THE IN-SERVICE EDUCATION AND TRAINING (INSET) NEEDS OF EDUCATORS OF PRIMARY SCHOOL MATHEMATICS

BY

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DECLARATION

I hereby declare that this dissertation is my own work and that all the sources I have used or quoted have been indicated by means of complete references.

RANJINI NAIDOO

January 2003

DEDICATION

This dissertation is dedicated to:

My husband and daughter who have been a source of inspiration and encouragement to me.

All the senior primary mathematics educators who feel the need for professional growth in our rapidly changing world.

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ACRONYMS/ABBREVIATIONS USED IN THIS STUDY

AMESA - Association of Mathematics Education of South Africa
B.A. - Bachelor of Arts
B.Ed. - Bachelor of Education
B.Sc. - Bachelor of Science
CASME - Centre for the Advancement of Science and Mathematics Education
C2005 - Curriculum 2005
DET - Department of Education and Training
ERIC - Education Resources Information Centre
HOD - House of Delegates
HOR - House of Representatives
HSRC - Human Sciences Research Council
INSET - In-Service Education and Training
KZDEC - KwaZulu Department of Education and Culture
KZN - KwaZulu-Natal
KZNDEC - Department of Education and Culture: KZN
LACs - Learning Area Committees
LEAs - Local Education Authorities
M.Ed. - Master of Education
MCPT - Maths Centre for Primary Teachers
NED - Natal Education Department
NFER - National Foundation for Educational Research
NGOs - Non-Governmental Organisations
NQF - National Qualifications Framework
OBE - Outcomes Based Education
PGCE - Postgraduate Certificate of Education
PRESET - Pre-Service Education and Training
RADMASTE – Research and Development in Mathematics, Science and Technology
RDP - Reconstruction and Development Programme
SABINET - South African Bibliographic Information Network
SAQA - South African Qualifications Authority

TOPS - Teacher Opportunity Programmes
USSR - Union of Soviet Socialist Republics

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Curriculum 2005

In-Service Education and Training (INSET)

KwaZulu-Natal (KZN)

Mathematics education

Mathematics educators

Mathematics teaching

Outcomes Based Education (OBE)

Pre-Service Education and Training (PRESET)

Primary schools

Senior primary phase

ABSTRACT

This investigation is primarily concerned with the In-Service Education and Training (INSET) needs of primary school mathematics educators. The research is grounded in the proposition that in order for senior primary mathematics educators to keep abreast with the current knowledge explosion and rapid rate of technological growth, they are under serious obligation to improve their expertise, knowledge and skills in mathematics teaching and learning through INSET. Pre-Service Education and Training (PRESET) serves only as preparation for entry into the teaching profession and cannot last the whole teaching career. INSET is thus necessary for the senior primary mathematics educator's continuing education.

In this investigation an attempt is made at establishing a framework for INSET and mathematics educators. It is hoped that these theoretical frameworks will enable mathematics educators to cope with the changing needs of senior primary mathematics education.

There is no doubt that the developments of senior primary mathematics education and INSET in the United Kingdom can have a profound effect on the senior primary mathematics education in South Africa. The extent to which the developments in the United Kingdom influences the educational initiatives presently being undertaken in South Africa will depend upon those who teach senior primary mathematics and those who are responsible for the provision of INSET of senior primary mathematics educators.

The past South African discriminatory policies led to numerous iniquities in the provision of mathematics materials and development of mathematical human resources. Consequently, there is a large number of unqualified and under-qualified mathematics educators especially amongst Blacks in South Africa. It is through INSET that this condition can be rectified.

A questionnaire survey revealed that senior primary mathematics educators are fully conscious of the importance and significance of

INSET. The recommendations made for the INSET of primary school mathematics educators based on the literature survey and the empirical investigation are: the need to establish a national and provincial policy for the INSET of primary school mathematics educators; there must be a concerted effort to establish school focused INSET; many of the methods of INSET courses emphasising the participative approach needs to be explored; the value of teachers' centres as exciting brokers for new ideas and as networks for personnel proves invaluable and finally, pivotal to the INSET of primary school mathematics educators is the need for them to update their in-depth knowledge of mathematics.

There is no doubt that the INSET of primary school mathematics educators is a crucial factor in KwaZulu-Natal (KZN). It is clear from this research that INSET for both academic and professional upgrading of the senior primary mathematics educators and the improvement of mathematics teaching and learning in the primary school is only limited by one's imagination.

CHAPTER ONE

ORIENTATION

1.1 INTRODUCTION

In South Africa, the need for large-scale educational changes has largely been articulated in response to the educational system of apartheid. The entire curriculum shift in post apartheid South Africa, essentially seeks to alter educators' classroom practices. Sarason (cited in Hargreaves, 1994:49) echoes that significant change in curriculum is unlikely to be successful if serious attention is not paid to educator development. Skemp (1989:211) commenting on educator development states the following:

> ***'Those who learn from one who is still learning drinks from a running stream, those who learn from one who has ceased to learn drinks from a stagnant pond.'***

This comment is as applicable in 2003 as it was in 1989. Whatever the underlying drives of educational change may be, any debate on the pivotal role of educators as frontline implementers of changing classroom practices, must focus on the need for educators to be involved in ongoing programmes of professional development. In keeping abreast with the current knowledge explosion and rapid rate of technological growth, educators are under serious obligation to improve their expertise, knowledge and skills through In-Service Education and Training (INSET).

Pre-Service Education and Training (PRESET) serves only as preparation for entry into the teaching profession and cannot last the whole teaching career. Bagwandeen (1991:1) affirms that, the education of educators does not end with their departure from University or College. He elaborates further that, as long as knowledge about education continues to evolve and new techniques and devices are established, there will be something new for educators to learn, regardless of their qualifications or years of experience.

Hofmeyr (1994:37) in remarking on INSET in the South African context claims that INSET requires an enabling policy framework which links PRESET and INSET in a continuum of educator development. She claims further that, educator development must be underpinned by the values of non-racism, non-sexism, democracy, equity and empowerment and that educator competence should be based on effective classroom teaching and learning. This leads the researcher to the following statement made by Darling-Hammond (1997:155):

> ***'The quality of teaching and learning in countries like Germany, France and Japan are considerably better due to their preoccupation with making direct investments in continuous training and capacity-building of their teachers.'***

1.2 FACTORS LEADING TO THE RESEARCH

The motivational factors for undertaking this research are two fold. Firstly, personal experience has led to an interest in the teaching of mathematics in the senior primary phase and secondly, current reform initiatives call for reflective practices.

The researcher, a senior primary mathematics educator, has experienced disappointment over the years by the observed conservatism displayed by educators introduced to new ideas in the teaching of mathematics. Educators lack enthusiasm towards methods of instruction different from the 'educator tell' type of lesson. Furthermore, educators still believe that they are sole transmitters of knowledge. These beliefs could provide a barrier to facilitate opportunities for learners to learn mathematics independently.

This lack of enthusiasm for innovation and change is problematic in a context in which changing classroom practices, based on an alternative paradigm shift for teaching and learning mathematics is being introduced. This envisaged research, seeking to examine the INSET needs of primary school mathematics educators with particular reference to senior primary mathematics in KwaZulu-

Natal (KZN) is a response to the more reflective role required of mathematics educators.

1.3 STATEMENT OF THE PROBLEM

Initial reading indicated that the INSET needs of senior primary mathematics educators as a theoretical and conceptual study was neglected in South Africa. This could be largely attributed to the fact that, under the previous government of apartheid, the fragmented Departments of Education had their unique problems and each Department attempted to resolve these problems in the best way it deemed fit.

With regard to the INSET needs of senior primary mathematics educators, it was resolved to analyse and evaluate the theories, methodologies as well as various models of INSET and primary school mathematics. The critical questions that emanated from the statement of the problem are:

- What are the strategies concerning the INSET needs of senior primary mathematics educators?
- What is the theoretical and conceptual framework that would inform the provision of INSET of mathematics educators at the senior primary level?

Sub-questions arising from these critical questions are:

- What can we learn from the experiences of the INSET of senior primary mathematics educators in a developed country?

- What are the problems relevant to the INSET of senior primary mathematics educators in KZN?

- What are the views of educators about expressing the problems they experience in mathematics teaching in the primary schools in KZN?

- What are some of the conclusions and recommendations that could lead to the effective provision of INSET of senior primary mathematics educators?

1.4 THE PURPOSE OF THE RESEARCH

The basic aim of the present research is to examine ways in which mathematics teaching in the senior primary phase can be enhanced through INSET. The following specific aims may be listed:

- To determine the theoretical and conceptual framework that would lead to the effective INSET of senior primary mathematics educators.
- To determine who is responsible for the provision of INSET of senior primary mathematics educators.
- To determine the possible problems that could be encountered in the provision of INSET of senior primary mathematics educators.
- To determine the nature of INSET courses for senior primary mathematics educators.
- To determine the need for mathematics educators to keep abreast with the developments in mathematics.
- To undertake an empirical investigation with respect to the provision of INSET of senior primary mathematics educators.
- To make recommendations for the effective INSET of senior primary mathematics educators.

1.5 RESEARCH METHODOLOGY

A descriptive and qualitative analysis mode of study was employed. McMillan and Schumacher (1993:373) argue that qualitative research is concerned with understanding the social phenomenon from the participants' perspective. Understanding for McMillan and Schumacher is acquired by analysing the contents of the participants and by narrating meanings for these situations and events. Participants' meanings include their feelings, beliefs, thoughts and actions.

Bogdan and Biklen (1982:27) list the following characteristics of qualitative research:

- It has the natural setting as the direct source of data.
- It is descriptive, with emphasis on words rather than numbers.
- It is concerned with processes rather than products or outcomes.
- Data is analysed inductively.
- Meaning made by different participants is of essential concern.

In addition to an empirical investigation of the research topic through the use of questionnaires, source material was also derived from various sources. Reference will now be made to the various sources.

