; Potter, 2002:123).

The following additional methods used were a focus-group interview with four foundation phase teachers from a local primary school; an interview with a lecturer of educational psychological assessment at a university in Gauteng; and an incomplete-sentences questionnaire completed by ten second year master’s degree students in the educational psychology programme. These additional methods were used so that the reasons for doing this literature review could be validated and in support of the findings in the literature.

3.4.1 The interview

Merriam (1998:74) describes an interview as “a conversation but with a purpose”. For triangulation purposes, which according to Leedy (1997:169) enhances the overall validity of research, an individual interview as well as a focus-group interview with a narrow topical focus were used. Rubin and Rubin (1995:195) define a topical interview as an interview where the interviewer has chosen the subject, and the concern is more with fact and less with eliciting meaning. Both the individual and the focus group interview can be described as a semi-structured interview referring to the degree of latitude given the interviewees (Freebody 2003:133). Semi-structured interviews begin with a set of predetermined questions, but allow some latitude regarding relevance. This
means that the interviewer is able to follow a particular line of talk with ad-hoc follow-through questions (Freebody, 2003:133). Following on from that, according to Vockell and Asher (1995:133), the advantage of an interview is that it can be flexible. It is possible for the researcher to ask questions as a situation unfolds and to react to the respondent’s new ideas (Merriam, 1998:74). I decided to use a semi-structured format for both interviews.

Both the focus group and individual interviews were transcribed. Silverman (2000:136) sees transcribing as an opportunity to overcome the tendency to ‘tidy up’ the ‘messy’ features of natural conversation. Transcribing the interviews allows other researchers to have access to the data and therefore is one of the ways of ensuring reliability.

3.4.1.1 The focus group interview

The focus group interview began with questions regarding the curriculum and moved onto questioning about mathematics assessment and an educational psychologist’s report. I thus needed to interview foundation phase teachers who had worked with both the Draft Numeracy Document for the foundation phase as well as the revised National Curriculum Statement for Mathematics.

The teachers in question needed to teach in an environment where learners who were experiencing barriers could be referred to educational psychologists and therefore in my view it had to be a school in an average to upper-income socio-economic group. Thus, small, purposeful and non-random sampling (Merriam, 1998:8) was used in order to choose the participants for the focus group. A sample of four ladies who met the requirements as discussed above, formed the group. The focus-group interview was held on Monday 24th April 2006, in the school’s staff-room about half an hour after the school closed for the day. The focus-group interview lasted for approximately 30 minutes. The following questions were asked at the focus-group interview:
1. Tell me about implementing the Revised National Curriculum Statement of Mathematics?
2. How did you find working with the numeracy draft policy document? (pre-RNCS)
3. What are the most common areas where children struggle with mathematics?
4. What are your expectations regarding a referral to an educational psychologist in respect of an assessment of mathematics?
5. Regarding the feedback from an educational psychologist (usually a report, interview either telephonically or face-to-face), what is your opinion?
6. (If the discussion is general) And regarding the mathematics assessment?

The transcription of the focus group interview can be found in Appendix 2, pages ii-ix.

3.4.1.2 The individual interview

The individual interview was held in the lecturer’s office at the university in question on Tuesday afternoon the 2nd of May 2006 and lasted for about 20 minutes. The questions that were asked at the individual interview were as follows.

1. Tell me about the changes in assessment?
2. Tell me about the changes in educational psychological assessment?
3. Tell me about the changes in the mathematics assessment as part of an educational psychology assessment?
4. Tell me about the changes in educational psychological report writing?
5. What is your opinion of the assessment of Mathematics by an educational psychologist?
6. (depending on the answer) How in your opinion could it change or improve in order to add value to the assessment process?

The transcription of the individual interview can be found in Appendix 3, pages x-xvi.

3.4.2 Incomplete questionnaires

A collection of questions is called a questionnaire, and should be brief and easy to respond to (Gay & Airasian, 2003:282). McMillan (2000:38) defines a questionnaire as a written document containing statements or questions that are used to obtain subject
perceptions, attitudes, beliefs, and so on from the respondents. An incomplete, self-administered questionnaire, which Fink (1995:49) describes as consisting of questions that can be completed by themselves, was included.

The questionnaire was structured in such a way so that the first part of the question would prompt the respondent to answer on a particular topic. The questions could be referred to as structured items (Gay & Airasian, 2003:284). Once again, a small, purposeful and non-random sample of second year educational psychology master’s students were approached to complete the questionnaire at a University in Gauteng, where fifteen questionnaires were handed out and ten were returned one week later. The following incomplete sentences were given to the students:

1. Mathematics assessment of a foundation phase learner entails__________________________________________________________

2. In order to carry out the mathematics assessment I ______________________________________________________________

3. The information gained from a foundation phase learner’s mathematics assessment is __________________________________________

4. In my opinion, for a mathematics assessment to have value it ________________________________________________________

5. An educational psychologist’s report pertaining to mathematics assessment should____________________________________________

An example of a completed questionnaire can be found in Appendix 4 page XIV. After the literature had been searched, the interviews carried out and the incomplete questionnaires collected, the next stage of data analysis was ready to begin.

3.4 DATA ANALYSIS

Data analysis is a complex process of selection, sorting, focusing, discarding and organising data in order to make sense of, integrate, draw conclusions and verify the data (Merriam, 1998:127; Miles & Huberman, 1994:10). Data collection produces data that requires ‘processing’. Data processing involves two stages, namely that of data reduction,
during which data is summarised, and data analysis. Miles and Huberman (1994:7) state that most analysis of qualitative research data is done with words which can be assembled, sub-clustered and broken down.

3.5.1 Content analysis

Data analysis includes processes such as thematical and content analysis and is followed by synthesis, which involves ‘interpretation’ and ‘explanation’ of the data (Mouton, 1996:67). The National Curriculum Statement and the Principles and Standards for school Mathematics were analysed using content analysis. Merriam (1998:160) states that content analysis is the analysis of themes and recurring patterns of meaning. Altheide (in Merriam, 1998:160) states that certain categories and variables may initially guide the work but that other categories may emerge throughout the study. Merriam (1998:160) and Gay and Airasian (2003:232) summarise this process as the simultaneous coding of raw data and the construction of categories that capture relevant characteristics of the content of the documents. The procedures showing the compilation of common themes and categories will now be discussed.

3.5.2 The process of data reduction and analysis of the National Curriculum Statement for Mathematics (2002) and the Principles and Standards for School Mathematics (2000)

I analysed the National Curriculum Statement for Mathematics (Department of Education: 2002) and the Principles and Standards for School Mathematics (National Council of Teachers of Mathematics, Inc: 2000) as from the outset of this research project I have been interested in the development of the ‘new’ Mathematics curriculum for foundation-phase learners, and the affects that it would have on educational psychological mathematics assessment. I had wondered ‘who’ had put ‘it’ together and how it had been informed. As the National Curriculum Statement for Mathematics (2002) is un-referenced it was not possible to do further enquiry.

As mentioned in the preceding chapter, I approached a departmental official, Mr Bopape in an informal interview. I wanted to know in addition to the learning theory informing the new curriculum, what processes were followed in order to develop the new
curriculum. He mentioned that the starting point was “a working group of experienced mathematics teachers, who were involved with mathematics associations in line with current trends”. These “teachers were dedicated, engaged in continuous study in the mathematics education field and active in mathematics associations, particularly the Association for Mathematics Education of South Africa (AMESA)”.

The new curriculum was a debated process. Previous syllabi and local books were considered as well as the findings of the above working groups while taking cognisance of international standards. This was all the information that Mr. Bopape offered regarding the development of the new curriculum and at the time I was of the opinion that it was a bit vague.

Upon further research and according to Bopape (2004:4), “the new curriculum was a product of inputs from among other areas, People’s Mathematics. Peoples’ Mathematics was a product of ‘People’s Education for People’s Power”, a key action-fighting plan. The respective web-sites of People’s Mathematics, AMESA, Department of Education, Gauteng Institute for Educational development (GiCD) and the Mathematics Centre for Professional Teachers were accessed in an unsuccessful attempt to obtain more information on how the Mathematics curriculum was developed in South Africa.

Then, while reading one of the American textbooks (Kennedy & Tipps, 2000:3-21), I came across an explanation of the development of a curriculum for children for the 21st century. This was being implemented by the National Council of teachers of Mathematics and was called the Principles and Standards for School Mathematics. The immediate similarities between the National Curriculum Statement and the Principles and Standards for school Mathematics was very noticeable. I thus decided to analyse the two documents, in an attempt to answer ‘my’ question of the source of the NCS as well as to gain insight into the documents and to understand the assessment of foundation phase mathematics within the NCS. In addition, a further question in my mind was whether the documents could play a role in the educational psychological assessment of mathematics.
The analysis of these documents was based mainly on content comparison between the two documents (Gay & Airasian, 2003:232; Merriam, 1998:160; Mouton, 1996:67).

In order to describe the process of how I analysed the two documents I have taken excerpts from both. Below, the Number and Operation Standard and the expectations from the Principles and Standards for school Mathematics (2000) has been scanned and inserted and below I have indicated the assessment standards for the Grade 2s from the National Curriculum Statement (2002).

**Number and Operation Standard**

Instructional programs from prekindergarten through grade 12 should enable all students to

**Understand numbers, ways of representing numbers, relationships among numbers, and number systems**

**Pre-K-2 Expectations:**

In prekindergarten through grade 2 all students should

- count with understanding and recognize "how many" in sets of objects;
- use multiple models to develop initial understandings of place value and the base ten number system;
- develop understanding of the relative position and magnitude of whole numbers and of ordinal and cardinal numbers and their connections;
- develop a sense of whole numbers and represent and use them in flexible ways, including relating, composing, and decomposing numbers;
- connect number words and numerals to the quantities they represent, using various physical models and representations;
- understand and represent commonly used fractions, such as ¼, 1/3, and ½.

**Excerpt 3.1: Number and Operation Standard**

**Learning Outcome 1. Numbers, Operation and Relationships**

The learner will be able to recognise, describe and represent numbers and their relationships, and to count, estimate, calculate and check with competence and confidence in solving problems.

**Grade 2 Assessment Standards**

Comment [V8]: Category: Different terminology - common meaning
We know this when the learner:

- counts to at least 100 everyday objects reliably
- counts forwards and backwards in:
  - ones, from any number between 0 and 200
  - tens, from any multiple of 10 between 0 and 200
  - fives, from any multiple of 5 between 0 and 200
  - twos, from any multiple of 2 between 0 and 200
- knows and reads number symbols from 1 to at least 200 and writes names from 1 to at least 100
- orders, describes and compares the following numbers:
  - whole numbers to at least 2-digit numbers
  - common fractions including halves and quarters
- recognises the place value of digits in whole numbers to a least 2-digit numbers
- solves money problems involving totals and change in rands and cents.
- solves and explains solution to practical problems that involve equal sharing and grouping and that lead to solutions that also include unitary fractions (e.g. ¼), etc.

Excerpt 3.2: Assessment standards for the Grade 2s from the Learning Outcome, Numbers, Operation and Relationships from the National Curriculum Statement

The analysis was based on comparing the content of the two documents. According to the Mouton and Marais (1996:106), analysing data involves making inferences. Even the fairly simple process of allocating selected data to certain categories is an inferential process. In order to do this I firstly read and re-read the two documents to get an overview of the content and then decided on the categories based on the content using my own inferences. The main categories that emerged were different terminology-common meaning, common mathematical concepts and range of mathematics documents.

Having completed the content analyses, the analysis of the data from the interviews and incomplete questionnaires was begun. That process will now be discussed.
3.5.3 The constant comparison method of analysis

Maykut and Morehouse’s (1994:126) and Dana and Yendol-Silva’s (2003:90) constant comparative method of analysis based on Glaser and Strauss’ (1967) work was used to analyse the focus group interview, the individual interview and the incomplete questionnaires. The constant comparative method is described by DuPoy and Gitlin (1994:143), and Dana and Yendol-Silva (2003:90) as one where data is constantly compared and contrasted with successive segments of data, to determine similarities and differences and subsequently to categorise them. All new data is compared to the existing categories to determine similarities between new and previously obtained information. Data that fits the existing categories is classified accordingly, but new categories are developed in cases where the data does not readily fit.