1.5.1 **DOCUMENTARY STUDY**

A detailed literature review comprising books, Sabinet, Eric and HSRC database, university catalogues, internet, relevant articles in periodicals and journals and research dissertations and theses were used to obtain information on the following:

- Theories, methodologies as well as various models of INSET and primary school mathematics.
- The evaluation of mathematics teaching and the INSET of senior primary mathematics educators in England.
- The general provision of INSET in KZN prior to 1994.
- Current educational reforms in South African education.

1.5.2 **RESEARCH BY QUESTIONNAIRE**

In attempting to evaluate the INSET of senior primary mathematics educators in KZN, an empirical investigation through a questionnaire (See Appendix H) was undertaken: the objective being to collect necessary data and feedback. In addition, permission was granted to conduct the research by the Acting Director: Education and Support Services (See Appendix E).

The questionnaire was designed taking cognisance of the increasing awareness for the improved INSET of senior primary mathematics educators. This increasing awareness could be attributed to the current educational reforms and changes in classroom practices.

Questions were also included in the questionnaire to collect updated data concerning the educator's mathematics qualification, gender, age and mathematics teaching experience. These details were integral to the research as they affect the special circumstances of educators such as:

- Married women having to have special requirements in terms of the INSET course timing and attendance.
- The younger educators' needs for INSET would differ from the needs of experienced educators.

1.6 ASSUMPTIONS AND LIMITATIONS OF THE RESEARCH

1.6.1 ASSUMPTIONS

This study is based on the following assumptions:

- That mathematics teaching in the primary schools require specialised educators.
- That INSET be used as the vehicle for effective mathematics teaching and learning in the primary school.
- That INSET requires a policy framework that must be enshrined in legislation by a committed state.
- That school focused INSET is a recurring process leading to ongoing educator development in mathematics teaching in the primary school.

It is also assumed that the mathematics educators in the primary schools responded without bias or prejudice to the questions included in the questionnaire. In this regard, a letter was attached to the questionnaire explaining the collation of data (See Appendix F). In selecting the schools, it is assumed that the sample of educators who completed the questionnaire is a good approximation of the total population of senior primary mathematics educators in KZN.

1.6.2 LIMITATIONS

Like many research studies of this nature, the study has the following limitations:

One limitation concerns the return rate of questionnaires. 74% of the educators responded. It was not possible to determine why 26% of the original sample preferred not to participate in the study. Furthermore, it cannot be determined whether their non-participation has had a significant impact on the outcome of this study.

Another major drawback in this research was the limitation experienced by the researcher in locating source materials concerning the INSET of senior primary mathematics educators in a developing country (See Appendix A, B and C). Due to this limitation, the sub-section concerning the INSET needs of primary school mathematics educators in a developing country was excluded in this study. This is regrettable, because in order to contextualise the research topic, this information would have been of integral value.

1.7 RESEARCH LOCATION

This research was undertaken in the province of KZN. It involved a sample of primary schools as time, safety and cost made it impossible for the researcher to send questionnaires to all the primary schools in the area of study.

1.8 THE POTENTIAL SIGNIFICANCE OF THE STUDY

The potential significance of this research is to:

- Provide a theoretical and conceptual framework that would lead to effective INSET of senior primary mathematics educators in KZN.
- Highlight the current INSET of senior primary mathematics educators KZN.
- Contribute to further research on the INSET of senior primary mathematics educators.

1.9 THE STRUCTURE OF THE RESEARCH

This study is comprised of six chapters:

In Chapter One an orientation of the research is presented. An introduction to the study, factors leading to the research, a statement of the problem, the purpose of the research, the methods used in the study, the assumptions and limitations of the research, research location and the potential significance of the study are presented.

Chapter Two is critical to the study as it presents a theoretical and conceptual framework. The definitions of INSET and concepts relevant to INSET and mathematics as a discipline are discussed. This is followed by the aims and objectives of INSET and mathematics. Selected models and theories associated with INSET and mathematics are also enunciated.

In Chapter Three a brief history of mathematics is provided, followed by a presentation of the evolution of mathematics teaching and the INSET of senior primary mathematics educators in England.

Chapter Four focuses on the general provision of INSET in KZN prior to 1994. This is followed by an evaluation of the current INSET of senior primary mathematics educators in KZN. The contribution of Non-Governmental Organisations (NGOs) is also highlighted in this chapter.

Chapter Five discusses the empirical investigation. A description of the research methodology including the instrument, the selection of samples and the techniques employed were given. This was followed by a detailed analysis of the data obtained from the questionnaires

Chapter Six comprises findings, recommendations and conclusion based on the general survey and the empirical investigation discussed in Chapter Five.

1.10 CONCLUSION

In this chapter, an introduction to the study was provided. Factors leading to the research, statement of the problem and the purpose of the research were outlined. In addition, a description of the method of study, assumptions and limitations of the research, the research location and the potential significance of the study were detailed, followed by an outline of the structure of the study. The outline of the structure of the study took the form of a synopsis of the content of each chapter of this study.

In the next chapter a theoretical and conceptual framework of the research topic will be outlined. This chapter is critical to the study, as it would inform the provision of INSET of senior primary mathematics educators in KZN.

CHAPTER TWO

CONCEPTUAL AND THEORETICAL FRAMEWORK

2.1 INTRODUCTION

In this chapter, the broad perspective of the theoretical and conceptual framework for the INSET of educators with reference to mathematics will be presented. The first part of the chapter reviews the theoretical constructs of INSET. The second part of the chapter underscores the theoretical considerations related to mathematics.

2.2 THE RELEVANCE OF THEORY

Referring to Garrison (1989:111), Bagwandeen (1999:88) declares that:

> ***'Theory is important to any field of study to establish its identity, recognition, conceptualisation and development.'***

In this regard, Moore and Kearsley (1996:197) asseverates:

> ***'Theory is very, very valuable. A theory is a representation of everything that we know about something. Theory gives us a common framework, a common perspective, and a common vocabulary that help us ask questions in a sensible way and make sense of problems.'***

(As quoted by Bagwandeen, 1999:88)

This contention is supported by Rubin (1978:313) who states that:

> ***'... the great value of theory is that it tells us how to achieve the goals we seek.'***

(Bagwandeen and Louw, 1993:69)

It is perhaps for this reason that Dewey said 'nothing is as practical as good theory,' (Moodley, 1992:193). As will be indicated in this chapter, the researcher selected key theories concerning INSET and mathematics, which in her considered opinion, could form the theoretical basis for the provision of INSET and for the upgrading and improvement of mathematics education at the senior primary level.

2.3 THEORIES RELEVANT TO INSET

2.3.1 INTRODUCTION

Watkins (1973:12–18) contends that support for INSET comes from social, political, scientific and technological changes and growth in knowledge. Their effect on the school curriculum and teaching methods also have a vital impact and need for INSET. Educators need to adapt to these changes and INSET is a vehicle through which these changes can be met.

INSET caters for the professional growth of educators because the initial training gained by educators cannot equip them to cope with complex, demanding and changing needs of education. Viewed against this background, Pather (1995:19) maintains that, INSET should relate to all forms of activities, both formal and non-formal on a continuing basis. This will help educators to improve their professional competence and the quality of education.

With regard to the theories relevant to INSET, the researcher referred primarily to four sources, namely, Bagwandeen (1991:42–111; 132–136; 1999:52–67), Hofmeyr (1991:295–349) and Pather (1995:19–34;78–82). The afore-mentioned sources confirmed the need and value of INSET for educators across the spectrum.

2.3.2 DEFINITION OF INSET AND CONCEPTS RELEVANT TO INSET

2.3.2.1 DEFINITION OF INSET

With regard to the definition of INSET, Bagwandeen (1999:54) states that Bolam and Porter (1976:3) noted that, 'no agreed definition exists for INSET.' Pather (1995:30) states further that 'there are as many definitions as there are INSET programmes.' Hofmeyr (1991:57) concludes that 'INSET suffers from a lack of agreed definitions and nomenclature resulting in INSET meaning different things to different people.' In light of this, Pather (1984:19), in his research undertaken on the professional development of educators, states that:

> ***'In-service education and training (INSET), in-service training, in-service education, professional development and teacher development are often used interchangeably for all the activities that contribute to the continuing education programme of professional personnel in the field of education.'***

In the absence of consensus with respect to the definition of INSET, the researcher chose to discuss a few important definitions. Bagwandeen and Louw (1993:19; see also, Bagwandeen, 1991:42; 1999:54–55) maintain that, the definition of INSET depends to a large extent on the emphasis that is placed on it in terms of its plan or design. INSET would include such aspects as updating educator skills and knowledge without a change in role; preparation of new roles and positions; upgrading and improvement of professional and academic qualifications; external or internal school provision; focus on pedagogical issues and needs; and programmes available throughout the careers of educators. Cane (1969:X) in the 1960s stated that INSET refers to:

> ***'…all those courses in which a serving teacher may participate for the purpose of extending his professional knowledge, interest or skill. Preparation for a degree, diploma or other qualification subsequent to initial training is included within this definition.'***

Bagwandeen and Louw (1993:20) declare that this definition was proposed as the outcome of a major survey undertaken by the

National Foundation for Educational Research (NFER) in England and Wales. They conclude that this definition was seen as one which was tighter and central in its approach towards intended experiences. It presupposes that activities should be planned deliberately in order to effect specific changes that will ultimately result in improving the educator's performance in school.

Thompson (1984:4–5) defines INSET rather broadly as:

> *'... the whole range of activities by which serving teachers and other categories of educationists within the formal school systems may extend and develop their personal education, professional competence and general understanding of the role which they and the schools are expected to play in their changing societies. INSET further includes the means whereby a teacher's personal needs and aspirations may be met as well as those of the system in which he or she serves.'*

(Ashley and Mehl, 1987:82)

With regard to Thompson's definition, Pather (1995:30) states that, while the definition includes both the individual's and the system's needs in its approach, Thompson also restricts his definition to the formal school system. He states further that Hartshorne (1985:9) recommends that Thompson's definition, if amended by omitting the phrase 'within formal school systems,' could allow for 'some flexibility' and 'provide a starting point for further discussion.'

According to Bagwandeen (1999:55) a detailed analysis of the literature of INSET undertaken from an international perspective enabled him to concede that the definition suggested by Henderson (1977:163; 1978:11; 1979:17) was generally applicable to most of the objectives of INSET:

> *'... in-service education and training, may, in the most general sense, be taken to include everything that happens to the [teachers] from the day [they take] up [their] first appointment to the day [they retire] which contributes, directly or indirectly, to the way in which [they execute their] professional duties.'*

Bagwandeen also maintains that this definition has been predicated on the commonly accepted view that INSET embraces the many professional experiences of educators. In their aggregate such experiences promote the ultimate upgrading and improvement of the qualifications of educators. Bagwandeen (1991:49; 1999:56; see also, Bagwandeen and Louw, 1993:20; Pather, 1995:31) conclude that a single definition would not satisfy every need and facet. The determination of such a definition is a complex and formidable task. With regard to this, Pather (1995:31) argues further that it is the absence of consensus and conformity on the definition of INSET that can lead to paradigm shifts. Depending on their own assumptions the variety of INSET providers can transmit different signals to the same group of clients as to what INSET is.

Besides the lack of a uniform definition of INSET, there are various concepts relevant to INSET. We need to consider the various concepts related to INSET.

2.3.2.2 CONCEPTS RELATED TO INSET

Pather (1995:19) maintains that a wide range of terms is used to refer to INSET. For the purpose of this study, the researcher chose to give a brief overview of the following terms that are used interchangeably with INSET by many researchers.

2.3.2.2.1 CONTINUING EDUCATION

Continuing education for educators in particular, can be summarized as, the provision of opportunities for qualified educators to update their professional knowledge, skills and attitudes to enable them to remain competent educators. With respect to this, Bagwandeen and Louw (1993:24; see also, Bagwandeen, 1999:57) maintain that, continuing education is seen as a purposeful interlacing of induction, renewal and redirection accentuating career – long teacher education.

2.3.2.2.2 STAFF DEVELOPMENT

Bell (1991:89) asserts that staff development refers to the activity of ensuring the personal development of the staff of the school. Furthermore, Hewton and Jolly (1991:3) claim that staff development refers to:

- any activity involving individuals or groups of staff which is undertaken to enhance knowledge, skills or behaviour or to change attitudes for the benefit of learners, schools and their staff, and
- the creation of settings which encourage and enable changes.

The researcher is of the firm belief that educators must grow and mature in their field. Growth is related to an increase in the amount and quality of knowledge possessed by individuals. Maturation means that the individual has been able to interrelate the knowledge of various types in order to reinforce the goal achievement, which each individual is entitled to identify (Sebolai, 1995:45). A static state would refer to a state of decay rather than growth. In this respect, Wideen and Andrews (1987:108) asseverate:

> ***'A teacher who is not growing personally and professionally is unlikely to make significant developments in the classroom program.'***

2.3.2.2.3 RECURRENT EDUCATION

This concept makes reference to the incompleteness of Pre-service Education and Training (PRESET), as part of the initial training of educators. Referring to Cropley and Dave (1978:41), Bagwandeen and Louw (1993:21) describe recurrent education as:

> *'That aspect of INSET which alternates periods of teaching service with periods of further training or other forms of training. These would include components that would be seen as formal, non-formal and informal.'*

2.3.2.2.4 PROFESSIONAL GROWTH / DEVELOPMENT

This concept underpins the argument that educators should be exposed to learn rather than to live through the familiarity of daily events. In this regard, Bagwandeen (1999:58) refers to Rudduck (1987:129) who maintains that:

> *'Professional growth / development of teachers signifies inter-alia, the capacity of a teacher to remain curious about the classroom; to identify significant concerns in the process of teaching and learning; to value and seek dialogue with experienced colleagues as support in the analysis of data; and, to adjust patterns of classroom action in the light of new understanding.'*

2.3.2.2.5 ON-THE-JOB TRAINING

According to Bagwandeen (1999:59) this concept is the handmaiden of INSET, not only for the beginner educator but also in the execution of innovative concepts for the older educator. Moreover on-the-job training empowers educators to learn to observe their own classroom activities as well as those of others, to reflect on such practices, recognise problem areas, discuss and effect solutions, evaluate the results and modify responses in the light of such evaluations. These are key elements of INSET.

Having considered the various terminologies associated with INSET, we now need to consider the objectives of INSET. This will be discussed as general and specific objectives.

2.4 OBJECTIVES OF INSET

2.4.1 INTRODUCTION

For the effective provision of INSET, it is important that general and specific types of objectives be established and communicated to all involved in INSET programmes.

2.4.2 GENERAL OBJECTIVES

Conceptual clarity can be obtained by setting the following general objectives.

- The improvement of the competencies (job performance) of individual educators (including those in managerial positions) and whole school staff.

- Extending the experience of individual educators for career development or promotion purposes.

- Developing the professional knowledge and understanding of each educator and extending the personal or general education of an educator.

(Pather, 1995:34)

2.4.3 SPECIFIC OBJECTIVES

INSET can be directed towards the attainment of certain specific objectives. These can be listed as follows:

- Extension of knowledge.
- Familiarization with curriculum development and new methods.
- Acquaintance with the psychological development of children and the youth.
- Acquaintance with the sociological basis of education.
- Acquaintance with the principles of organisation and administration.

- Positive retraining of educators returning to school after a period of absence.
- Conversion and re-tooling of educators especially for scarce subjects.
- Mastering of new aids and technology of education.
- Familiarity with changes in local and national policy.
- Comprehending the new relationship between educator and learner.
- Understanding the cultural revolution.
- Development of measuring and testing techniques.
- Acquaintance with and participation in educational research.
- Legal requirements.
- Combating 'burn out' among educators.

(Bagwandeen, 1991:89–111; 1999:60–62; see also, Bagwandeen and Louw, 1993:43–45)

These objectives of INSET may differ with regard to approach, strategy and implementation. However, the common thread is that all are concerned with the upgrading and improvement of the professional competence of the educators. Furthermore, it is also important to note that to satisfy these objectives, coordinated efforts of all providers of INSET are essential. The researcher is also confident that a sound theoretical knowledge of INSET models can also contribute to the achieving of these objectives by educators. It is for this reason that INSET models that bear relevance to this study will now be discussed.

2.5 MODELS OF INSET

2.5.1 INTRODUCTION

With respect to INSET models, Joyce (1980:32), a leading American authority on teacher education, had forecast that, in the near future, it is unlikely that a model which is both comprehensive and specific enough to be useful, could be designed for any education system. Two decades have lapsed since this statement has been made and although there have been much research, development, evaluation and improvement of INSET methods, leading to more refined models, there has not been the construction of new models. This could be attributed to the several problems that make the construction of new models in INSET so complex. A discussion of the several problems is beyond this study. However, reference can be made to Pather (1995:66–69) and Bagwandeen (1999:63–64). While several models and typologies of INSET exist, the Traditional INSET Model and the Life-Long Learning/Continuing Education INSET Model will be discussed. These models are deemed most pertinent to this study.

2.5.2 THE TRADITIONAL INSET MODEL

This model presently used by the South African Education Departments refers to curriculum related courses in which Education Department officials explain changes. These could apply to syllabus revision, teaching methods and organisational development in school. Groups of educators meet on a regional basis in a lecture or workshop situation in schools or teachers' centres. According to Pather (1995:74–75) the following criticisms have been levelled at the use of this model:

- Department officials offer solutions to problems without taking into consideration that the problems may not be the same in all schools.
- Even when a common problem is addressed by an INSET course, the conditions, facilities, resources, qualification and experience of participating educators may vary from school to school.
- Course members have minimum communication with programme leaders after they return to their schools. This does not allow for much development and can minimize change, both, in the individual and the school.
- Minimal effects of the model can also be attributed to limited or no follow-up support.

Pather (1995:77) claims further that, despite the above criticisms, and similar to all other models of INSET, the Traditional INSET Model has the following advantages:

- Educators from different backgrounds in meeting outside their school can acquaint themselves with problems in education.
- Educators can identify and redefine their future needs.
- Educators can also in an atmosphere of professional co-operation evaluate their own work and the status of the subject they teach, such as in the case of this study, mathematics.
- Such meetings also tend to reduce educator isolation.

Pather (1995:78) also maintains that in order for this model to have greater impact by facilitating change, both in the educator and the school, the following have to be assured:

- Proper needs assessment.
- Homogenous grouping of participants.
- Follow-up and on-site support.
- Adequate time must be allocated for the experimentation of new ideas so as to ensure that follow-up could be undertaken.
- On-site success will depend on resource back up and guidance to Heads of Department.

2.5.3 **THE LIFE-LONG LEARNING/CONTINUING EDUCATION INSET MODEL**

Pather (1995:79) affirms that life-long learning or continuing education through INSET may be defined as the means through which educators can evaluate themselves to being true professionals so that they can adjust to changes. Pather believes that in order for life-long learning or continuing education to be successful the following should apply:

- The concept should be introduced as early as possible, in that, educators in training should be exposed to the principles and importance of continuing education or life-long learning.

- The educator has to adapt an attitude of critical questioning, a keenness to keep abreast of development in education and to participate voluntarily in professional activities.

The important aspects of the processes of life-long learning is that while educators obtain formal qualifications, they should also respond to informal INSET programmes such as reading professional journals, attending seminars and conferences and becoming active members of subject societies (Pather, 1995:80). Based on this discussion, the researcher concedes that the Life-Long Learning/Continuing Education INSET Model views INSET as effective when it is part of training that continues over an extended period.

Having discussed two INSET models the researcher is of the firm belief that if these models are to be successful, educators should adopt a positive attitude to change. The researcher being a mathematics educator is constantly involved in pedagogical conversations with fellow mathematics educators and is therefore of the view that educators are resistant to change. One reason advanced for this view is the limited or lack of knowledge of the theory of change. The researcher therefore finds it pertinent to this study to devote a section to the theory of change.