Analysing data usually consists of two stages, the first being to reduce the data to manageable proportions and the second being to identify patterns or themes that emerged from the data (Mouton, 1996:161). According to Dana and Yendol-Silva (2003:92) analysing data involves the following four-step process, which the researcher followed:

- **Step 1**: The entire data set is read and reread in order to get a ‘descriptive sense’ of what has been collected
- **Step 2**: Thereafter ‘sense making’ begins where the researcher begins to notice which data stands out and which different pieces of data fit together
- **Step 3**: The interpretation of the data
- **Step 4**: Analysing the data

Data from each interview and from the incomplete questionnaires was highlighted and sorted into related groups or themes. These themes were compared with one another and the comparisons resulted in tentative categories being made and continuously compared with the concepts across all the data (Merriam 1998:179).
3.5.4 The process of data reduction and analysis of the focus group interview, the individual interview and the incomplete sentences questionnaire

After carefully reading the transcribed focus group interview, codes that seemed to answer the research questions were highlighted. From these codes, categories and then were devised in order to group all the codes extracted. This process was repeated for the individual interview and then for the incomplete sentences questionnaire. An excerpt from both of the transcriptions as an example (Excerpt 3.3 and 3.4), and an example from the incomplete questionnaire (Excerpt 3.5) will demonstrate how the themes were devised from these concepts.

3.5.4.1 Analysis of the interviews

In order to demonstrate how the codes were extracted in order to identify the categories into which the data was sorted, an extract from the analysis of both the interviews is given in Excerpt 3.3 and 3.4 on the following pages. During this process all the codes were clustered together in order to form the categories.

3.5.4.2 Extract from the individual group interview

This is an extract from the individual interview which the researcher transcribed verbatim prior to analysis. The analysis of this extract illustrates which phrases or groups of words led to the formation of codes as demonstrated. Six categories emerged which were the main categories for the individual interview, namely:

1. Assess for learning
2. Learning potential
3. Changes in educational psychology/ Medical model
4. Social constructivism
5. Bio-ecological model
6. Inclusive education

The highlighted sections are shown to illustrate the parts highlighted by the researcher in the original script. In this extract R refers to the researcher and L to the lecturer.
Excerpt 3.3: Individual interview with the lecturer

3.5.4.3 Extract from the focus group interview

Below is an extract from the focus group interview which the researcher transcribed verbatim prior to analysis. The analysis of this extract illustrates which phrases or groups of words led to the formation of categories as demonstrated. The categories that emerged were the main categories for this interview and are:

1. Department of education documents
2. Barriers to learning mathematics
3. Medical model
4. Expectation of educational psychologist
5. Feedback from educational psychologist
6 Educational psychologist report

7 Teacher support in inclusive education

The highlighted sections illustrate the parts highlighted by the researcher in the original script. In this extract R refers to the researcher and JR., A., K, and JM. refers to the teachers who participated in the focus group.

20. R: Do you feel that your query or concerns are met, regarding a report or when the educational psychologist phones you or do you just get a written report? Do you find that regarding that you are given an answer as to why this child may be struggling?

21. A. My answer is no? I was just go to say to J. that is great that you send to these people but what do they do to make him understand maths that you can’t.

22. JK: No, what do they do better to make him understand than you.

23. JM: Well the sometimes there the diagnosis, that actually as much as I would try it’s not going to help any way, that they would need specialised education, special.

24. JK: That is why I was saying that hopefully they could narrow it down.

25. R: Do you think educational psychologists do that?

26. JK: Not always no.

27. JR:… and very often we have just referrals on to occupational therapists, that’s about as far as it goes.

28. JK: Ja, also the feedback, look I, uh I must admit that people obviously come to the school and they’ve got 6 or 7 children but as the teacher I would like all the feedback from the therapist as well. You know they give a written report to the parents and the parents don’t understand half the things and then parents come to you and I say well I haven’t seen the report, so there’s never that three-way conversation where you’re either called in and chat and it is said, you know this is what I think is best for your or …

29. A: I. You know and sitting here thinking, that we do need to speak to the therapist and we can say to the therapist “listen here, what is this oke’s problem, how…what must we do in the classroom to help him.”

Excerpt 3.4: Focus interview with teachers
3.5.4.4 Extract from the incomplete questionnaires

To analyse these questions I cut and pasted all the question 1s, 2s, etc. together. Then the same process that was used in analysing the interviews was followed, regarding searching for phrases and groups of words to form categories for the incomplete questionnaires. Below are only three examples, (because of space constraints), of the ten question 1s. The excerpt has been re-typed as I have been unable to insert the comments in the scanned example. An example of all the scanned question 1s can be seen in the Appendix 5, page XV. The main categories identified were:

1. Mathematics assessment
2. Curriculum-based assessment
3. Barriers to learning
4. Educational psychologist
5. Assessment tools
6. Emotional impact on assessment
Mathematics assessment of a foundation phase learner entails concrete activities to assess what the learner is able to do at school in maths and what they battle with related to the curriculum.

Mathematics assessment of a foundation phase learner entails the professional having a sound knowledge of the outcomes that are specified in the National Curriculum Statement.

Mathematics assessment of a foundation phase learner entails a process whereby the child is able to demonstrate whether certain foundational skills are in place. These would include spatial orientation, sequencing, patterning, number concept, shapes, etc. Many of these skills overlap with emergent literacy.

Excerpt 3.5: Analysis of the incomplete questionnaire

3.4 FINAL CATEGORIES

The next step in the process of analysis was a cross-comparison of the three sets of categories using the constant comparative method in order to compile one set of final categories, which follows in table 3.3.

Table 3.1: Cross comparison of the three sets of categories

<table>
<thead>
<tr>
<th>Final Category Educational Psychology</th>
<th>Final Category Social constructivism</th>
<th>Final Category Mathematics Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in Ed. Psych/Medical model</td>
<td>Asset mapping</td>
<td>Change in mathematics assessment</td>
</tr>
<tr>
<td>Assessment for learning</td>
<td>Inclusive education and support of the teacher</td>
<td>Mathematics assessment</td>
</tr>
<tr>
<td>Assessment tools</td>
<td>Bio-ecological model</td>
<td>Curriculum-based assessment</td>
</tr>
<tr>
<td>Expectations of educational psychologist</td>
<td>Learning potential</td>
<td>Barriers to learning</td>
</tr>
<tr>
<td>Skills of an educational psychologist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback from an educational psychologist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The educational psychological report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional impact of assessment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:

- [VA32]: Code: Mathematics assessment
- [VA33]: Code: Learning potential
- [VA34]: Code: Curriculum-based assessment
- [VA35]: Code: Barriers to learning
- [VA36]: Code: Educational psychologist skills
- [VA37]: Code: Curriculum-based assessment
- [VA38]: Code: Asset mapping
- [VA39]: Code: Mathematics assessment
The interpretation of these categories with the sub-categories will be discussed in Chapter Four.

3.7 BUILDING PRECISION INTO THE DESIGN

In order to build precision and rigour into the design, issues of trustworthiness and ethical considerations will now be reviewed. A researcher is inevitably asked how these design issues will be built into a research design, and it is these factors that ensure a study should yield believable, trustworthy and valid findings, all of which has been carried out in an ethical manner (Henning, 2004:146, & Merriam, 1998:198). I have referred to Guba’s model (1981) in Krefting (1991) and Denzin and Lincoln (2005).

3.7.1 Establishing trustworthiness

As mentioned previously, this study falls within a constructivist paradigm and in order to ensure that a research project has rigor and trustworthiness within this paradigm, there are certain criteria to be met. These criteria are credibility, transferability, dependability and confirmability. These terms replace the positivist criteria of internal and external validity and reliability (Denzin & Lincoln, 2005:24). Each of the criteria relevant to this study will be reviewed.

The question of trustworthiness essentially asks first, to what extent can confidence in the outcome of this review be given, and second whether the content of the researcher’s report can be believed (Maykut & Morehouse, 1994:145). Trustworthiness incorporates credibility, transferability, dependability and confirmability (Denzin & Lincoln, 2005:24; Krefting 1991:217). The first criterion of credibility requires adequate submersion in the research setting to enable recurrent patterns and themes to be identified (Krefting 1991:217). The researcher was able to extract themes from the research setting which ensured further investigation.

To ensure credibility a strategy called reflexivity refers to an assessment of the researcher’s own background, perceptions and interests (Denzin & Lincoln, 2005:210; Krefting 1991:218). In this study the researcher declared her personal presuppositions
Triangulation is a powerful strategy for enhancing the quality and credibility of the research. Triangulation of data methods, where data was collected from various means was compared (Krefting 1991:219). Multiple methods of data collection were used in the form of interviews and incomplete questionnaires in order to strengthen the study. Triangulation of data sources maximises the range of data by using different groupings of people (Krefting 1991:217). A lecturer, teachers and postgraduate students were approached. The strategies described above can bolster the credibility of a research project.

The second criterion of credibility is transferability or applicability which refers to the degree to which the findings can be applied and the ability to generalise from the findings to larger populations groups (Krefting 1991:216). An important point made by Lincoln and Guba in Merriam (1998:173) where they use the old terminology, is the importance of first establishing ‘internal validity’ (credibility) before ‘external validity’ (transferability/applicability) is discussed, as they say “there is no point in asking whether meaningless information has any general applicability”. The researcher believes that her findings are credible as described above and are therefore applicable to other contexts.

The third criterion for establishing credibility is the dependability strategy. Guba (in Krefting, 1991:221) proposed that the dependability strategy relates to the consistency of the findings. The findings from the interviews and incomplete questionnaires were fairly consistent with each other and the literature. Dependability can also be enhanced through triangulation to ensure that the weaknesses of one data-collection method are compensated by the use of other data-gathering methods. As mentioned before, the researcher used triangulation of data collection.

Lastly, a number of strategies are useful in establishing confirmability and aims for researcher neutrality, data and interpretational confirmability (Krefting, 1991:221). They are triangulation of multiple methods, data sources and the theoretical perspective which tests the strength of the researcher’s ideas. According to Guba (in Krefting, 1991:221), an
investigator should provide at least two sources for every claim or interpretation to support the researcher’s analysis and interpretation of the findings. Reflexive analysis is also useful to ensure that the researcher is aware of their influence on the data. In this study I made use of triangulation of methods, data sources and theory to confirm my findings, all the while reflecting on the process.

In order to assess the trustworthiness and rigor of a research project the strategies of credibility, dependability, transferability and confirmability were applied. A discussion on the ethical consideration now follows.

3.7.2 Ethical considerations

There is an ethical code associated with being an educational psychologist (Creswell, 2005:62) and this review was conducted bearing that in mind. Issues of confidentiality, anonymity, explanation of the purpose of the study and voluntary participation were considered (Creswell:2005:64).

In this study no harm came to any human being. Where I held informal interviews both in person and telephonically, the purpose for my interview was explained to the interviewees. I informed them about my research project and thereafter requested permission to talk to them. As I quoted from and directly used some of the content of the discussions in the study, anonymity was assured by not using the respondents’ names and therefore confidentiality was ensured. As a literature review was included in this design the ethical considerations in this regard were that every author was acknowledged both in the text and in the references. Where the original source was used the text was quoted to avoid plagiarism.

For the focus-group interview and the incomplete questionnaires, permission was requested for participation in the study by asking that the respondent sign a letter, which set out the details of the study. For the interviews I asked for and received permission to tape the sessions. (An example of the letters given to the respondents can be found in Appendix 5 pages XVI-XVII). Confidentiality was assured for each participant and an
undertaking was made not to breach it and/or break anyone’s trust. During each phase of the process withdrawal from the situation took place without any negative consequences. This refers to when the researcher left the interviewees they were not left with any unresolved emotional issues as the content of the questions were not of an emotional nature. I did not ask or deal with any emotionally laden or personal questions or issues leaving a respondent uncomfortable and with the feeling that they had not dealt with a problem. For each participant feedback was promised which I intend to present in the form of letter summarising the findings. Finally, the data will be kept safely until after the research process has been completed, whereupon it will be destroyed.

3.8 CONCLUSION

This chapter has given an overview of the research design, methods of data collection, analysis of data, trustworthiness, reliability, validity and the ethics that were considered. Chapter Four will present a detailed description of the analysis of data and discussion of themes. The integration of these themes and existing theory will be presented.
CHAPTER FOUR
DISCUSSION OF THE FINDINGS

4.1 INTRODUCTION

In this chapter the findings of the research will be interpreted. Firstly the categories that were developed from the contents analysis of the two documents will be presented.
Secondly the themes that emerged from the constant comparative method of analyses of the focus group interview, the individual interview and the incomplete questionnaires will be interpreted from the theoretical framework presented in the literature search. From the conclusions and interpretations, the guidelines for the educational psychologist when assessing foundation phase mathematics will be proposed.