2.6 THEORIES OF CHANGE

Hofmeyr (1988:17) alludes to the fact that a major theme in practically all the literature on INSET is change (Bagwandeen, 1991:136).

In education particularly, Barbara D. Day (1981:vii) points out:

> *'... the school or staff which does not change and grow is destined to atrophy, to become obsolete, and to be a burden rather than a bulwark to us and to the communities we serve.'*

(Bagwandeen and Louw, 1993:72; see also, Bagwandeen, 1991:138)

Bagwandeen and Louw (1993:72–73; see also, Bagwandeen, 1991:138) state further that educational institutions are caught up in the ebb and flow of change in society. The school as an important educational institution will carry the double burden of maintaining traditional values while preparing society's young members to deal with a changing world.

INSET is seen as the mechanism for change. In theory the purpose of educational change is to help schools accomplish their goals more effectively by replacing some programmes or practices with new ones. Change suggests the acquisition of new teaching skills or the introduction of new resources which imply a modification of the logic of teaching (Bagwandeen, 1991:73; see also, Bagwandeen and Louw, 1993:73).

2.7 SUMMATION

In concluding this section it is important to note that in our rapidly changing world, traditional structures, truths and knowledge are questioned and changed at a very fast pace. In this context of rapid and major changes, educators are faced with the problem of developing contemporary models of teaching and learning and appropriate learning theory upon which to construct approaches to formal and non-formal life-long learning.

Viewed against this background of change, the researcher in investigating the problem in this study, needs to focus on the theoretical constructs of mathematics. This theoretical construct will provide educators with a common framework that will enable them to cope with the changing needs of mathematics education.

2.8 THEORETICAL AND CONCEPTUAL FRAMEWORK FOR MATHEMATICS AT THE SENIOR PRIMARY LEVEL

2.8.1 INTRODUCTION

Among the many questions that face present day mathematics educators, perhaps the four most fundamental ones are:

What is mathematics?
Why teach mathematics?
How do children learn mathematics?
How to teach mathematics?

The researcher while drawing on assumptions concerning these questions attempts to provide a theoretical framework for mathematics in this part of the chapter. In considering the first question, what is mathematics?, the researcher, in her considered opinion, believes that an overview of mathematics education as a discipline highlighting the nature of the subject should provide some form of insight into the question, if not a solution to the problem.

2.8.2 MATHEMATICS EDUCATION AS A DISCIPLINE

Dean (1982:173) maintains that the two main proponents of the disciplines thesis are Philip Phenix and Paul Hirst.

2.8.2.1 PHENIX'S ACQUISITION OF UNDERSTANDING

Phenix, an American philosopher, argued in 1964 that education is a process whereby people acquire understandings of 'meanings' and that these may be designated into six clearly defined groups. He outlined them as symbolics, empirics, aesthetics, synnoetics, ethics and synoptics (Graves, 1977:68). Phenix explains each of these concepts as follows:

- aesthetics : concerned with the meanings to be found in contemplation of the arts and music;

- empirics : a term used to describe the physical, biological and social sciences, since these all rely on scientific method and accept certain rules for the verification of the meanings which they propound;
- ethics : denotes moral meanings, emphasising the development of ideas;
- symbolics : comprises the understanding of symbols used in ordinary language, in mathematics, in gestures and rituals;
- synnoetics : a term neologised by Phenix from Greek roots; it denotes knowledge of objects and persons arrived at through personal experience, derived intuitively rather than being based on a rational nature; and,
- synoptics : comprise those fields of knowledge, which combine or integrate other meanings, for example, philosophy, religion and history.

2.8.2.2 <u>HIRST'S FORM OF KNOWLEDGE</u>

Hirst, a British philosopher, in 1965 stated that, the objectives of education are all basically connected with the development of a rational mind. He argued that, the knowledge of which the mind is constituted consists of a range of 'forms of thought' each of which represents a way of interpreting one's experience of the world. A learner should have the opportunity to develop his/her mind across the whole range of its rational constituents. Hirst recognised seven distinct disciplines or 'forms of knowledge' as follows:

- mathematics and logic
- physical science
- history and human sciences
- literature and fine arts
- morals
- religion
- philosophy

(Henning, 1984:7)

Phenix and Hirst's grounds for determining a discipline include a distinctive structure that connects certain representative concepts or ideas, and distinctive methods of enquiry and testing. Based on these grounds they have tried to justify their conclusions that include mathematics being a separate discipline. Phenix and Hirst's arguments follow that a school curriculum based on units in each discipline will be the most effective way of learning about the different forms of knowledge, whereas cross-disciplinary studies are more likely to offer shallow and undisciplined thinking (Dean, 1982:173).

2.8.2.3 DAVID P. AUSUBEL'S STRATEGIES FOR MEANINGFUL VERBAL LEARNING

Bell (1978:134) maintains that Ausubel regards each academic discipline as having a distinct organisational and methodological structure and each individual as having a distinct cognitive structure. Ausubel conceptualises the information-processing structure of the discipline and the information-processing structure of the mind as analogous. Both a discipline such as mathematics and a human mind contain a hierarchical structure of ideas in which the most inclusive ideas are at the top of the structure and subsume progressively less inclusive and more highly differentiated sub-ideas.

Ausubel argues further that since each discipline has its unique structure, disciplines should not be taught using an interdisciplinary approach; rather each subject should be taught separately. He regards the structure as the most important part of a discipline and combining the teaching of two disciplines will cause the unique structure of each one to be obscured from the learner. It is for this reason that he does not regard unified mathematics – science programmes as an appropriate way to teach these two subjects (Bell, 1978:134).

With regard to this, Moodley (1992:2) argues that, mathematics education emerged as a scientific discipline in the post Sputnik era of the 1960s. Though mathematics education encapsulated its own objectives, problems, language and research methodology, it bears a complex relationship to other disciplines.

In this context, Moodley (1992:2) goes on further to cite Wittman (1984) who contends that, mathematics education investigates, in an interdisciplinary manner the complexity of mathematical learning and teaching and relates mathematical and educational studies to one another providing the necessary bridge to teaching practice. Mathematics education is a discipline of its own which is related to mathematics, psychology and practice of mathematics teaching.

Moreover, in accordance with these relationships, the views about mathematics education as enunciated by Moodley (1992:2), are coloured by the opinions held about the nature of mathematics and the educational process. The researcher therefore provides a brief overview of the nature of mathematics, which will form a useful framework for this study.

2.8.2.4 <u>NATURE OF MATHEMATICS</u>

In this regard, Moodley (1992:2–3) refers to Skovsmose (1985) who has identified the following three broad trends:

- Structuralism – the essence of mathematics can be determined by crystallising fundamental concepts through logical analysis of existing mathematical theories and conveyed to the learner by means of suitable concretisations in accordance with the epistemological potentials of pedagogy of 'teach the disciplines' which means that the learner's knowledge has to be built up in accordance with structures and contents identified independently of the learners.

- Pragmatism – the essence of mathematics is to be found in its applications, and thus, in a sense, outside mathematics. The educational process must therefore demonstrate the ways in which mathematics can be useful. This trend has been largely interpreted as a reaction against structuralism.

- Process-orientation – the essence of mathematics is neither connected to particular concepts nor to the applicability of mathematics as such, but to the process of thought that have led to the mathematical insight. In this view the main concern of mathematics education is to provide learners with opportunities to construct their own mathematical ideas.

An overview of the nature of mathematics leads to the next point of educators' conceptions about the nature of mathematics. Educators' personal beliefs will be analysed in the empirical investigation. However, the approach of educators to the teaching and learning of mathematics will undoubtedly be guided by the views they hold about the nature of mathematics.

2.8.2.5 **CONCEPTIONS ABOUT MATHEMATICS**

Hobden (1999:23) outlines the following three conceptions of mathematics:

- A dynamic view, in which mathematics is regarded as an incomplete and ever expanding human creation – the result of an ongoing search for patterns and relationships that can be formalized into new knowledge to be interrogated and contested by fellow mathematicians.
- A Platonists view, in which mathematics is regarded as a complete and static body of knowledge with logic and structure.
- An instrumentalist view, in which mathematics is regarded as a collection of facts, rules, algorithms and skills to be mastered for utilitarian purpose.

In this regard Hobden (1999:23) states that, although these conceptions seem to be mutually exclusive conceptions, it is likely that an individual educator's conceptions of mathematics would include aspects of more than one of the discussed conceptions. Further to this Hobden (1999:23) in referring to Skemp (1978:11) identifies two conceptions of the nature of mathematical understanding which are linked to the already mentioned conceptions of the subject mathematics. The first is the instrumental understanding that is based on knowledge of rules and algorithms to be applied in particular circumstances. This is easiest understood as 'knowing how to do the problem.' The second type of understanding is relational understanding which implies an understanding of how to do the problem coupled with an understanding of why the procedure works and how it relates to the other areas of mathematics.

Skemp (1978:11) suggests that the classroom practice of educators who hold each of these conceptions of mathematical understanding will differ to the extent that there are two effectively different subjects being taught under the name mathematics. Teaching for instrumental understanding involves the educator's demonstration of techniques followed by practice until the rules and procedures are mastered. On the other hand, teaching for relational understanding requires more learner centred sense making activities and investigations. The rules and procedures become evident through such activities (Hobden, 1999:23–24).

Orton and Cassell (1994:11) are of the opinion that mathematics means many things to many educators such as an organised body of knowledge, an abstract system of ideas, a useful tool, a key to understanding the world, a way of thinking, a deductive system, an intellectual challenge, a language, the purest logic possible, an aesthetic experience and a creation of the human mind. However, they also believe that whatever views educators hold about the nature of mathematics and how it should be reflected in what they teach in school will have some effect on their own particular aims and objectives of teaching mathematics.

It can be conceded that the approach of educators to the teaching and learning of mathematics is guided by the view they hold about the nature of mathematics. Pivotal to this will be the knowledge that they have about the aims and objectives of mathematics.