The analysis identified categories which were based on the areas of comparison. The following main categories emerged:

1. Different terminology - common meaning
2. Common mathematical concepts
3. Range of mathematics documents

4.2.1 The documents

In the National Curriculum Statement for Mathematics, mathematics is defined and the Learning Area is introduced which includes interrelated knowledge and skills from Grade R to Grade 9. Under knowledge, five areas are indicated and six skills are listed. The purpose of mathematics is discussed as well as the unique features and scope of learning and teaching mathematics (Department of Education, 2002:4-5).

In the Principles and Standards for School Mathematics, five content and five process standards are presented. These standards describe mathematics as a connected body of mathematical understandings and competencies and also specify the understanding, knowledge and skills that students should acquire from pre-kindergarten through to Grade 12 (National Council of Teachers of Mathematics, 2000). The knowledge and skills referred to in the National Curriculum Statement and the content and process standards in the Principles and Standards for School Mathematics are presented in table 4.1 on the next page.
Table 4.1: Knowledge/content areas and skills/process areas

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>The content standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Numbers, operations and relationships</td>
<td>1. Numbers and operations</td>
</tr>
<tr>
<td>2. Patterns, functions and algebra</td>
<td>2. Algebra</td>
</tr>
<tr>
<td>3. Space and shape (geometry)</td>
<td>3. Geometry</td>
</tr>
<tr>
<td>5. Data handling</td>
<td>5. Data analysis and probability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skills</th>
<th>The process standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Representation and interpretation</td>
<td>1. Representation</td>
</tr>
<tr>
<td>2. Estimation and calculation</td>
<td>2. (there is no equivalent to estimation and calculation)</td>
</tr>
<tr>
<td>3. Reasoning and communication</td>
<td>3. Reasoning and proof</td>
</tr>
<tr>
<td>4. Problem posing</td>
<td>4. Connections</td>
</tr>
<tr>
<td>5. Problem solving and investigation</td>
<td>5. Problem solving</td>
</tr>
<tr>
<td>6. Describing and analysing</td>
<td>6. Communication</td>
</tr>
</tbody>
</table>

4.2.2 Scope of the two documents

The National Curriculum Statement for mathematics range includes Grade R to Grade 9, whereas the Principles and Standards for School Mathematics cover kindergarten to Grade 12.

4.2.3 Different terminology – common meaning.

For the sake of clarity while reading, the blue writing refers to the National Curriculum Statement of Mathematics and the red writing the Principles and Standards for School Mathematics in order to demonstrate the different terminology but common meaning.

In the National Curriculum Statement for Mathematics, the Learning Area indicates the content that the learner needs to learn from Grade R to Grade 9 and the standards in the Principles and Standards for School mathematics outlines the content that the student needs to cover from kindergarten to Grade 12. The knowledge and content standards in both documents respectively describe the content that learners should learn, and the skills and process standards refer to the ways of acquiring and using the content knowledge.
The National Curriculum statement refers to learning mathematics as involving interrelated knowledge and skills. The Principles and Standards for School Mathematics describe the acquisition of mathematics as involving connected content and processes. Both documents refer to the process of learning mathematics as interrelated and connected.

The ‘knowledge’ referred to above in the National Curriculum Statement for Mathematics is the outcomes, whereas in the Principles and Standards for School Mathematics the ‘knowledge’ is the content standards. With each learning outcome the assessment standards are listed. The assessment standards for each grade show progression of knowledge, skills and values within the phase. In the Principles and Standards for School Mathematics the expectations comprise of a small number of goals that apply across the grades, which focus on growth in student’s knowledge and sophistication as their progress through the curriculum. Thus, the National Curriculum Statement refers to outcomes and assessment standards and the Principles and Standards for School Mathematics refers to content standards and expectations.

4.2.4 Common mathematical concepts

The assessment standards in the National Curriculum Statement and the expectations in the Principles and Standards for School Mathematic are common mathematical concepts. Referring to the extract in Chapter Three the following assessment standards and expectations are examples of the common mathematical concepts in the two documents.

The first example of the expectation of “Counts with understanding and recognise ‘how many’ in sets of objects” (NCTP, 2000: Appendix) and the assessment standard of “Counts to at least 100 everyday objects reliably, counts forwards and backwards in ones from any number between 0-200, tens from any multiple of 10 between 0 and 200 and fives from any multiples of 5 between 0 and 200” (NCS, 2000:21). Counting is thus the common mathematical concept.

Another example is the expectation of “understands and represents commonly used fractions, such as ¼, ½ and ⅓ (NCPT, 2000: Appendix), and the assessment standard of
“solves and explains solutions that also include unitary fractions e.g. ¼, etc.” (NCS, 2002:21). Fractions are then the common mathematical concept. There are obviously many more but these two have been selected and highlighted by way of example.

It thus, appears to the researcher that the Principle and Standards for School Mathematics have provided guidelines for the National Curriculum Statement. The expectations of the Principles and Standards for School Mathematics indicated the correlation with the assessment standards of National Curriculum Statement for Mathematics.

The content analysis of the two documents resulted in the researcher surmising that the National Curriculum Statement had taken the Expectations of the Pre-K to Grade 2 from the Principles and Standards for School Mathematics, and embroidered on them to provide clear and descriptive assessment standards for Grade R-3 in order to give teachers direction in their teaching. This has been an interesting exercise for the researcher as it answers the question as to where the National Curriculum for Mathematics might have originated from. The reading of both documents has given the researcher more food for thought when planning educational psychological assessment of foundation phase mathematics, as well as more insight into how curriculum-based assessment could be carried out.


In this section the researcher will discuss the final categories that emerged from the constant comparative analysis of the focus group interview, the individual interview and incomplete questionnaires. The integration of these categories will be done with the support of theory from Chapter Two. These findings correlate with the literature and confirm the initial reasons for doing this research topic, which was, determining which guidelines the educational psychologist should consider when assessing foundation phase mathematics. The final and main categories will be re-introduced to refresh the readers memory:
Table 4.2: Final and main themes

<table>
<thead>
<tr>
<th>Final Theme</th>
<th>Final Theme</th>
<th>Final Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational Psychology</td>
<td>Social constructivism</td>
<td>Mathematics Assessment</td>
</tr>
<tr>
<td>• Changes in Ed. Psych/</td>
<td>• Asset mapping</td>
<td>• Change in mathematics</td>
</tr>
<tr>
<td>Medical model</td>
<td>Medical model</td>
<td>assessment</td>
</tr>
<tr>
<td>• Assessment for learning</td>
<td>Inclusive education and</td>
<td>Mathematics assessment</td>
</tr>
<tr>
<td>• Assessment tools</td>
<td>support of the teacher</td>
<td>Curriculum-based assessment</td>
</tr>
<tr>
<td>• Expectations of educational</td>
<td>Bio-ecological model</td>
<td>Barriers to learning</td>
</tr>
<tr>
<td>psychologist</td>
<td>Learning potential</td>
<td></td>
</tr>
<tr>
<td>• Skills of an educational</td>
<td></td>
<td></td>
</tr>
<tr>
<td>psychologist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Feedback from an educational</td>
<td></td>
<td></td>
</tr>
<tr>
<td>psychologist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The educational psychological</td>
<td></td>
<td></td>
</tr>
<tr>
<td>report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Emotional impact of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>assessment</td>
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</tbody>
</table>

4.3.1 Educational psychology

From the data analysis six following important sub-themes were identified and will be discussed under separate headings.

Sub-theme 1: Changes in Educational psychology/ Medical model

The field of educational psychology has felt the impact of the paradigm shift from modernism to postmodernism as discussed. According to the lecturer in assessment, an important change was the “move away from the medical model where a learner was assessed in order to give remedial education in order to fix something in a child” (Lecturer, line 6-8: Appendix, 2). This was emphasised in Chapter Two by Swart et al., (2005:1), where the medical model resulted in learners being labelled and where the problem was seen to be within the child.
Sub-theme 2: Assessment for learning

Another “important change for educational psychology was the understanding that assessment is for learning and for support for learning” (Lecturer, line 5-6: Appendix, 2). This is supported by the literature, where Gipps (1994:3), Pahad (1997:39) and Van den Heuvel-Panhuizen et al., (2003:698) state that the main purpose of assessment is for learning. Assessment should also provide information about learning difficulties to support learners who may be experiencing learning difficulties. In this regard one of the master’s students state that “it should pinpoint the learner strengths and weaknesses and should also be at the appropriate level” (Masters student 6, incomplete question 4: Appendix 3). She continues that “all children can learn” (Lecturer, line 37-38: Appendix 2). Assessing for learning means that there is a belief that all learners can learn in keeping with one of the underlying beliefs in Curriculum 2005, that all individuals can learn (Department of Education, 2002). Therefore, an assessment aims to find out “how can children learn, how do they learn and what support structures are put into place for them to get to the next level” (Lecturer, 3, line 37-39: Appendix 2).

The lecturer explained that a further important development is that the assessment process is not just a once-off occurrence. It is a process of a few weeks and there may be therapy, crisis, community or learning support interventions during that process. From the outset parents are told that as it is a process and that it will be carried out over a couple of days. A master’s student stated that the assessment should be done over a period of time as learners may have an “off” day” (Lecturer, line 176-194: Appendix 2). Simmons (2004:40) confirms this as on any given day learners may be ill, overtired, depressed or simply unhappy. Many an educator can confirm that their learners bring personal issues with them into the classroom. As a result there is always a concern that a single assessment may reflect an inaccurate view of the learners’ knowledge and skills.

McBee (in Simmons, 2004:40) states that “the stress induced in students by the conditions of test-taking and the consequences for test ‘failure’ can become self-perpetuating test anxiety, which can cause students to ‘freeze’ or ‘go blank’ and forget the information they know”. These factors will obviously affect the results of the test.
Gould (in Neisworth & Bagnato, 2004:199) continues to say that “misrepresenting children through mis-measuring them denies children their rights to beneficial expectations and opportunities”. For this reason it is recommended that an assessment takes place over a period of a few days. Therefore, a letter is sent to the school in which they are informed that the assessment process has begun and that it may take a while, as the lecturer stated “this is because schools usually expect immediate feedback” (Lecturer, line 187-190: Appendix 2).

**Sub-theme 3: Assessment tools and skills of an educational psychologist**

Kennedy and Tipps, (2002:150); Smith, (2001:220) and Dednam, (2005:204) state that data-collection tools are observation, interviews with learners, parents, teachers, anecdotal records kept by the teacher, learner’s books including self-assessment and error analysis of their work, portfolios and curriculum-based-assessment. The lecturer confirmed this by saying that “batteries of tests are no longer used, but rather tools of assessment. The assessment process is triangulated by having interviews, observing, recognising artefacts, informal assessment for e.g. a curriculum-based assessment and formal assessment for e.g. an IQ assessment, where applicable. An IQ test as a tool of assessment would only be used if it is relevant and within a specific context” (Lecturer, line:145, 147,191-194: Appendix, 2). According to one of the master’s students, in order to carry out a curriculum-based assessment “the professional must have a sound knowledge of the curriculum” (Master’s student 2, incomplete question 1: Appendix 3). Elliot (2000:61) states that as teachers have become increasingly skilled at curriculum-based assessment, educational psychologists need to contribute to an assessment in a way which will add more value.

**Sub-theme 4: Expectations of an educational psychologist**

- **Expectations regarding an educational psychological assessment**

The teachers stated that they seldom referred a child for an assessment for only a mathematics problem. When they did refer, it was usually for a literacy- and/or an emotional problem or when the teacher believed that the learner needed ‘specialised’
education (Teacher JM, lines 133-136, Teacher K, 139-143, Teacher A, 185, 188-189: Appendix 1). I believe that if teachers received an educational psychological assessment that not only indicated a learner’s IQ score and the grade or age level that they function at mathematically, but one that answered the question as to ‘why’ the specific learner was not making progress, ‘what’ the learner can or can’t do and from the teacher’s point of view, ‘how’ the child can best be helped, more teachers would seek out the advice of an educational psychologist with respect to mathematics (Elliot, 2000:61). Teacher A (line 196: Appendix 1) said that she had never found the mathematics part of an educational psychological report has given worthwhile information. Teacher A (lines 198-199: Appendix 1) continued, “if you’re asking us does it help US, then the answer is no”.

- **Expectations regarding feedback from an educational psychologist**

Teachers felt that they would also like feedback from the therapist and that it should not be given only to the parents as they often did not completely understand it (Teacher JK, lines, 159-16:Appendix 1). She continued that “there’s never a three way conversation where you’re called in and chat and it is said, you know this is what I think is best …” (Teacher, JK, lines 163-165: Appendix 1). From the views expressed by the teachers interviewed, it appears that they have a need for more contact with the educational psychologist regarding feedback, so that they can ask what exactly the problem is and how the teacher can help to fix it. The teachers believed that an educational psychological report and feedback needed to say WHY and HOW (Teacher, A, K, JK, JK, lines 215-215: Appendix 1).

**Sub-theme 5: The educational psychological report**

The general feeling among the teachers was that at the moment, an educational psychological assessment and report did not give a specific answer as to why the child may be struggling. Often recommendations are made to refer for occupational therapy or other therapies (Teacher JR, lines, 172: Appendix 1). The recommendations do not help

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1 MS refers to Master’s student
the teacher because no specific guidelines are usually given for the teachers. The only
time an answer was given was when a diagnosis for specialised education was made
(Teacher JR, lines, 173-177: Appendix 1).

Conversely, it is exciting to see that student educational psychologist’s are working
towards a new approach to report writing. Sattler (2001:677-736) indicates that the
writing of an educational psychological report has changed, from listing and interpreting
quantitative results to a more qualitative and dynamic asset-based approach (Sattler,
2001:677-736). The master’s students stated that an educational psychologist’s report
pertaining to mathematics assessment should be written in “jargon” that make sense to
teachers and parents and that practical suggestions and guidelines to help remove the
barriers to learning are given (Master’s student 1, incomplete question 5: Appendix 3). It
should be directed in a straightforward manner (Master’s student 2 & 7, incomplete
question 5: Appendix 3) to all those who interact with the learner thus, the role of the
teacher and the parents in supporting the learner must also be considered (Lecturer, line
136-137: Appendix 2).

The reader should have a clear idea of the child’s difficulty, but all should not be “doom
and gloom” (MS 2, IQ 5: Appendix 3), therefore “the focus is not the deficits coming
from the medical model perspective, but rather a conversation with the parents about the
child and what can be done to support the child. The same thing should be done with the
teacher” (Lecturer, line 139-142: Appendix 2). Both the lecturer and a master’s student
stated that the report should focus on strengths, assets and abilities and how they can be
utilised to support the learner (Lecturer, line135-137: Appendix 2 & MS 3,4,6 IQ:5:
Appendix 3). Learner’s strengths and weaknesses, their approach to tasks, and the
process of how they attempt to solve mathematics problems with recommendations for
areas that may be causing problems, should also be included. The master’s students
continue that recommendations are aimed to support the learner so that he is able to
benefit in his present environment. The report should include the learner’s background;

IQ refers to the number of the Incomplete Question
the overall achievement based on the assessment as well as the learning outcomes and assessment standards. The approach of report writing would differ depending on the reason for assessment and for whom the report is aimed (MS 3, 4, 5, 9: Appendix 3). “A different report could be written for a professional person.” (Lecturer, line 142-143: Appendix 2).

**Sub-theme 6: Emotional impact of assessment**

One of the master’s students was of the opinion that the learner’s behaviour during the assessment and their experience of the assessment process should also be indicated on the report. Learners should be made to feel relaxed, and an explanation given so that they understand what they are about to do (MS 5, IQ 5 & 2: Appendix 3). The researcher agrees and concurs with (Weeden, et al., 2002:14) where they state that “instruction touches the mind, assessment touches the heart”. Reineke (in Weeden, et al., 2002:15) states that “student’s assessment experiences remain with them for a lifetime and substantially affect the capacity for future learning…emotional charge is part of the character of assessment information”. An anxiety-provoking atmosphere must therefore be eliminated.

The first of the three final categories has been discussed at length. The second final category of social constructivism will now be presented.

**4.3.2 Social constructivism**

An important theme of social constructivism and all its tenets pertaining to the theory was identified from the findings. From the analysis of the data the following sub-themes were developed: learning potential, asset mapping and inclusive education.

**Sub-theme 1: Learning potential**

According to the lecturer, assessment for learning entails initially an indication of where the learner is, and then by using scaffolding one can ascertain what is needed to go to the next level. The assessor must determine how much scaffolding and mediation is needed in the process of learning as well as that which the learner needs to reach his potential
Smith (2001:17) states that by scaffolding (supporting), educational psychologists can help learners to construct their next level of understanding. These mediations challenge the learner at whatever level he is in order to develop his understanding to more powerful level, but would gradually withdraw as the learner reaches a level of constructing his own internalised understanding (Donald et al., 2002:69-70). The lecturer discussed that learning potential can be established by including an assessment of the child’s zone of proximal development (Line 37: Appendix 2). Resing (2000:232) states that measuring learning potential is mainly aimed at assessing how much a learner can profit from incomplete instruction and ‘inferred’ from establishing the amount of help the learner requires during the assessment procedure. The zone of proximal development is also an important indicator of the child’s learning potential, and is part of the scaffolding and supporting process.

The concepts of scaffolding, mediation and the zone of proximal development, ZPD, fall within dynamic assessment (Lecturer, lines 28-33, & 77-85: Appendix 2). Smagorinsky (1995:192,195) defines the ZPD as each person’s range of potential for learning, where that learning results in advancement in development, through the assistance of an adult or more capable peer. Dynamic assessment according to Lidz and Elliot (2000:5) is the assessment of the ability to learn where actual learning is incorporated within the procedure. The lecturer indicated that “dynamic assessment could be either informal or formal for e.g. the Ray secret drawing” (Lecturer, line 37-42: Appendix 2). According to the master’s students the information gained from a foundation phase learner’s mathematics assessment should inform the assessor of the learner’s potential (MS 2, IQ 3: Appendix 3) in mathematics by using the concepts discussed above.

Sub-theme 2: Asset mapping, bio-ecological model and inclusive education

According to the master’s students the information gained from a foundation phase learner’s mathematics assessment should highlight that which the learner is capable of as well as what he finds difficult (MS 2, IQ 3: Appendix 3). It should determine the areas where a learner requires consolidation and support and the kind of support needed (MS 4 & 6, IQ 3: Appendix 3). This approach is known as Kretzmann and McKnight’s asset-
based approach and focuses on what is available for intervention. It moves away from an approach which focuses on problems, needs and deficiencies of the individuals involved in the assessment (Kriek & Eloff, 2003:36, 55). The lecturer states that “to understand the development of the learner in the social context to be able to identify the different area, um, to look at the strengths … that you map all the assets that’s available to support that child’s learning and to focus on the deficits that the child is having” (Line 18-21: Appendix 2). The social context can be explained by referring to Bronfenbrenner’s ecological and bio-ecological model. The lecturer continues to say that by “rather looking at a bio-ecological model of development, to understand the development of the learner in the social context” ensures that relevant contextual factors are incorporated for a coherent overview of the child. These factors impact on teaching and learning, examples of which are socio-historic influences, cultural and economic issues (Lubbe, 2004:319, Mashile, 2000:96 & DoE, 2001:5, 11, 12). These factors need to be considered when working with children’s development or change, and must be seen in context (Swart & Pettipher, 2005:10).

Assessment in the framework of inclusive education has the role of assessing in order to “look at how would you assess, accommodate this learner within a classroom system. Not only in the classroom, but also within the whole curriculum and the whole school context” (Lecturer, line 22-25: Appendix 2). Inclusive education refers to an educational policy which ensures that the full variety of educational needs are optimally accommodated and included in a single education system (Landsberg 2005:17-18).

Social constructivism as a final category has been considered and now the last of the three categories namely mathematics assessment, will be reviewed.

4.3.3 Mathematics assessment

The sub-categories as identified from the data form the important final category of Mathematics assessment. The sub-themes are the changes in mathematics assessment, curriculum-based assessment and mathematics assessment.
**Sub-theme 1: Changes in mathematics assessment**

The lecturer stated that “I will never use just the one-minute test, or the old … University of Cape Town or Durban Westville, all those tests for reading and writing, and for Maths, because I don’t think that they are applicable any more, because the curriculum has changed” (Lecturer, line 97-100: Appendix 2). She continued that “you can’t use those old tests that were utilised for a difference setting, or a different context and different children. The assessment of mathematics is problematic in South Africa at the moment” (Lecturer, line 103-105: Appendix 2).

**Sub-theme 2: Mathematics assessment**

Therefore, continuing from above, in order to do an assessment of mathematics within the new paradigm a curriculum-based assessment should be carried out, in addition, looking at “the books, the child, talking to the child about maths, looking at the child emotionally in terms of maths is linked to anxiety” (Lecturer, line 165-167: Appendix 2). In addition to the learner’s books, interviews with the teacher and parents should be conducted “but, interview with the teacher about the maths, interview with the parent about the maths, I think interview with the learner about the maths, so to me it’s not only about the curriculum, and the curriculum assessment, based assessment, but also broader, influencing this child with the maths. It may be a language thing” (Lecturer, line 168-172: Appendix 2).

According to Prinsloo (2005:37), many South African learners have a dominant language for communication that differs from the language of learning and teaching (LoLT). They are therefore referred to as linguistically diverse learners and may develop learning and academic difficulties as a result of their limited language proficiency in the language of teaching.

When learning a language other than mother tongue, there is a strong likelihood that the learner will make errors in production and/or comprehension and that he will have difficulty in processing information in the non-proficient language (Naude, 2004:122),
therefore according to the lecturer “it may be a language thing” (Lecturer, line 172: Appendix 2). The teachers agreed and stated that all the grades found that word problems and word sums was an area where many learners experienced barriers to learning and felt that it was specifically to do with language and those who struggled with reading (Teachers K & JM, line 88, 91: Appendix 1). The master’s students concur as they state that a mathematics assessment should give information as to whether there is a difficulty in understanding mathematical language as far as second language learners are concerned as language ability may influence mathematical ability (MS 8, IQ 3: Appendix 3).

The teachers stated that other areas where learners experienced difficulty, especially the grade 2 and 3 learners were “conceptualisation, of a number, what a number actually is and the breaking up of a number using spray cards, e.g. 35 = 3 tens and 5 or 30+5” (Teacher A, line 73-78: Appendix 1). Grade 1 children tended to struggle with differentiating between the plus and the minus signs (Teachers JM, line 94: Appendix 1).

Finally, with regards to mathematics assessment the master’s student’s state that the information gained from a mathematics assessment should guide teaching and learning and give feedback to the learner and stakeholders. It should determine whether foundation skills are in place as these would impact on later performance in mathematics. One would be able to ascertain whether the learner has knowledge of all the operations, word problems, timetables, etc. (MS 1, 3, 7, IQ 3: Appendix 3).

**Sub-theme 3: Curriculum-based assessment**

The lecturer stated that “in terms of maths assessment, I want to stress the whole idea of curriculum-based assessment” (Lecturer, line 159-160: Appendix 2). In order to do this the students believed that the assessor should have a sound knowledge of the NCS and the outcomes that are specified in the National Curriculum Statement for that grade. In addition an appreciation of the concepts that learners require in order to successfully do mathematics is needed (MS 1, 6, 9, 10, IQ 2: Appendix 3). The lecturer continued that they [educational psychologists] “would need to look at the revised National Curriculum
Statement for mathematics, look at the outcome for that specific grade and then develop a curriculum-based assessment” (Lecturer, line 111: Appendix 2).

According to Dednam (in Landsberg 2005:204), a curriculum-based assessment should be carried out in order to assess mathematics. The lecturer explained that a curriculum-based assessment is a criterion referenced assessment which will ascertain the criteria that the child has met and what needs to be put into place to support the learner to reach its level (Lecturer, line 124-129: Appendix 2). One of the master’s students stated that the assessment should have content validity, as all sections should be covered (MS 10, IQ 4: Appendix 3).

Regarding the process of assessment one of the master’s students stated that “an assessment should be interactive and the activities assessing the skills must be fun and do-able” (MS 3, IQ 4: Appendix 3). Following from that the researcher believes it would be pertinent to remind educational psychologists of the role of self-esteem and motivation. Studies (in Weeden et al., 2002:15-16) reported that learners who had good levels of self-esteem were more confident and therefore experienced a sense of achievement. As a result they were more likely to profit from schooling and to be successful in life.

At the same time those learners who realised that they were not going to excel in the assessment system experienced a growing sense of alienation, dissatisfaction and boredom. Professionals in the field of education know that this is so. They know the importance of encouragement and the necessity of a sense of achievement for their learners. An assessment experience should ensure that the learner feels a sense of achievement therefore it must have something that the learner is able to do.