2.9 AIMS AND OBJECTIVES OF MATHEMATICS EDUCATION

In most countries, mathematics has formed an integral part of the curriculum for many decades. Yet many learners find it extremely difficult to comprehend. It may be that mathematics is distasteful due to the methods of teaching it, or, on the other hand, perhaps mathematics is inherently difficult to understand. This leads to the bold question of why is mathematics taught to primary school learners in most countries today?

In attempting to provide insight into this question it is paramount that the researcher provides a brief discussion on the aims and objectives of mathematics at the senior primary level. The brief discussion could be attributed to the fact that the terms aims and objectives in the senior primary phase have been replaced by the terms critical outcomes, learning area outcomes and specific outcomes. These new terms are due to a new policy for the establishment of curricula for schools that was announced by Professor Sibusiso Bhengu as Minister of Education on 24 March 1997. This new curriculum is called Curriculum 2005 and will be discussed at length in the sections that follow.

From a theoretical perspective it is important to bear in mind that aims and objectives play a pivotal role in the successful teaching of mathematics. It provides a framework for the requirements of the subject.

2.9.1 <u>THE AIMS OF MATHEMATICS EDUCATION</u>

In this regard, Wallace (1974:27) maintains that aims are broad in context and are useful in suggesting general policy for a particular educational institution, for a group of institutions or for a type of educational programme. Furthermore, Moodley (1992:98) claims that while aims, when heeded, may give shape and direction to education they are of little use in making the more specific decisions about selection, organisation and evaluation of learning experiences in the classroom. He specifies that aims merely reflect the value judgements of a particular philosophical viewpoint. Referring to Taba (1962) Moodley (1992:98) deems aims to be:

> ***'... only a step towards translating the needs and values of a society and of individuals into an educational programme.'***

Moreover, Moodley(1992:98) believes that the translation of aims into action in the classroom can provide clarity about what the curriculum is meant to achieve and make those concerned with education clearly accountable. He vindicates this contention by referring to Wood (1968) who regards aims as 'general declarations of intent' that give shape and direction to a teaching programme. While aims in any course are essential in so far as they give direction in a general way, they are insufficient for classroom use.

Considering that this study pertains to mathematics teaching in the senior primary phase, the researcher finds it apt to outline the specific aim of mathematics education. Specific aims as was provided in the KZN Department of Education and Culture Provincialised Interim Core Syllabus and Guide for Mathematics Senior Primary Phase (1996:1-2) will be outlined.

2.9.1.1 SPECIFIC AIMS OF MATHEMATICS EDUCATION

The aforementioned syllabus is aimed at fostering and developing the following specific aims of mathematics education at the senior primary phase (Grades 4 - 6):

- to enable learners to gain mathematical knowledge and proficiency;
- to enable learners to apply mathematics to other subjects and in daily life;
- to develop insight into spatial relationships and measurement;
- to enable learners to discover mathematical concepts and patterns by experimentation, discovery and conjecture;
- to develop the ability to reason logically, to generalise, specialise, organise, draw analogies and to prove mathematical concepts;
- to enable learners to recognise a real-world situation as amenable to mathematical representation, formulate an appropriate mathematical model, select the mathematical solution and interpret the result back in the real-world situation;

- to develop number sense and computational capabilities and to judge the reasonableness of results by estimation;
- to develop the ability to understand, interpret, read, speak and write mathematical language;
- to develop an inquisitive attitude towards mathematics;
- to develop an appreciation of the place of mathematics and its widespread applications in society;
- to provide basic mathematical preparation for future study and careers; and,
- to create an awareness of and an appreciation for the contribution of all peoples of the world to the development of mathematics.

In order to make aims more feasible it is necessary to describe and specify the expected outcomes or intended behaviour in any particular field of study. When aims have been refined in this way to an even more specific level in terms of intended behaviours or statements of what the learners should be able to do at the end of a course of study, they are called objectives (Moodley, 1992:99). These are discussed below:

2.9.2 THE OBJECTIVES OF MATHEMATICS EDUCATION

Moodley (1992:101) expresses the view that the taxonomy of educational objectives by Bloom represents the first of three interacting areas of behaviour roughly corresponding to thinking (cognitive), feeling (affective) and acting (psychomotor). In teaching mathematics emphasis is often laid on the cognitive domain, because it is difficult to measure objectives in the affective domain and assessment instruments in this field are not as well developed as those for the testing of the attainment of cognitive objectives. Apart from the development of psychomotor skills it is difficult to visualize many objectives in the psychomotor domain.

Bloom classified objectives within the cognitive domain into six categories, namely, knowledge, comprehension, application, analysis, synthesis and evaluation. These are conceived as a hierarchy of objectives in which the achievement of one class of objectives is likely to make use of the preceding categories. The greatest benefit to mathematics educators is that Bloom's taxonomy of objectives has a direct bearing on mathematics teaching, in that, the mathematics educators are able to structure and systematize their teaching of mathematics along more scientific lines in terms of their educational objectives. Mathematics tests are also designed to cover the range of Bloom's objectives, though clearly a test designed for the senior primary phase will tend to be relatively more directed to items in the 'knowledge', 'comprehension' and 'application' categories than in the others. Aligned to the importance of aims and objectives in mathematics education is the rationale for including a subject like mathematics as compulsory in the curriculum for all primary school learners.

2.10 THE CASE FOR MATHEMATICS EDUCATION IN THE SENIOR PRIMARY PHASE

With respect to validating mathematics education at the senior primary phase Van Den Berg (1978:21) mentions that the programme is orientated towards achieving the following:

- to enable learners to cope with mathematical situations they may be faced with in everyday life;
- to help learners to develop logical habits of thought and systematic, concise expressions;
- to develop in the learner an interest, an appreciation and a love for the unchanging nature of the laws of numbers;
- to prepare the learners to perform calculations which may be needed in other school subjects or in further studies; and,
- to develop in the learners an ability to make calculations accurately and rapidly.

It can be conceded that the role of mathematics as a subject is to build upon, extend and develop values the child already has in relation to numbers and the environment. Its justification as a subject lies in its contribution to the development of a key area of all children's experiences in a world within which they exist and increasingly act. To assist in the attainment of its positive contribution will be the key concern of educators and their knowledge of how children learn. Understanding theories about how children learn and the ability to apply these theories in teaching mathematics are important pre-requisites for effective mathematics teaching. Many people have approached the study of intellectual development and the nature of learning in different ways and this has resulted in several theories of learning. Consequently, at this juncture we need to consider aspects of learning psychology with particular emphasis to mathematics education.

2.11 DEVELOPMENT IN THE FIELD OF LEARNING PSYCHOLOGY THAT CONTRIBUTES TO MATHEMATICS EDUCATION

Mathematics education has had the benefit of the thinking of mathematicians, educators and psychologists. For the purpose of this study, consideration will be focused only on the work of psychologists. In particular, the contributions of Skinner, Gagne′, Piaget and Bruner who seem to have had an impact on the trends of mathematical education. It is imperative that the researcher firstly outlines two opposing learning theories that will illustrate the different perspectives from which these psychologists derived their viewpoints.

2.11.1 LEARNING THEORIES

Bell (1978:9) argues that a sound knowledge of mathematics is necessary for good teaching, but understanding of content is not sufficient. Outstanding educators will know, understand and apply various theories about how learners learn mathematics in their teaching and will evaluate the success of each application of a learning theory. In the light of this, the researcher chose to outline the following two opposing learning theories, behaviourism and constructivism.

2.11.1.1 **BEHAVIOURISM**

Nichols and Behr (1982:451) indicate that from a behaviouristic point of view, the educational environment is highly structured. The central question for educational experience begins by specifying behaviours in terms of behavioural objectives. Once behavioural objectives are specified, learning programmes and activities are carefully structured to guide learners to the specific objectives.

Bell (1978:195) maintains that the behaviourist theory of learning relates to an empiricist philosophy of science, that all knowledge originates in experience. Behaviourism also assumes that all learners learn what they are taught, or at least some subset of what they are taught, because it is assumed that knowledge can be transferred intact from one person to another. The learner is viewed as a passive recipient of knowledge, an 'empty vessel' to be filled (Bell, 1978:195).

The behaviourist theory sees learning as conditioning, whereby specific responses are linked with specific stimuli. Copeland (1982:2) in this regard comments:

> *'Provide the proper conditioning and you can get human beings to behave in almost any way you want. Hence the name 'behaviourists.'*

2.11.1.2 **CONSTRUCTIVISM**

Njisane (1992:28) believes that in order to throw light on what constructivism seems to be, it is important that he refers to Labanowicz (1985) who stated that:

> *'We see what we understand rather than understand what we see. Man's drawings on reality and interpretations of situations reflect the internal organization, of his network of ideas.'*

These statements emphasise that learners construct understanding. Njisane (1992:28) states that 'to construct' implies that the structures the learner ultimately possesses are built up gradually from separate components in a manner initially different from that of an adult. He also refers to Bodner (1986) who emphasises the constructive view of learning as:

> ***'Construction is a process in which knowledge is both built and continually tested. Individuals are not free to construct any knowledge, their knowledge must be viable, it must work.'***

These statements imply that concepts, ideas, theories and models that learners construct in their minds are constantly being tested by their experiences and they last as long as the experiences are interpreted by the learners. No lasting learning takes place if the learner is not actively involved in constructing knowledge.

The different types of construction are distinguished by the way reality of knowledge is viewed. Empiricists maintain that reality exists independently of a person's cognitive activity. To them knowledge is in the world before man's actions give meaning to the world. Mathematical knowledge is ever true and it is the educator who provides learning materials that will bring the learner to appreciate this knowledge. On the other hand radical constructivists argue that mathematics does not exist pre-packed but has to be created constructively (Njisane, 1992:36).

Bell (1978:196) in evaluating the learning theories states, that, to the constructivists, learning is not, as for the behaviourist, a matter of adding and of stockpiling new concepts to existing ones. Rather, learning leads to changes in the unit of interrelated ideas in the learner's mind, which he refers to as schema. Having outlined the learning theories, the researcher will now examine the contributions of psychologists to mathematics education.