4.4 CONCLUSION

The findings of this study were explained in this chapter. The researcher discussed the final categories resulting from the content analysis of the two departmental documents and from the constant comparative analysis of the two interviews and the incomplete questionnaire. All the categories and subcategories were explained and verified with
quotes from the raw data together with evidence from the literature. This brings us to the final chapter, Chapter Five where the guidelines, strengths, limitations and suggestions for further study are presented.
CHAPTER FIVE
GUIDELINES, STRENGTHS AND LIMITATIONS OF THE STUDY,
SUGGESTIONS FOR FURTHER RESEARCH AND CONCLUSION

Figure 5.1: Overview of Chapter Five
5.1 INTRODUCTION
In Chapter Four the findings from the research process were discussed. Themes were identified in order to formulate guidelines for the educational psychologist in the assessment of foundation phase mathematics. This chapter will offer guidelines inferred from those themes. The limitations of the study will be described and the conclusions and recommendations presented.

5.2 GUIDELINES FOR THE EDUCATIONAL PSYCHOLOGIST IN THE ASSESSMENT OF FOUNDATION PHASE MATHEMATICS
Guidelines for educational psychologists wanting to improve their assessment of foundation phase mathematics will be presented based on the research conducted for this study.

A. The Educational Psychologist

• Role of an educational psychologist
According to Naude (in Eloff et al., 2004:120-121), educational psychologists have three roles regarding assessment of mathematics. Firstly, to analyse learners’ learning needs within a specific educational setting, keeping in mind that relevant contextual factors must also be incorporated for a coherent overview of the child such as socio-historic influences, cultural and economic issues (Lubbe, 2004:319, Mashile, 2000:96 & DoE, 2001:5, 11, 12). These factors need to be considered when working with childrens’ development or change, and must be seen in context (Swart & Pettipher, 2005:10).

Secondly, in keeping with learners’ developmental levels to give consultative advice on individualised programme development and implementation regarding procedures, methods and techniques to those who work with the learners, such as teachers and learner support staff. Thirdly, to provide educator support, individualised learning support to specific learners, and parent guidance on issues related to their educational needs. Educational psychologists should be continually
thinking about the efficacy, acceptability, practicality and integrity of assessment practices (Lubbe 2004:324).

- **Guidelines for report writing**

The educational psychologist’s report should be more narrative in form, as opposed to simply listing and interpreting quantitative results. The report should include the learner’s background; the overall achievement based on the assessment, the learner’s strengths and weaknesses, their approach to tasks, and the process of how they attempted to solve mathematics problems as well as the learning outcomes and assessment standards that they are having difficulty with. The report should not be filled with psychological jargon but written in a language that makes sense to the reader. It should be honest stating the child’s difficulty but not overly negative and should focus on the strengths, assets and abilities of the learner and how they can be utilised to support the learner. More importantly the report should contain practical suggestions and guidelines for the teacher and parent for assisting the learner as the recommendations are aimed to support the learner so that he is able to benefit in his present environment. The approach of report writing could differ depending on the reason for assessment and for whom the report is aimed.

**B. Assessment from an eco-systemic perspective**

During an assessment, which should be from an eco-systemic perspective, factors such as the emotional impact of an assessment, extrinsic and intrinsic barriers to learning should be considered. Furthermore, a learner’s language proficiency should be investigated, as language competency is essential for the learning of mathematics. The preceding factors will now be discussed in more detail.

- **Emotional impact of assessment**

Learners about to be assessed should know why they are being assessed and be given some information about the assessment which should decrease anxiety about the process (Burden, 1996:101; Department of Education, 2001:16). The assessor should create a safe and caring atmosphere during the assessment which will help the learner...
to relax (Sattler, 2002:5). Parents should be fully informed about the assessment and how it is to be carried out. The parents will be asked to contribute personally to the assessment process and will be fully informed of the outcome. Assessment procedures should be guided by the principle of respect for all concerned.

- **Language proficiency**

  Language competency is essential for successful performance in mathematics (Naude, 2004:124). Below (Table 5.1) is a checklist of the skills that need to be intact and that the educational psychologist should include in the assessment. These language skills encompass both receptive and expressive language skills. Receptive language is the language an individual thinks with and expressive language is the language a person communicates with. All the areas in the checklist have either or both expressive and receptive language requirements.

<table>
<thead>
<tr>
<th>Table 5.1: Table detailing the language competency skills necessary for the foundation-phase learner</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expressive language</strong> is the process of producing spoken language. Problems may be in remembering and expressing words or child speaks in single short words and phrases.</td>
</tr>
<tr>
<td><strong>Receptive language</strong> is the process of understanding verbal symbols. Auditory problems such as an inability to discriminate between pitch (tone discrimination), single letter sounds (phonemic discrimination) and small word parts within a sentence (morphemic discrimination). Problems in understanding meanings of words or a behaviour where a child repeats words (Echolalia).</td>
</tr>
<tr>
<td><strong>Mathematical vocabulary</strong> is the naming and articulating of mathematical concepts which ensures mastery of mathematics (expressive). It is a requisite for higher cognitive functioning and abstract thought (receptive).</td>
</tr>
<tr>
<td><strong>Ready knowledge</strong> is general knowledge concerning the facts that are essential for adequate functioning inside and outside the school (expressive and receptive).</td>
</tr>
<tr>
<td><strong>Memory</strong> is the ability to store and reproduce verbal and nonverbal information for shorter or relatively longer periods of time. It includes both short-term and long-term memory.</td>
</tr>
</tbody>
</table>
**Associative ability, conceptual thinking and relational thinking skills.** Includes verbal fluency, the ability to show connections between two or more things and the ability to create, originate or visualise an abstract principle.

**Integration of graphic/pictorial information with verbal descriptions.** Problem-solving in mathematics requires concrete practical judgement based on language comprehension, the construction of hypotheses and the reinterpretation of ideas and symbols. During the problem-solving process the relationship between graphic stimuli and representative verbal descriptions must constantly be checked and evaluated.


- **Inclusive education**
  The assessment process should identify barriers to learning with the purpose of improving the teaching and learning process for the learner experiencing barriers to learning thereby effectively changing the very act of assessment into the first steps of learning support in mathematics (Bouwer, 2005:51). Educational psychologists should assess in order to understand the learner’s areas of personal strength and assets in mathematics together with dynamic assessment practices.

- **Assessment from an ecosystemic perspective**
  Assessment needs to be a continuous process that is built into the teaching and learning process. It should be systemic in nature, located within the framework of barriers at the individual, curriculum, institution, family, community and social contextual levels (Department of Education, 2001:16). Barriers to the acquisition of mathematics literacy may be intrinsic and/or extrinsic. Extrinsic barriers are barriers caused by the system, the school and environment (see Table 5.2) on the following page. Intrinsic barriers (see table 5.3) are those barriers within the learner which hamper acquisition of mathematics (Naude, 2004:121-122). Some learners lack experience and are not developmentally ready to learn and others have limited language proficiency. These barriers must be investigated as part of a holistic mathematics assessment.
Table 5.2. Table detailing possible causes of external barriers to learning

<table>
<thead>
<tr>
<th>External barriers to learning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Absenteeism</strong></td>
</tr>
<tr>
<td>Regular absence from school and change of school and the extent to which it happens should be investigated. Learners miss work which involves learning concepts, and this results in gaps in mathematical knowledge which they may find difficult to catch up. The teacher may not be trained to identify and rectify any problems that the new learner may have (Dednam, 2005:199-200).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Inappropriate teaching methods</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>When interviewing the teacher, the educational psychologist must gently probe the following areas:</td>
</tr>
<tr>
<td>o Are learners involved in the learning of mathematics?</td>
</tr>
<tr>
<td>o Are they aware if all learners have the basic preschool mathematical knowledge when they enter school for the first time.</td>
</tr>
<tr>
<td>o How are new mathematical concepts and processes taught or are the learners left to discover them haphazardly on their own instead of the teacher explaining unfamiliar concepts step-by-step.</td>
</tr>
<tr>
<td>o Is the teacher familiar with all mathematical concepts and does she know how to teach it?</td>
</tr>
<tr>
<td>o At what level is the teacher teaching the subject matter? Is it at too high a level- the level of abstraction is too advanced and/or the formal demands too great. These learners then execute the mathematical steps as shown, but do so mechanically and therefore do not have any insight in the process of the problem-solving activity.</td>
</tr>
<tr>
<td>o Does the teacher use drilling of combinations?</td>
</tr>
<tr>
<td>o Is the learning tempo too accelerated? Chinn (2004:10) asks why does mathematics have to be done fast? He says that having to do mathematics quickly can raise levels of anxiety. Anxious learners learn avoidance. Avoidance can reduce anxiety, but not being involved in doing mathematics and practising mathematics does not enhance learning. He believes that it is worth cultivating a slower approach to any problem, and states that the learner must “relax, take their time, review the problem, and consider the alternative”.</td>
</tr>
<tr>
<td>o Find out whether the teacher has labels for children who are having difficulty in mathematics, for e.g. lazy or lacks ability. Often those learners can be identified as having barriers within them (Dednam, 2005:199-200, Malmer, 2004:3).</td>
</tr>
</tbody>
</table>
• Intrinsic barriers to learning

These barriers may affect the acquisition of mathematical skills and range from problems of attention and concentration; poorly developed imagery, memory and abstraction, including mental manipulation; difficulties in symbol substitutions and processing of graphic symbols; difficulties in visual spatial relationships; to difficulties in analysis, synthesis and reproduction of patterns, in seeing whole versus part relationships and in visualisation (Naude, 2004:121-122).

Table 5.3: Table detailing possible causes of intrinsic barriers to learning

<table>
<thead>
<tr>
<th>Intrinsic barriers to learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problems with basic underlying skills</td>
</tr>
<tr>
<td>Underdeveloped <strong>gross motor, visual motor and tactile motor</strong> skills means that learners do not successfully perceive and manipulate objects around them.</td>
</tr>
<tr>
<td>Poor <strong>fine motor co-ordination, tactile kinaesthetic and visual motor integration skills</strong> result in learners not having an opportunity to manipulate 3-D objects, to perceive their texture, size, mass and form, in addition to finding it difficult to write letters and numbers.</td>
</tr>
<tr>
<td>Difficulty with <strong>perceptual skills</strong> means that learners struggle to give meaning to data perceived through one's senses.</td>
</tr>
<tr>
<td><strong>Visual perceptual difficulties.</strong> Weaknesses in spatial orientation and directionality, visual discrimination and form constancy, figure ground discrimination and visual memory result in confusion and difficulties where visual processing is required.</td>
</tr>
<tr>
<td><strong>Auditory perceptual problems.</strong> Problems in this area have less of an effect on mathematics than visual perceptual difficulties however, deficiencies in auditory discrimination, sequencing and memory can affect learners when the numbers sound the same and in counting sequences.</td>
</tr>
<tr>
<td><strong>Problems of attention and concentration.</strong> Learners with short attention spans resulting in distractibility, do not follow all the steps needed to complete mathematical problems, they often do not finish their work and need much repetition and/or help from the teacher. Hyperactive and impulsive learners seem careless and inattentive and make many unnecessary mistakes.</td>
</tr>
</tbody>
</table>
**Reading difficulties.** Poor reading causes difficulties in reading mathematical combinations and construction of word sums as learners cannot read and comprehend the text.

**Emotional problems.** Emotional problems may develop when a learner has a negative attitude towards mathematics, lack self-confidence when doing mathematics, demonstrates passivity during mathematical lessons and anxiety especially when the demands of teachers and parents are very high.


C. **Assessment for learning**

In order to assess whether learning has taken place a process of dynamic assessment can be undertaken. At the same time an asset-mapping approach can be carried out to ascertain the assets that a learner has in order to assist the learner. The approach that a mathematics assessment should take is discussed as well as curriculum-based assessment as a tool of assessment. Tools of assessment are discussed in more detail.

- **Dynamic assessment**

  Dynamic assessment has no one specific approach, it can make use of informal or formal (static) approaches. Therefore this is an approach to assessment which could be successfully used when assessing foundation phase mathematics. This is because a dynamic assessment approach can observe a foundation phase learner’s cognitive processing to understand how that learner thinks and to determine his approach to solving mathematical problems. During a dynamic assessment procedure the educational psychologist can provide mediation in order to observe how much help the learner requires to be successful at the task at hand. The extent to which the learner makes use of manipulatives in mathematical problem-solving can also be observed. Thereafter, the educational psychologist can ascertain whether transfer of learning has taken place by presenting additional tasks. This process of mediated learning in dynamic assessment allows for the creation of a safe environment where the assessor establishes a reciprocal relationship and converses with the learner which would allow for observation of the child’s emotions, motivation and social interaction. These observations would also provide the educational psychologist with
valuable information about the learner who is being assessed regarding his individual assets, as well as information to provide a programme of intervention. In working through the plan of intervention the learner will require support from those around him, be it the teacher or parent. By being part of a system the learner can depend on help from his environment and those who care about him.

- **Asset mapping**

![Asset Mapping Diagram](image_url)

**Figure 5.2: Graphic representation of asset mapping**

An asset-based assessment can be used as part of the mathematics assessment for a foundation phase learner by drawing up an asset map. Asset mapping is a process of making a graphical representation of identified assets in the system where the educational psychologist is working. It is a process of making assets ‘visual’. The first step is to identify the individual’s assets and to place it in the middle of the asset map that is proposed in the book by Ebersohn et al., (2003:15). It is explained how to identify an individual’s assets by dividing them into sections. These sections overlap and are dynamic. In exploring the individual’s assets the educational psychologist should identify the *skills and knowledge* that the learner possesses, for example the learner reads well, or does well at karate, or presents neat work, etc.

*Personal characteristics* should also be acknowledged and may refer to an individual’s core capacity for self-awareness, for self-regulatory behaviour, for empathy, and the ability to calm themselves. It could include characteristics such as tolerance, social skills, effective problem-solving and time management, as well as an
ability to listen, accept, care and to generally have a positive attitude to life’s problems (Ebersohn et al., 2003:21).

The area of interests, values and experience could also be considered, although this is an area which relates to potential assets for the foundation phase learner. The fact that an individual already has an interest in something or values something deeply, is already an asset (Ebersohn et al., 2003:22). This means that not only will the child be receiving support in the area that he struggles with, but his self – who he is – will be validated.

The principles of assessment in an Inclusive Education and Training System are that educators, parents and learners need to be centrally involved in the process. It must be fair, bias free and sensitive to gender, race, cultural background and abilities.

- **Mathematics assessment**

The assessment process should be interactive and concrete aids should be available, whereby the child is able to demonstrate whether certain foundational skills are in place. Many of these skills will overlap with emergent literacy skills, for example spatial orientation, sequencing, patterning, number concepts, shapes, etc. The mathematics assessment should ascertain how the learner understands mathematical concepts and how they are able to apply that mathematical knowledge.

- **Curriculum-based assessment**

A good knowledge and understanding of the National Curriculum Statement for Mathematics and how to achieve the outcomes is required. The assessment should be planned based on the assessment standards to be achieved. Thus, as educational psychologist it would be useful to get hold of a copy of the NCS for Mathematics and use it when planning a curriculum-based assessment.

- **Assessment tools**

An assessor should use information from a variety of sources and the assessment should be varied. An assessor should have clearly defined criteria, methods, tools and
techniques to assess learners. For example, curriculum-based tools, standardised testing, dynamic assessment and an informal games approach should be used. In addition, looking at samples of work to track progress, asking for information from the teacher as to what is expected from the learner in that particular grade, reviewing the work covered, looking at the learner’s book in order to triangulate findings will be invaluable to the assessment.

5.3 FINAL CHECKLIST FOR AN EDUCATIONAL PSYCHOLOGIST IN THE ASSESSMENT OF FOUNDATION PHASE MATHEMATICS

Based on the preceding research and using the tables of language competency, extrinsic and intrinsic barriers to learning as a guide, a final checklist for the educational psychologist was compiled. The idea is that the educational psychologist should interview the learner, his or her parents or caregiver and the teacher, ensuring an ecosystemic approach to the assessment and based on the information given begin to complete the checklist. The educational psychologist could also request permission to spend some time observing in the learner’s classroom during a mathematics lesson and together with the information gleaned from the time spent in observation as well as from the interviews the educational psychologist can begin to complete the checklist. Many of the skills mentioned in the checklist can be assessed and confirmed during the assessment process with the learner.

<table>
<thead>
<tr>
<th>Table 5.4: Final checklist for the educational psychologist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input from teacher/parent (interview)</strong></td>
</tr>
<tr>
<td>Language proficiency</td>
</tr>
<tr>
<td>Mathematical vocabulary</td>
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<tr>
<td>Mathematical ready knowledge</td>
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<tr>
<td>Memory</td>
</tr>
<tr>
<td>Associative ability, conceptual thinking, relational thinking skills</td>
</tr>
<tr>
<td>Integration of graphic/pictorial information and verbal descriptions</td>
</tr>
</tbody>
</table>
### Extrinsic barriers to learning

<table>
<thead>
<tr>
<th>Absenteeism</th>
<th>Inappropriate teaching methods: are learners involved when learning mathematics?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of pre-school mathematical knowledge</td>
<td></td>
<td></td>
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<tr>
<td>Method of teaching mathematical concepts</td>
<td></td>
<td></td>
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<tr>
<td>Level of teachers’ mathematical teaching skills</td>
<td></td>
<td></td>
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<tr>
<td>Are drilling of combinations taught?</td>
<td></td>
<td></td>
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<tr>
<td>Level of subject matter taught</td>
<td></td>
<td></td>
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<tr>
<td>Learning tempo- too fast</td>
<td></td>
<td></td>
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<tr>
<td>Maths avoidance taking place?</td>
<td></td>
<td></td>
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<tr>
<td>Does teacher label children?</td>
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<tr>
<td>Lazy, or lacks ability</td>
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<tr>
<td>Learner participation during lessons</td>
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</tbody>
</table>

### Intrinsic Barriers to learning

<table>
<thead>
<tr>
<th>Gross motor skills</th>
<th>Input from teacher/ parent (interview)</th>
<th>Achieved</th>
<th>Partially Achieved</th>
<th>Experiences Barriers (difficulties)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine motor co-ordination</td>
<td></td>
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<td></td>
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<tr>
<td>Visual motor co-ordination</td>
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<tr>
<td>Perceptual skills- visual</td>
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<tr>
<td>-auditory</td>
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<tr>
<td>Problems of attention and concentration</td>
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<tr>
<td>Completion of work</td>
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<tr>
<td>Reading difficulties</td>
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<tr>
<td>Emotional problems</td>
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<tr>
<td>Lack of self-confidence</td>
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<tr>
<td>Mathematics anxiety</td>
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<tr>
<td>Mathematics/ Curriculum-based</td>
<td>Input from teacher/parent (interview)</td>
<td>Achieved</td>
<td>Partially Achieved</td>
<td>Experiences Barriers (difficulties)</td>
</tr>
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<td>-------------------------------</td>
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<tr>
<td>Counting skills: Grade 1: to 34 2: to 100</td>
<td>Achieved</td>
<td></td>
<td></td>
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<tr>
<td>Forwards and Backwards</td>
<td>Achieved</td>
<td></td>
<td></td>
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<tr>
<td>Recognition of number Grade 1: to 100 Grade 2 to 200 Grade 3 to 1000</td>
<td>Achieved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writes numbers Grade 1: to 34 Grade 2 to 100 Grade 3 to 1000</td>
<td>Achieved</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Common fraction</td>
<td>Achieved</td>
<td></td>
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<tr>
<td>Place value</td>
<td>Achieved</td>
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<tr>
<td>Working with money</td>
<td>Achieved</td>
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<tr>
<td>Sharing and grouping</td>
<td>Achieved</td>
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<tr>
<td>Calculations: addition</td>
<td>Achieved</td>
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<td></td>
<td></td>
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<tr>
<td>: subtraction</td>
<td>Achieved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>: multiplication</td>
<td>Achieved</td>
<td></td>
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<td></td>
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<tr>
<td>: division</td>
<td>Achieved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doubling and halving</td>
<td>Achieved</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Patterns</td>
<td>Achieved</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Space and shape</td>
<td>Achieved</td>
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<tr>
<td>Measurement</td>
<td>Achieved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data handling</td>
<td>Achieved</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment of assets</th>
<th>Input from teacher/parent (interview)</th>
<th>Reported by learner</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual assets: skills and knowledge that the learner possesses (e.g. karate, works neatly)</td>
<td>Achieved</td>
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<tr>
<td>Personal characteristics (empathy, tolerance social skills)</td>
<td>Achieved</td>
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<td>Interests, values and experience</td>
<td>Achieved</td>
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<td>Parental support</td>
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<td>Caregiver</td>
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<td>Support in school environment</td>
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<td>Extended family</td>
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5.4 STRENGTHS AND LIMITATIONS OF THE STUDY

5.4.1 Strengths

The strength of this study can be found in the representativeness of sources used, as many different sources were referred to in order to comprehensively search the literature. In addition, triangulation was used by including a literature review, an individual and focus-group interview and incomplete questionnaires in order to verify the information found in the literature.

5.4.2 Limitations

One of the limitations of this process is that I did not tape the interview with Mr Bopape. If I had I would have been able to transcribe the interview and would have been in a better position to accurately indicate the process of the mathematics curriculum development. The limitation was that I had to rely on notes taken while in the interview and it is impossible to write down everything said. As a result I am sure I missed some important information.

Another limitation is that the sample of teachers was small (four) and only from one school. It would have been interesting to speak to small groups of teachers from a number of schools and in differing socio-economic milieu’s.

In addition, I interviewed the students and a lecturer from only one university. It would have been useful to speak to masters’ students and a lecturer of assessment from a couple of other universities.

5.5 SUGGESTIONS FOR FURTHER RESEARCH

The assessment of mathematics from the educational psychologist’s point of view needs to keep up with current trends. It would be useful for further research to be done in curriculum-based mathematics assessment in terms of developing a more comprehensive assessment or one using dynamic assessment principles. Another area of research would
be to see how the results of a curriculum-based mathematics assessment would correlate to an intellectual assessment. Finally, educational psychologists and teachers could use this checklist in practice and from the feedback tailor it to make it user-friendly.

5.6 CONCLUSION

The aim of this study was to investigate guidelines for the educational psychologist in the assessment of foundation phase mathematics, in the light of Outcomes-based education, which is the philosophy of education in South Africa at present. Outcomes-based education has necessitated far-reaching changes in education and assessment alike. Educational psychology has not been untouched and is also required to re-look its approach to assessment generally and of mathematics specifically.

Within the new paradigm, I believe that it is necessary for educational psychologists in South Africa to develop an approach to the assessment of foundation phase mathematics that will yield credible information in order to support the learner in the best way possible. It is hoped that these guidelines will assist educational psychologists to begin this process.

Finally, I would like to conclude with a quote that, for me, is a reminder of why the process of assessment is so important.

_There are few injustices deeper than the denial of an opportunity to strive or ever hope, by a limit imposed from without, but falsely identified as lying – within._

(Gould in Niesworth & Bagnato 2004:199)
BIBLIOGRAPHY


APPENDIX 1: TRANSCRIPT OF THE FOCUS GROUP INTERVIEW
WITH THE TEACHERS


1. R: My first question is, you ladies are all working now with the revised National
   Curriculum tell me how you finding it?
2. A: Are we talking about OBE methods now?
3. R: Just to put it into context did you all work with the revised, uh, with the draft
   curriculum in numeracy, did you all work with that one?
4. A: Yes probably if this the….. , if this is one's about two or three years old ?
5. R: I am talking prior to that, the draft numeracy policy document was
   implemented in '97 because it was written in '97. Did you all work with that?
6. JR: Yes
7. A: Yes
8. K: Ja
9. JM: Yes
10. R: How did you find that one first of all? Let, lets go back a step.
11. A: Quite structured I must say, and quite formal um, ja possibly the…. the newer
   one is a bit more user friendly and I know it's cliched, but it is, although there are
   still some statements in that document, that we sometimes think what is that
12. you're actually wanting. ja, and perhaps that's just uselessness on our part, but
13. you know, but if you've got 12 teachers together I don't think, you know, if one of
   us are not understanding it then I can say that makes sense, but with the amount of
   people that are saying, ooh maybe it's this or maybe it's that, you know, then surely
   it's an indication that perhaps there is something or perhaps they can reword it, to
   make it even more user friendly.
   JR: Revise it again
14. A: Yes revised the revised
15. R: Going back to the, um, draft numeracy statements how did you find that?
17. R: More so than the revised?
18. K mmmmm, yes
19. A: Let me exclude myself this point I before that any other time before that I was
   not in the teaching game so for me initially to use these new documents was ja
   quite difficult to get into.
20. K: Last year, we had, at least for the past three years an NGO at the school that I
   was teaching at called SUPEDI, I do not know if you aware of it, and they actually
   made that quite user friendly they took the document and they set it out, the
21. outcomes and the assessment standards and we covered the whole lot throughout
the year. Aah it required lots of money because they had to purchase all the um
necessary equipment and aids that we needed, but I found that aah fantastic
worked like a dream, and I think we were basically spoonfed because you know
they started right at the beginning they told us what we needed to recap on and
what we needed to reinforce then they worked out your lesson for you, what
apparatus to use, and questions to pose it was very good.
R: That was the revised curriculum or the draft?
A: That was fortunate, we didn't get that.
JR: So where were we?
K: The revised, the latest, the latest ja
R: So you found that very useful.
K: Ja, that that was useful. I've actually got the file
JR: We must have a look at it sometimes
A: Bring it to school
R: So what I hear you saying is that the first um draft was actually more useful?
JR: yes
A: Ja
JR: Although 'cause I found it more structured and more specific, more to the
point, but here as A was saying that, that um ja sometimes you actually think now
what are we actually supposed to be assessing, what are you actually meaning,
from the document
JM: I'm on the whole I'm happy with this one, I remember working, you know,
every year was, we had to do our prep, re-do our prep for the entire year, um and I
am happy with this the latest one. I feel it was a step forward to the other one, it's
more refined.
A: It's probably the language is better than the old one.
JM: Ja
K: Ja
K: Ja, it's definitely better, but coming from lets call it your disadvantaged schools,
where I come from, the language usage the ability to master the language was
actually a problem. You're actually, not you know, familiar or actually aware of
what is required of you, some of you know the terms.
A: Ja, I was going to say that.
R: The draft as opposed to the revised?
Mmmmmmmmmmm
R: Great thanks, now getting onto..........., what do you as teachers find are the
most common areas that children struggle with maths?
A: Where does one start? Conceptualisation of a number, of what a number
actually is. Cause, even I am now a grade three teacher, I was in grade two last
year, some children know well how to work with numbers but they have actually no concept of the number and understanding.