2.11.2 PSYCHOLOGISTS THAT CONTRIBUTED TO MATHEMATICS EDUCATION

The reforms in the teaching of mathematics were associated with the development of psychology and took account of the psychological findings and insights (Connel *et al*., 1967:181). The following conceptualisations are significant for this study, as clearly indicated.

2.11.2.1 B.F. SKINNER

Postlethwait *et al*. (1977:59–60) suggests that Skinner is widely known for his work with 'operant' behaviour which is behaviour that is initiated by an organism, the results of which affect the organism in specific ways. The discovery of this mechanism, they believe, provided the theoretical framework upon which to build new approaches to investigating and understanding what organisms can do and will do.

They state further, that material can be presented such that the learner can be positively reinforced by immediate feedback to the correct responses to questions. The learner is then encouraged by one's own behaviour to proceed. According to Postlethwait *et al*. (1977:59-60) Skinner maintains that the art of using this knowledge lies in the ability to arrange appropriate contingencies for the establishment and maintenance of desired behaviour.
Bell (1978:148) in referring to Milhollan and Forisha (1972), pithily comments that:

> ***'Skinner's system probably represents the most complete and systematic statement of the associationist, behaviourist position in psychology.'***

Copeland (1982:5) asserts that Skinner emphasises the importance of carefully sequenced instructional experiences through maximum guidance by educator or instructional material. Basic association of facts is stressed. The term association refers to the familiar stimulus-response or S-R mechanism. Control the stimulus to get the desired response. It is a psychology applied to teaching learners, with positive reinforcement of praise, a good grade or a gold star for the right response. The reward is external, that is, provided by the educator (Copeland, 1982:5).

Bell (1978:148) states that a study of teaching and learning depends primarily upon the observable behaviours of educators and learners and he is of the opinion, that, nearly all identifiable human behaviour can be categorised into the following:

- **Respondent behaviours** : Involuntary reflex behaviour that result from special environment stimuli. In order for the respondent's behaviour to occur it is firstly necessary that a stimulus be applied to the organism. Skinner feels that only a few of the behaviours are respondent behaviours.

- **Operant behaviours** : Behaviours that are neither automatic or predictable, nor related in any known manner to easily identify stimuli. The word 'operant' describes an entire set of specific instances of behaviour that operate upon the environment to generate events or responses within the environment. Skinner suggests that if these events or responses are satisfying, the probability that the operant behaviour will be repeated is usually increased.

Skinner argues that reinforcements are happenings or stimuli that follow a response and which tend to increase the probability of that response, thus facilitating learning and changes in behaviour. He believes that reinforcements fall into the following two categories:

- **Positive reinforcements** : Stimuli, which, when presented following a behaviour by the learner, tends to increase the probability that, that particular behaviour will be repeated. The behaviour is strengthened.

- **Negative reinforcements** : Stimuli whose removal tends to strengthen behaviours. For example, many times, the learner's behaviour of attentiveness to appropriate classroom activities can be increased by removing distracting stimuli such as undesirable noise and a disruptive learner. Skinner regards punishment as the deliberate presentation of negative reinforcement.

The researcher is of the opinion that Skinner's research on the science of learning and the art of teaching can suggest the following reasons why some learners fail to learn certain mathematical skills after repeated attempts.

- Instead of studying mathematics in order to obtain positive reinforcement, learners do their mathematics to avoid negative consequences, such as the educator's displeasure, ridicule from fellow classmates, poor results leading to punishment from parents or poor results in competition with other learners.

- In the event of reinforcement occurring, the reinforcement may be given minutes following the learner's response. In this regard, Skinner maintains that even a time lapse of a minute or two between a response and a reinforcement can, at times, remove much of the positive effects of an immediate reinforcement.

- The frequency of reinforcement is inadequate.

The researcher being a mathematics educator, is of the firm belief that educators are often concentrating on completing their work, thus neglecting the need to reinforce responses. At this juncture, it is also important to note that Skinner's theory has relevance to mathematics education. The following examples will highlight this point.

When a chosen stimulus, for example, 5 x 3 is given by the educator, the learner would immediately respond and if the response is correct the learner would be reinforced in some way such as praise. However, if the response is incorrect, the educator would construct sufficient cues and prompts to elicit the correct response or may correct the incorrect response. The numerical example quoted above is of a very simple mathematical skill, but it is rather important for educators to know ways by which simple skills can be effectively learnt because the absence of the mastery of simple skills often puts a learner at a disadvantage as they proceed to more complex mathematics.

Mathematical skills can also be taught by rote learning which is by repetition of facts that are not understood, until they can be correctly written down or repeated. This method is often used in the senior primary phase by which multiplication tables are taught. The stimulus might be 'say your three times table' and the correct response would be, 'One three is three, two threes are six' and so on. Reinforcements are then awarded accordingly.

In the case of a mechanical process, for example, subtraction, a learner can be given a drill which shows how to set the sum out and how to 'borrow one' from the previous column if need be and the learner is then given several exercises on which to practise the drill.

Another occasion when S-R learning seems to be effective is when carefully designed sequences of tiny mathematical units of work are used. Learners work through these mathematical units to achieve knowledge and understanding and each tiny unit is an effective stimulus. The correct response leads to the next mathematical unit. This type of learning is successfully used by mathematics learners in the senior primary phase to obtain the lower level of Bloom's taxonomy of educational objectives which is knowledge and comprehension. The important goal for the mathematics educator is to give all learners an amount of practice that they need to allow them to move confidently to the next stage in the mathematics teaching.

It can thus be conceded that Skinner's work is of great benefit to mathematics education. Mathematics educators can create more effective learning situations by using appropriate techniques to elicit desirable behaviours from learners.

2.11.2.2 <u>ROBERT GAGNE′</u>

The American psychologist, Robert Gagne′, suggests that there are eight types of learning which he calls signal learning, stimulus-response learning, chaining, verbal association, discrimination learning, concept learning, rule learning and problem solving. Gagne′ believes that these eight learning types occur in the learner in the following four sequential phases as described by Bell (1978:110–111):

- ***The apprehending phase*** : Refers to the learners' awareness of the stimulus or a set of stimuli which is present in the learning situation. Awareness will enable the learners to perceive characteristics of the set of stimuli. What the learners perceive will be uniquely coded by each individual and will be registered in their minds. The way in which learners apprehend given stimuli results in a common problem in mathematics teaching and learning. When educators present mathematics lessons or stimuli they may perceive different characteristics of the content of the lessons than are perceived by learners. Each learner may have a different perception from other learners.

- ***The acquisition phase*** : Refers to attaining or possessing the fact, skill, concept or principle that is to be learned. Acquisition of mathematical knowledge can be determined by observing or measuring the fact that a learner does not possess the required knowledge or behaviour before an appropriate stimulus is presented, however, the learner attains the required knowledge or behaviour immediately after presentation of the stimulus.

- ***The storage phase*** : Refers to the retaining or remembering of a newly acquired capability. The human storage facility is referred to as the memory and research indicates that there are two types of memory. Short-term memory has a limited capacity for information and lasts for a short period of time. Long-term memory is the ability to remember information for a longer period of time and much of what is learnt is stored permanently.

- ***The retrieval phase*** : Refers to the ability to recall the information that has been acquired and stored in memory. To assist learners in progressing through these four stages in learning, for example, the square root algorithm, the educator firstly evokes apprehension by working through an example on the chalkboard, secondly the educator facilitates acquisition by having each learner work out an example by following, step-by-step, a list of instructions, thirdly assists storage by giving problems for homework and finally evokes retrieval by giving a quiz the next day.

As a mathematics educator it is also important to understand Gagne'’s eight types of learning that were mentioned earlier. Knowledge of the learning types will enable the educator to select teaching strategies and classroom activities that promote each learning type when that particular type seems appropriate for learning the mathematics topic being taught. The types are defined in summary form as described by Walklin (1990:11–14):

- **Signal learning** – this involves the learner in responding to a signal, it is a form of classical conditioning of behaviour.
- **Stimulus-response learning** – sometimes also called trial and error learning, operant learning, instrumental learning, instrumental conditioning or need reduction.
- **Chaining** – response chains and learning sets are learning structures in which elementary steps are mastered and linked together to form a procedure; having once acquired the knowledge, a learner will be able to carry out routine sequences almost automatically.
- **Verbal association** – one example of verbal association is naming; in order to be able to name an object, such as a cone or cube, the observer must see the object, recognise its shape and know its name.
- **Discrimination learning** – is the act of discerning that which constitutes a difference between two or more objects; it involves making judgements or observing characteristics.
- **Concept-learning** – groups of objects with common features are known as classes, while general ideas about classes are known as concepts.
- **Principle learning** – general ideas and concepts formed when different objects are seen to possess common features which should be forged into a well linked chain making up the

principles; having once acquired a number of principles relevant to a given problem, the learner can combine them in order to solve the problem.

- **Problem solving** – is the most complicated form of learning behaviour, it leads to the formation of new principles of a higher order where the learner is required to consider the problem and to organise knowledge of several principles at one time in order to reach a successful solution

Gagne′ suggests that each type of learning is of a different order of complexity from the others, and all eight may be arranged in a hierarchy, starting with signal learning at the bottom and culminating in problem solving at the top. He also maintains that each type of learning should be mastered before tackling higher levels. This entails competence in seven types before attempting problem solving at the highest level.

The following mathematical example of teaching learners in grade 4 (standard 2) about triangles will illustrate what, according to Gagne′'s theory of learning, is an appropriate order of experiences. The learners should be given a sequence of experiences going from lower to higher orders of learning, which will probably extend over a period of time.