R: So they do not understand that 35 is for example………..

A: 30 plus 5, 3 tens and a five.

K: We're actually battling with that.

J.K: We are working with that at the moment to try to get them to…………… that is the point I am trying to make. I know from grade two and still in grade three,
	rightly or wrongly, I hope I am doing the right thing, I was going to say discard the prep, no, I haven’t done that but I'm back to what I was trying to do in grade two, I am just re-hashing, working with those flaaad cards, so that understand they understand what a number is made up of.

R: So you find that a common problem?

A: I found that and I um…

K: Word problems. Though I also find problem sums.

JK: Yes

JM: That's a good one.

JM: In Grade 1 in it is a language which thing, they have to learn to read before the story sums makes sense. But we find we teach addition in a specific way 2+2=

something. As soon as you present addition in a different way jumbling up your sign or your = sign that they are lost, the majority. The same with minus.

A: As you saying it's more they cannot bring…………..

K: A child who cannot read………………………….

R: And if you do it orally?

K: It does make it better

A: We do that often as well.

R: But you do find that it continues to be an area of weakness.

A: No, but it is better and even in grade three go back to the practical then we work with them in a smaller group and if they managed to get it orally, well, then they have achieved something.

J.R: Our initial step with word sums it to draw the sum, so that it becomes concrete, it becomes a visual thing and if they cannot visualise it, you know, they might get to a step where they do not have to draw it.

A: With this one the kids have to work with very, very large numbers and it introduced just like that.

What are your expectations when you refer a child to educational psychologist for an assessment, in respect of mathematics?

J.K: I think firstly by referring I would then admit that I can't find out what the problem is, um … So hopefully they would be able to, to narrow it down and say listen we've got a problem with reversing or number recognition or so a), they
would be able to correct it with long-term programmes or therapy or whatever.

and say listen your child has an O.T. problem or a left or right or co-ordination problem. Ja I would think it needs to be narrowed down or help so that we could narrow it down.

A: Or either that or often I find for myself as well, if you have got 30 children in your class which you have, and am not undermining their abilities but sometimes they just need that extra one on one that you can't give them in the classroom you know, it almost makes you feel guilty that he is going to therapy when you could actually, if you just had the time to work with that child, I believe, that's for myself, I know a lot of those things … but your day doesn't allow for it and in that regard I think the kids are at a major disadvantage. Because, you know, but I know that we're one of the better classes but I still think is that 30 to 1 with what I want to do with my children is too much to give effective, effective individual attention.

R: So are you saying that when you refer the child you are in a way saying that if I had more time I could actually probably help.

A: Not all of them but there have been occasions where I think you know, or is if possibly the parents can work…. but you know jolly well that if finances if you know it comes easier, you're buying time.

JM: Not always, I refer for assessment when uh, for instance I see that they cannot understand the concept of plus or minus and the basics even with reinforcement and drilling and with bonds. And also when there are, you know, emotional problems at home or with the family.

R: It is well-known, that there is a connection between emotional problems and maths.

K: What I find rather interesting is that kids tend to have a problem with phonics and reading, and out of the group of 30 I worked with about 48 last year, out of a group of about 48, you would have maybe 5 of being who would have numeracy tendency is more to literacy, but as J. said the minute the child can't add or subtract then that child … we need to do something.

R: Do you feel that your query or concerns are met, regarding a report or when the educational psychologist phones you or do you just get a written report? Do you find that regarding that you are given an answer as to why this child may be struggling?

A. My answer is no? I was just go to say to J. that is great that you send to these people but what do they do to make him understand maths that you can’t.

JK: No, what do they do better to make him understand than you.

JM: Well the sometimes there the diagnosis, that actually as much as I would try its not going to help any way, that they would need specialised education, special
ed.

177. JK: That is why I was saying that hopefully they could narrow it down.
178. R: Do you think educational psychologists do that?
179. JK: Not always no.
180. JR: and very often we have just referrals on to occupational therapists, that's
181. about as far as it goes.
182. JK: Ja, also the feedback, look I, uh I must admit that people obviously come to
183. the school and they've got 6 or 7 children but as the teacher I would like all the
184. feedback from the therapist as well. You know they give a written report to the
185. parents and the parents don't understand half the things and then parents come to
186. you and I say well I haven't seen the report, so there's never that three-way
187. conversation where your either called in and chat and it is said, you know this is
188. what I think is best for your or ............
189. A: I. You know and sitting here thinking, that we do need to speak to the therapist
190. and we can say to the therapist "listen here, what is this okc's problem,
191. how … what must we do in the classroom to help him.
192. JK: You know, like a fix-it programme.
193. A: Ja
194. JK: We want that and its not a quick fix either
195. JR: Sometimes I get feedback from the occupational therapist, you know in grade
196. one you can actually do that, but not from the educational psychologist. What I
197. have had from the educational psychologist is that this child is not going to
198. actually cope in mainstream grade one, they will have to find a school that offers
199. special ed. There has been the odd child that has been moved to another school
200. into special ed.
201. R: So that’s a particular report that you have found has guided you possibly?
202. JR: Yes
203. R: But as for child who remains in your classroom? … I picked up somebody said
204. they don't tell you what you can do ........
205. A: That goes back to what K was saying they generally focus on literacy.
206. JK: Mostly, literacy. Now that you've mentioned I don’t think I have ever referred
207. a child for numeracy.
208. A: This has made me suddenly think I don't think I have referred for a maths
209. problem.
210. K: For numeracy?
211. A: I have referred cause there's a problem but never mainly … they might be
212. linked per se, like reversing number or numerals … or sentences.
213. K: …or word sums.
214. JK: Absolutely
R: And you know when you have referred a child, and if it is for numeracy if can you recall back to a feedback be it a report, or a face-to face interview or a telephonic conversation the maths part of the report did it give you worthwhile information?

A: No not that I can recall ever.

JK: I never had … worthwhile as in a diagnosis.

A: Yes in X and Y and Z and they often say what's recommended at the back, he needs therapy, he needs to see…. But as you say if you're asking us does it help had the time I know exactly what to do with this lad to help. As I say, I am not undermining anybody but…….

JR: But you would have to work an hour or two with him alone every day

A: Absolutely….and that’s the downfall….because it is….

K: One-on-one

JR: Practise over and over

A: Somewhere between 1 and 10 they have to cotton on unless there's something seriously amiss.I think.

R: But I am sure you would pick that up.

A: Yes, you know as JR says you've got a kid that’s got emotional problems and the whole lot lumped together…

R: And the word diagnosis……so am I right you, know, in saying what I hear is that you would like to know WHY?

A. K. JR. JK. Ja and HOW

A: How can we help him? Practical suggestion for us. And we go to courses at JCE and often we walk out and say we do that in class and it helps 70% of your children and if you do it a bit longer it will reach 80% but there are still children that at the end of the year you say you know what I did with this child in maths…..

Nothing? A good start would be more time.
APPENDIX 2: TRANSCRIPT OF THE INDIVIDUAL INTERVIEW WITH THE LECTURER

R=Researcher   L=Lecturer

1. R: Tell me about the changes in assessment?
2. L: Okay, Veronica, do you want to talk about changes in general in education
3. or in Educational psychology?
4. R: Educational psychology
5. L: Okay, I think uh, that in terms of both. I think the most important change
6. for me was the understanding that you assess for learning. Um, If you moved
7. away from the medical model when you talk about remedial education and that
8. you assess in order to give remedial education, that you assess in order um, to fix
9. something in a child, to support, and support for learning, assessment for learning.
10. Okay, so I think that is one of the significant changes in terms of assessment is the
11. basis from which to work.
12. R: That’s been the move.
13. L: That’s the whole move. And then in addition to that I think the changes in
14. assessments got a lot to do with the, the social constructivist perspective, from a
15. medical model to social constructivist perspective. And including that social
16. constructivist perspective as Cecilia Bower talks about in her book in chapter 3,
17. um is the idea of rather looking at a bio-ecological model of development, to
18. understand the development of the learner in the social context to be able to
19. identify the different areas, um, to look at the strengths, because as Cecilia
20. mentions about asset maps, that you map all the assets that’s available to support
21. that child’s learning and also focus on the deficits that the child is having. Also
22. the whole idea in the framework of education that you look at how you would
23. accommodate, how would you assess, accommodate this learner within a
24. classroom system. Not only in the classroom system but within the whole
25. curriculum, the whole school context.
26. So I think there’s been significant changes in terms of assessment areas. That’s in
27. short.
28. R: Super. I’d like to just pick up on two things. When you say “assess for
29. learning” - learning potential, or learning as to where they are or where they need
30. to be.
31. L: I think it’s both. I think its, ..the first place I want to see where they are, right
32. okay, it’s the scaffold, it was the scaffolding that’s needed, Ala Vygotski for
33. them to go to the next level.
34. R: Yes, so it’s not so much learning to fix up.
35. L: No
36. R: It’s learning and how can we help to continue with the process.
37. L: It’s like I’m saying that all children can learn, okay, I want to find out how
can they learn, how do they learn, how can I scaffold, put into place support
structures for them to get to a next level.
38. R: And how much scaffolding and mediation is applicable
39. L: And how much scaffolding and mediation do I need within that process of
learning.
40. R: I gathered that. Then the other thing I want to pick up on is when you
41. spoke about the development of the learner, I can’t help but going back to my
own training, thinking of, you know, the lower developing, or the slower
developing child and so on; that remains significant, doesn’t it?
42. L: Okay, just hang on a second, Are you looking at development and you’re
saying, “do I look slower learners ….” You see I think I look at development
within the bio-ecological model. So I look at development within the context. In
other words, if there’s a learner who’s experiencing HIV/Aids, and HIV/Aids in
the home, then my assessment is also going to focus on the support that that
learner will need, in order to be able to work with this, huge challenge in their
lives.
43. R: Absolutely. Look how being a, perhaps a parent whatever, will affect.
44. L: Yes. Okay. So before our interruption we talked about the development, I
think the development against this model, in the framework of this model.
45. R: For me, I’m finding it difficult to make that shift because I still think of,
for example that test, I just can’t think of the name offhand, I’m a bit rusty, where
we take those little babies and we, you know, assess them - 0 to 2 and what they
should be able to do and so on.
46. L: Yes, yes.
47. R: That wouldn’t really be applicable in the South African context, or not to
the same extent?
48. L: Not to the same extent. You see you come from a bio-ecological model,
you would say to yourself, Okay, Erikson, Piaget, Kolberg, all of them are
relevant, because they give me guidelines and tips on development, moral
development, cognitive development, whatever. But, I cannot just apply those
developmental theories and theories of learning, or whatever I use, on to the
South African context, I’ve got to look at the social context.
49. R: Because there’s children less, who have less development
50. L: And that has had influence on the learning. So that’s why again I’m saying
we assessing for learning, in order to put the support in place, to support this
learning in order for this learner to develop, to grow, to be able to learn, to go
forward.
R: And would you say that the zone of proximal development is one of the most important indicators of that child’s potential? That learner’s potential?
L: I think so. Well, how do you understand the zone of proximal development?
R: I understand that if you extend the child a little bit, or give him little clues, little cues, to answer a particular challenge, depending on how quickly he picks up. Have I understood it correctly?
L: Okay, yes I think maybe we understand a bit different. I would think it’s very much part of the whole scaffolding process, in which you can do ……..
R: Yes, it’s much the same thing, scaffolding and support.
L: Yes, I think so, it’s much the same thing.
R: Okay, great.
L: Okay, now are you going to use that in your transcript?
R: Right, now,
L: Is that clear, Veronica?
R: Yes, thank you. And fortunately, you know as I say, I’ve had this all this background reading, so you’re making sense. When I saw you the first time, perhaps I didn’t really know what you were saying and it’s making sense now.
R: Can you tell me about the changes in Mathematics assessment as part of an Educational Psychology assessment?
L: oi, yoi yoi … Veronica, I will never use just the one-minute test, or the old, what’s it, it’s that University of Cape Town, or Durban Westville, all those tests for reading and writing, and for Maths, because I don’t think that they are applicable any more, because the curriculum has changed.
L: So that’s not part of any assessment process that you can follow.
R: So how would we Educational Psychologists then do, or tackle a Maths test? Would they do a curriculum based assessment?
L: A curriculum based assessment
R: i.e., they would go to the revised National statement, have a look at what’s needed to,
L: At the outcome for that specific grade,
114. R: And then question that child, on this.
115. L: And then develop a curriculum based assessment.
116. R: And is that what a curriculum based assessment is?
117. L: Well, if you go back to this chapter, in terms what Cecilia says,
118. because that’s the most important thing, is to really, um, let me put it this
119. way. I think if you can see it in terms of the difference between a
120. criterion referenced assessment and a norm referenced assessment.
121. R: Yes, Okay.
122. L: That the formal IQ assessment will be norm referenced.
123. R: All right.
124. L: Your curriculum based assessment will be criteria referenced.
125. R: What criteria has the child met.
126. L: Yes.
127. R: In terms of reaching that outcome.
128. L: What needs to be put in place to support this child to get to its
129. reach level.
130. R: Okay, so it’s a change in terminology.
131. L: Yes, it’s quite a change in terminology.
132. R: Alright, tell me about the changes in Educational psychological
133. report writing.
134. L: Okay. I think if you listen to what we’re saying in terms of a
135. assessment for learning and then you’re report is going to focus on, what
136. is the strengths here, the assets, how can that be utilized to support the
137. learner? Also what can the teacher do or what can the parent do to support
138. the learner? So the focus is not, it’s not a type of report any more where
139. you talk about all the deficits, okay, and you talk from the medical model
140. perspective, but where you really change to have a conversation, I think,
141. with the parents, about the child, what could be done to support the child.
142. The same with the teacher. Obviously for a professional person, I would
143. still write a totally different report because they want something different.
144. R: Yes, so IQ is still used? You test IQ batteries?
145. L: I don’t talk about, of a battery. I don’t talk of a battery of tests. No.
146. R: What is the…?
147. L: I talk of a process of assessment, and the tools that you use within
148. that assessment.
149. R: Okay. So would an IQ test be a tool towards…?
150. L: One tool, yes, if it’s relevant within that specific context. If it’s not
151. relevant to that specific context, and to the development of the child, I will
152. not do it.
L: Okay, Helen, I think you’ve pretty much answered my, these last two questions, but I’m going to read through them anyway:

What is your opinion of the assessment of Mathematics by an Educational Psychologist?, and the last question would be.

R: How in your opinion could it change or improve to add value to the assessment process?

L: Yes, I think in terms of Mathematics assessment, I want to stress the whole idea of curriculum based assessment. If it’s a smaller child, there is the Vassie, which is a …

R: I’ve got it.

L: A South African norm test, but as you know it doesn’t go up far.

Yes, the Mathematics and the assessment of Mathematics is problematic at the moment. Okay, so the books, the child, talking to the child about Maths, looking at the child also emotionally in terms of Maths is linked to anxiety and all those things and it also influence.

But, interview with the teacher about the Maths, interview with the parent about the Maths, I think interview with the learner about the Maths, so to me it’s not only about the curriculum, and the curriculum assessment, based assessment, but also broader, influencing this child with the Maths. It may be a language thing,

R: Yes.

L: Okay.

R: As Naude in Eloff and Ebershon.

L: Yes, so to look broader than that perspective. Okay. Then the last one, “How in your opinion could it change, improve,” Yes, I think the most important thing about the development the last few years, is that the assessment process is not a once off process. You cannot have just a Saturday morning and assess that child and be done.

R: Yes.

L: To me, it’s a process of a few weeks. And there may be interventions in that process. There may be therapy intervention, or a crises intervention, or a learning support intervention. Or a community intervention in that process.

R: Yes. How many….

L: Okay. Also I, we now say to the parents from the start, it’s a process, we give them a little letter to say to the school that we are investigating the process, it’s going to be quite a while. We don’t want a school to expect immediate feedback report. And we also say to the schools that an IQ assessment is not the only assessment. If we can
triangulate the assessment process by having interviews, observations, recognition of artefacts, informal assessment like curriculum based, and the formal assessment where applicable.

R: Yes. And you’ve mentioned asset based assessment more than dynamic assessment, it doesn’t mean….

L: Not asset based assessment, was more asset mapping.

R: Okay. Yes.

L: So an assessment of the assets within the social context.

R: Yes. And what I really wanted to say is, so asset mapping, but then your curriculum based, your formal and informal and your interviews with the learner would all be much from a dynamic standpoint. Wouldn’t it?

L: No, the dynamic assessment to me is different in the sense that dynamic assessment…

R: Looking at scaffolding?

L: Really looking at scaffolding. Really mediating. Really looking at where’s the child now, what needs, what support does he need to go to the next level. Dynamic assessment is part of in a sense sometimes informal assessment or it can also be part of the formal assessment, the Ray secret drawing, for example,

drawing, for example,

R: Yes, and curriculum based?

L: Umm, No.

R: Not really, hey

L: Yes, I suppose I haven’t thought about that Veronica, curriculum based assessment, dynamic assessment. I suppose curriculum based assessment can be part of the process of dynamic assessment. Yes, but I’m not… I’d have to think about that!

R: Okay, I’m just wondering.

L: Okay?

R: Thank you very much.

L: Is that all?

R: Absolutely

L: You’re sure?

R: Yes, thank you.
The following appendices follow:

APPENDIX 3  COMPLETED INCOMPLETE-SENTENCES QUESTIONNAIRE

APPENDIX 4  EXAMPLE OF HOW THE RESEARCHER CODED SENTENCE 1 OF THE INCOMPLETE-SENTENCES QUESTIONNAIRE
Incomplete sentences questionnaire aimed at M2 Students at University of.

1) Mathematics assessment of a foundation phase learner entails a process whereby the child is able to demonstrate whether certain foundational skills are in place. These would include spatial reasoning, sequencing, patterning, number, concept, shapes etc. Many of these skills overlap with emergent literacy skills.

2) In order to carry out the mathematics assessment I would do a dynamic assessment, looking at samples of work to track progress and I would also use an informal, possibly games approach to assess whether these skills are in place.

3) The information gained from a foundation phase learner's mathematics assessment is necessary in determining whether foundational skills are in place as these will impact on later performance in years 1. It will give an indication of areas that you could assist the child in as well.

4) In my opinion, for a mathematics assessment to have value it needs to be taken, and all areas of development that affect performance must be assessed. The child also needs to have a sense of achievement, therefore activities assessing skills must be fun and do-able.

5) An educational psychologist's report pertaining to mathematics assessment should depend on what the report is for and the reason for assessment. I would obviously approach differently. However, the focus needs to be on the child's assets and abilities, and approach to tasks, with recommendations for areas that may be causing problems.

Thank you so much for your opinion and input.
1) Mathematics assessment of a foundation phase learner entails concrete activities to assess what the learner is able to do at school in maths and what they transfer with a related to curriculum.

1) Mathematics assessment of a foundation phase learner entails the professional having a sound knowledge of the outcomes that are specified in the National Curriculum Statement.

1) Mathematics assessment of a foundation phase learner entails a process whereby the child can be assessed whether within foundation skills are a place. These skills include spatial reasoning, shapes, patterns, numbers, concepts, shapes, etc. Many of these skills overlap with emergent literacy skills.

1) Mathematics assessment of a foundation phase learner entails determining the learners ability over concept of maths. It should be interactive.

1) Mathematics assessment of a foundation phase learner entails number operations and relationships, patterns, functions, and algebra; space, shape, and measurement; and data handling.

1) Mathematics assessment of a foundation phase learner entails questioning what ground work has been covered (the foundational concepts) has the learner is able to apply practically their mathematical knowledge. Determining what is understood with regard to mathematical concepts.

1) Mathematics assessment of a foundation phase learner entails checking out and investigating the difficulties learners that learners might be experiencing when it comes to maths.

1) Mathematics assessment of a foundation phase learner entails to gather valid and reliable information about the learners performance and to make judgement about the learners performance.

1) Mathematics assessment of a foundation phase learner entails understanding of number relations, patterns, shapes, measurements and data collection and handling.

1) Mathematics assessment of a foundation phase learner entails knowledge of the process for most grade 1 work covered in class. That the learner knows and an appreciation of concept foundation.
18th April 2006

Dear fellow Master's in educational psychology students

I am a Foundation phase teacher and am presently doing my research mini-dissertation towards the master's degree in educational psychology. I am thus approaching you as both teachers and students, in order to assist me in gathering some information pertinent to my study.

This letter serves to inform you of the aim of the incomplete sentences questionnaire and to request your permission to be part of this study and at the same time to inform you of the procedures.

The aim of this study is to provide guidelines for the educational psychologist in the assessment of Foundation Phase mathematics in the light of the revised National curriculum Statement. Firstly, your participation should be completely voluntary. Once you have agreed to participate, I will be seeking your written input and opinion on the themes surrounding the issue. I would like to assure and guarantee you anonymity, where no references will be made to names at all, and that what you write will remain confidential and secure. Once the study has been completed I will inform you of the outcome of the study.

Please complete and sign:

I acknowledge that my participation in the completion of the 'incomplete sentences questionnaire' is voluntary and agree to participate:-

Signed_________________________________

24th April 2006
Dear fellow teachers

I am a Foundation phase teacher and am presently doing my research mini-dissertation towards the master's degree in educational psychology. I am thus approaching the Foundation phase teachers at your school in order to assist me in gathering some information pertinent to my study.

This letter serves to inform you of the aim of this focus group, to request your permission to be part of this study and at the same time to inform you of the procedures.

The aim of this study is to provide guidelines for the educational psychologist in the assessment of Foundation Phase mathematics in the light of the revised National Curriculum Statement. Firstly, your participation in this focus group should be completely voluntary. After you have agreed to participate, I will be seeking your input and opinion on the themes surrounding the issue. I would like to inform you that our discussion will be taped and following from that would like to assure and guarantee you anonymity, where no references will be made to names at all, and that what you say will remain confidential and secure. Once the study has been completed I will inform your institution of the outcome of the study.

Please complete and sign:

I acknowledge that my participation in this focus group interview is voluntary and agree to participate:-

Signed__________________________________
### APPENDIX 6: TABLE OF MATHEMATICS ASSESSMENT

**BATTERIES USED BY EDUCATIONAL PSYCHOLOGISTS**

*Assessment batteries most frequently used by educational psychologists*

<table>
<thead>
<tr>
<th>Battery</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old T.E.D. one-minute test</td>
<td>One-minute test; tests all four operations separately (+, -, -, x)</td>
</tr>
<tr>
<td>Leicester Number Test</td>
<td>Tests basic number concepts and skills (1970)</td>
</tr>
<tr>
<td>Vernon Graded Arithmetic-Mathematics Test</td>
<td>Test (1976)</td>
</tr>
<tr>
<td>Young Group Mathematics test</td>
<td></td>
</tr>
<tr>
<td>Keymath-diagnostic arithmetic test</td>
<td>Test (1971)</td>
</tr>
<tr>
<td>UCT Maths test</td>
<td>All items are word problems</td>
</tr>
<tr>
<td>Milne Basic processes</td>
<td>All four operations tested, horizontal layout of sums</td>
</tr>
<tr>
<td>Intellectual Quotient tests</td>
<td>Numerical sub-tests</td>
</tr>
</tbody>
</table>