The educator will start by showing models of triangles and saying the word 'triangle.' After a while the educator will hold up a triangle and wait, expecting the learners to produce the word, whereby helping the learners to make a verbal association. Next the learners are shown a number of models of triangles and some models of non-triangles, for example, squares. The learners are asked to make two classes, assisting as necessary. This enables the learners to learn to discriminate among the properties of triangles and non-triangles. The learners are then given a collection of triangles with many different features, large ones, small ones, ones with right angles, ones with an obtuse angle and triangles turned in various positions. This is to help learners with concept learning. The learners then experiment with various models of triangles, with instructions to put the triangles together into sets, so that every triangle in each set is the same size and shape. In this way the learners will learn the principle that two triangles that are the same are congruent and finally the concept of triangle can be carried further into a problem solving situation.

It can be conceded that Gagne''s division of learning into eight types from the simplest through the progressively more complex types to the higher order types is a useful and valid way to view mathematics learning as clearly indicated in the example illustrated. However, it is important that educators acknowledge that learning does not usually progress in a sequence of easily definable and identifiable steps and the various learning types do not occur in chronological sequence. All of these eight learning types can occur nearly simultaneously. As was mentioned earlier, what is important for the mathematics educator, is to carefully select teaching strategies that promote each learning type when appropriately required to teach a particular mathematics topic.

2.11.2.3 **JEAN PIAGET**

In order to teach mathematics effectively, it is essential to understand how a learner thinks and learns. Piaget, a Swiss psychologist, was the first to make a systematic study of the acquisition of understanding in children. He is regarded, by many, to have been the major figure in the field of 20th century developmental psychology.

In Piaget's theory, human intellectual development progresses chronologically through four sequential stages. The order in which the stages occur has been found to be invariant among people. The ages at which people enter each higher order stage vary according to each person's unique hereditary and environmental characteristics.

Table 2.1 on the following page outlines Piaget's stages of intellectual development in children.

TABLE 2.1 OUTLINE OF PIAGET'S STAGES OF INTELLECTUAL DEVELOPMENT IN CHILDREN

STAGE	APPROXIMATE MENTAL AGE RANGE	SCHOOL PHASE
1. Sensori – motor	0 - 2	
2. Pre-operational		
a) Pre-conceptual thought	2 - 4	
b) Intuitive thought	4 - 7	Junior Primary Phase
3. Operational		
a) Concrete Operational thought	7 - 11	Junior and Senior Primary Phase
b) Formal Operational thought	11 - 16	Senior Primary and Junior and Senior Secondary Phases

Source : Behr (1980:23)

From the table above, it will be seen that the thinking of senior primary phase learners will be largely at the concrete operational level. If such stages of development as indicated in Table 2.1 are accepted in a general way then an understanding of the concrete operational stage by all senior primary mathematics educators is imperative. The researcher chose to discuss the concrete operational stage in particular as it is most pertinent to this study.

This developmental period is called concrete operational because psychologists have found that learners between seven and twelve years have trouble applying formal intellectual processes to verbal symbols and abstract ideas. The learner's ability to reason is almost totally dependent on concrete experience. By the age of twelve, nonetheless, most learners have become quite adept at using their intellect to manipulate concrete physical objects.

Piagetian theory explains intellectual development as a process of assimilation and accommodation of information into the mental structure. Elliot (1984:86) claims, assimilation is an absorption of new experiences and accommodation is the restructuring of the mind as a consequence of new information and experiences.

Bell (1978:100–101) maintains that the following factors influence intellectual development:

- The physiological growth of the brain and nervous system is an important factor in general intellectual progress. This growth process is called maturation.

- Experience in mental development. Experience has been identified in two types. Physical experience is the interaction of each learner with objects in their environment. Logico-mathematical experiences are those actions performed by individuals as their mental schema are restructured according to their experiences.

- Social transmission is the interaction and conception of a learner with other learners and is quite important for the development of logic in a learner's mind.

- Equilibration is the process whereby a learner's mental structure loses its stability as a consequence of new experiences and returns to equilibrium through the process of assimilation and accommodation.

Piaget believes that these factors account for intellectual development and that each one must be present if a learner is to progress through the four stages of intellectual development. At this point, it is important to consider the application of Piaget's stages of intellectual development within the context of the learning of mathematics in the senior primary phase. The following discussion will illustrate this.

Most of the school situations in which learners find themselves contain a large verbal element. This emphasises the need for mathematics educators to match instruction to the learner's level of thought.

Learners are expected to make judgements and inferences in mathematics, but they are still bound in such situations to a concrete thinking process. Handling models and materials in mathematics would provide the concrete experience necessary for learners to progress to the stage of being able to reason more formally.

Since the mental growth of learners advance through qualitatively distinct stages, the selection of mathematical experiences should be experiences for which the learners are ready. These experiences should also help prepare the learner to advance to the next stage.

Before a new concept is introduced to learners, it is important that they are tested to ensure that they have acquired all the pre-requisites for the thorough understanding of this concept. If they are not ready for the concept, they should be provided with the necessary experiences that will enable them to become ready. The mathematics educator must keep in mind that an answer or action that seems illogical from their point of view on the basis of their extensive experiences may seem perfectly logical from the learner's point of view on the basis of their limited experiences.

Learners' thinking is more flexible when it is based on reversible operations. Educators should teach pairs of inverse operations in mathematics together. For example, subtraction and addition nullify each other and division and multiplication nullify each other.

Lastly, in order for learners to learn effectively, they must be participants and not spectators. To develop their concept of number and space, it is not sufficient that learners merely look at things. They must also touch, move, turn, pull apart and put together things. For example, to pave the way for the concept of an angle, learners should be given opportunities to turn a hand of a clock or a pointer of a dial. However, the learners' activity should not be kept forever on the level of physical action. Physical action is merely the foundation for the mental operation that needs to be developed.

It can be conceded that Piaget through his simple studies of child development and his theoretical activity has produced a vast treasury of ideas on how learners learn and think. The task of drawing on this treasury for the benefit of teaching mathematics at the senior primary level will be the onus of the mathematics educator.

2.11.2.4 JEROME BRUNER

Whereas Piaget indicated that mental development must pass through the three stages of sensori-motor, concrete operational and formal operations, Bruner on the other hand, saw the human mind as having evolved three modes for representing the environment and events in it. Bruner calls these three modes the enactive, iconic and symbolic.

With respect to these three modes, Charles (1973:6) comments that the enactive mode is where the learners manipulate materials directly. The learners then progress to the iconic mode, where they deal with mental images of objects but do not manipulate them directly. Finally the learners move to the symbolic mode, where they strictly manipulate symbols and no longer mental images of objects. Charles (1973:6) states further that this sequence is an outgrowth of the development work of Jean Piaget.

Bell (1978:141–142) maintains that Bruner believes that any theory of instruction should have the following four major features that prescribe the nature of the instructional process:

- A theory of instruction should specify the experiences which predispose or motivate various types of learners to learn; that is, to learn in general and to learn a specific subject such as mathematics.
- The theory should specify the manner in which general knowledge and particular disciplines must be organised and structured so that it can be most readily learnt by different types of learners. Before knowledge is presented to learners, it should be organised so that it relates to the characteristics of learners

and embodies the specific structure of the subject, in this case mathematics at the senior primary level.

- The theory should specify the most effective ways of sequencing material and presenting it to learners in order to facilitate learning. The problem of sequencing material in mathematics is very complex and is closely related to each learner's individual learning characteristic.

- The theory should specify the nature, selection and sequencing of appropriate rewards and punishments in teaching and learning a discipline.

These four features of a theory of instruction suggest corresponding activities, which mathematics educators should engage in when preparing to teach their lessons. The method of teaching based on Bruner's theory provides a great contrast to those based on the S-R theory that was mentioned earlier under Skinner. Instead of providing a stimulus and teaching the learner to make the correct response the educator is now faced with the need to provide an investigatory activity and teaching the learner to relate experiences in a mathematical way. The activity provided by the educator must obviously be carefully chosen if the teaching and learning is to be effective.

In concluding this section it is important to note that as educators approach their work in the classroom, they should attempt to organise their understanding of classroom processes and plan learning activities in the light of concepts they have gained from their previous experiences. Due to their concern with human behaviour and learning they will find concepts and principles derived from psychological approaches to human behaviour and learning particularly pertinent to their work. Empirical studies of classroom processes and conditions affecting learning help the educators in planning their work in the classroom. Hence, it may be argued that educational psychology bears a significant relationship to methods of teaching. However, at this juncture it becomes important for us to consider the didactical perspectives pertaining to mathematics at the senior primary level.

2.12 DIDACTICS WITH PARTICULAR REFERENCE TO MATHEMATICS TEACHING AT THE SENIOR PRIMARY LEVEL

The researcher believes that it is imperative that prior to describing various ways of teaching, a discussion on curriculum models should be presented. Reason being, that for any teaching to be of value, it must be seen to be resulting in meaningful learning. In this regard Monica *et al.* (2000:95) maintain:

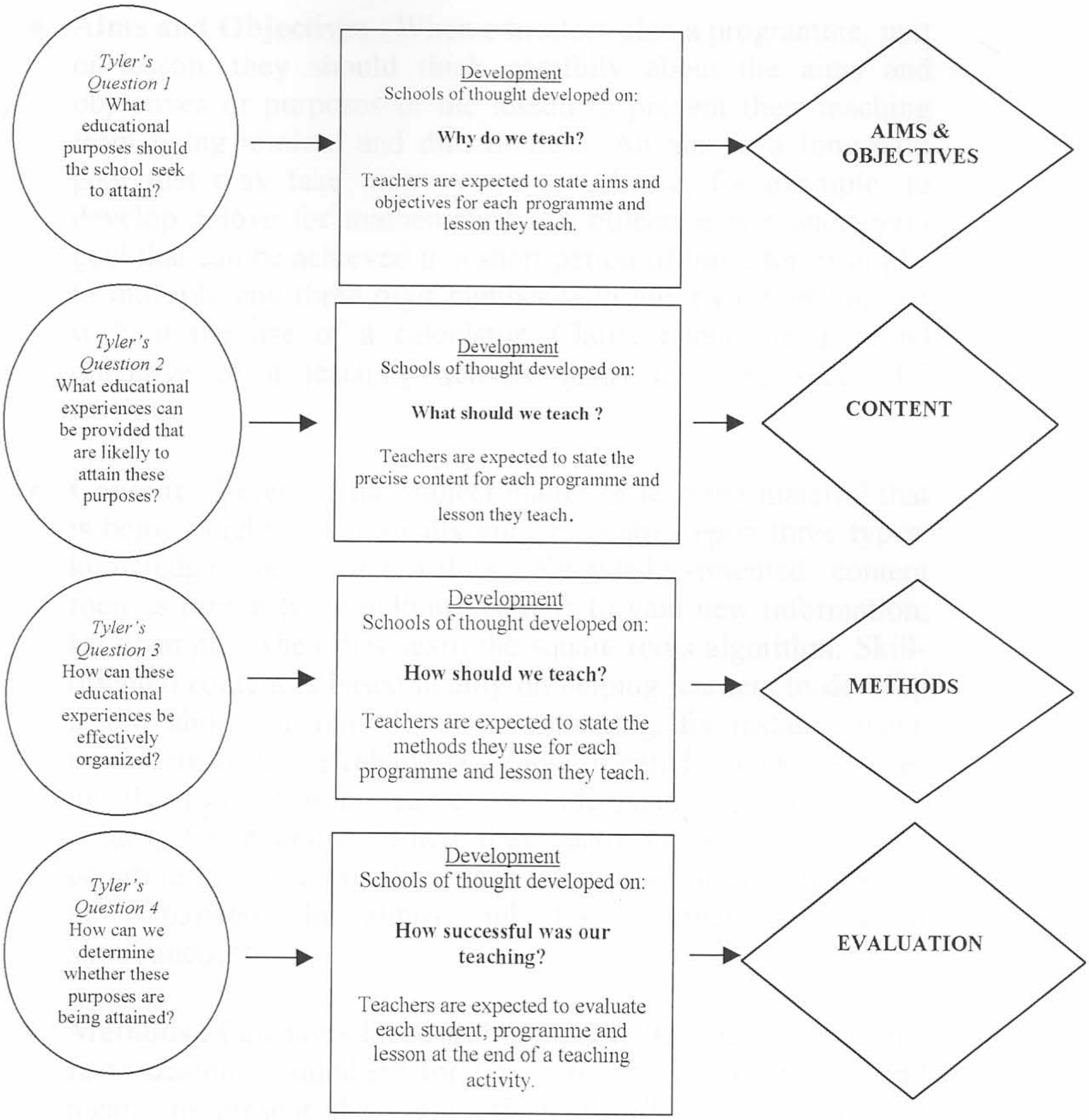
> ***'Curriculum models guide the process of decision making in designing learning programmes, because curriculum development should be perceived as a task that requires orderly thinking when one examines both the model and the learning that has to be accomplished.'***

2.12.1 THE PERENNIAL CURRICULUM MODEL

Perennial means evergreen, unchanging, recurrent, timeless and long-lasting. The Perennial Curriculum Model therefore means a timeless plan that most qualified educators use when they design a lesson, unit or programme. Four important concepts, namely aims and objectives, content, methods and evaluation together have become known as the Perennial Curriculum Model (Monica *et al.*, 2000:95).

The chief initiator of the Perennial Curriculum Model was Ralph Tyler. Tyler based his curriculum plan on four fundamental questions which curriculum planners should consider when they design a curriculum, as shown in figure 2.1.

Figure 2.1 Development process from Tyler's Rationale to the Perennial Curriculum Model



Monica *et al.* (2000:97)

It is important to look at the following four concepts outlined by Monica *et al.* (2000:96–97) that play an important role when educators plan curricula:

- **Aims and Objectives** : When educators plan a programme, unit or lesson, they should think carefully about the aims and objectives or purposes of the lesson to prevent their teaching from being aimless and directionless. An aim is a long-term goal that may take many years to achieve, for example, to develop a love for mathematics. An objective is a short-term goal that can be achieved in a short period of time, for example, to multiply any three digit number with any two digit number without the use of a calculator. Clarity about the aim and objective of a teaching activity leads to more successful teaching.

- **Content** : Refers to the subject matter or learning material that is being taught. Traditionally content centres upon three types: knowledge, skills and values. Knowledge-oriented content focuses primarily on helping learners to gain new information, for example, when they learn the square roots algorithm. Skill-oriented content is based mainly on helping learners to develop a new ability or aptitude to do something, for instance when they learn to use a calculator. Value-oriented content revolves mostly around helping learners to understand and acquire good values, for example, when they learn to be honest when counting money correctly. These three types of content cannot be separated. In almost all lessons they are learnt simultaneously.

- **Methods** : Educators faced with a topic to be taught such as the factorization of numbers for Grade 6, should find ways and means to present the topic effectively. They should decide which methods to use.

- **Evaluation** : Educators assess how effectively the learners have learnt as well as the weaknesses and strengths of the lesson, unit or programme. During this part, educators determine whether the curriculum aims and objectives have been met. Evaluation is not only done at the end of a lesson, it is a continuous process conducted before, during and after the lesson has been implemented.

2.12.2 OUTCOMES BASED EDUCATION (OBE)

The new democratically elected government of South Africa has, since its inception in 1994, worked towards the transformation of the system of education. A major change has been the formation of the South African Qualifications Authority (SAQA) a body constituted of various stakeholders in education and responsible for the establishment of the National Qualifications Framework (NQF). Table 2.2 on page 53 illustrates the structure of the NQF.

Table 2.2 National Qualifications Framework

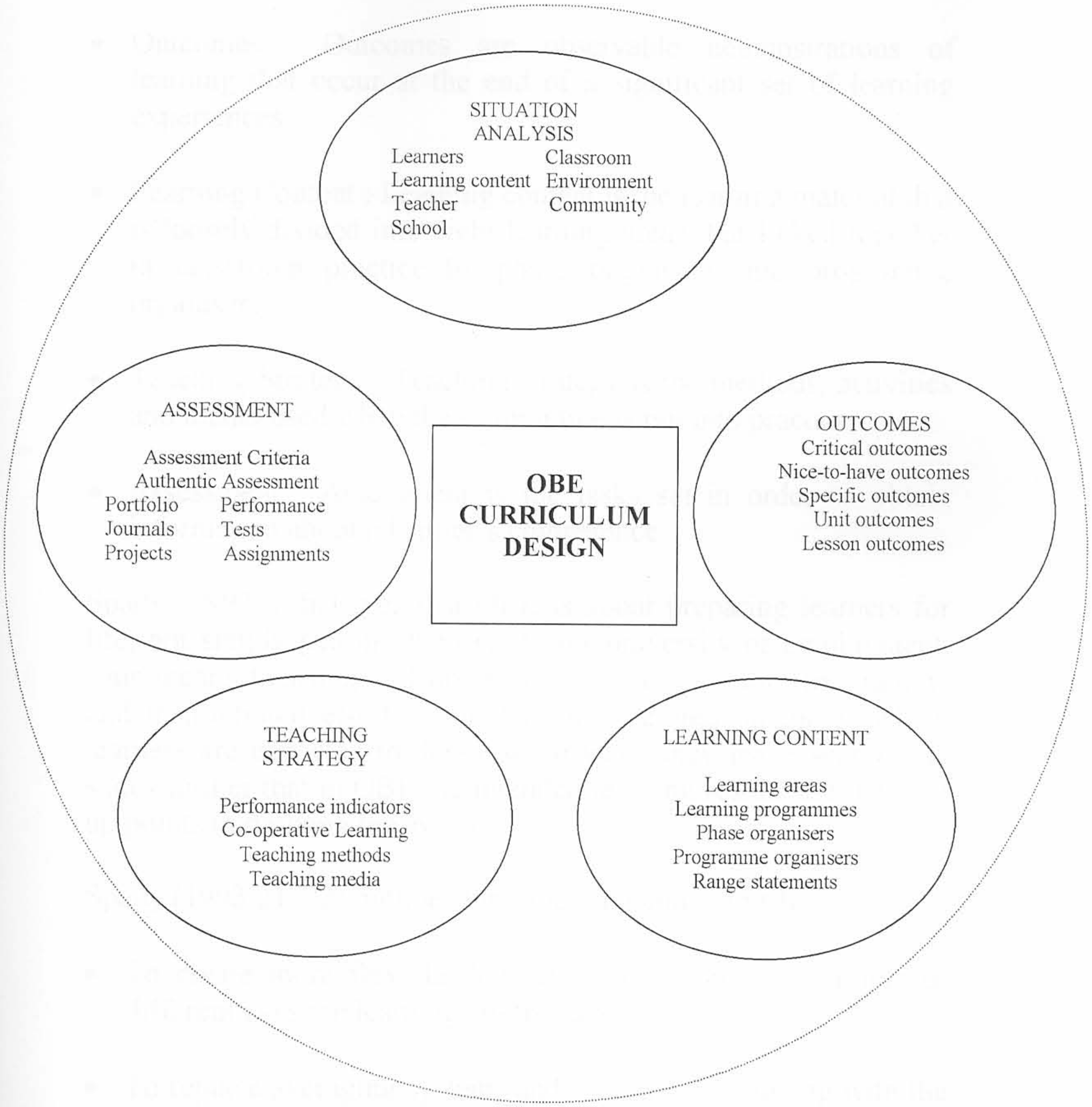
School Grades	NQF Level	Band	Types of qualification & Certificates	
	8	Higher Education and Training Band	Doctorates Further research degrees	
	7		Degrees, Diplomas & Certificates	
	6			
	5			
Further Education and Training Certificates				
12	4	Further Education and Training Band	School/College/NGOs Training certificates, Mix of units	
11	3		School/College/NGOs Training certificates, Mix of units	
10	2		School/College/NGOs Training certificates, Mix of units	
General Education and Training Certificates				
9 8 7	1	General Education and Training Band	Senior Phase	ABET 4
6 5 4			Intermediate Phase	ABET 3
3 2 1			Foundation Phase	ABET 2
R			Pre-school	ABET 1

Monica *et al.* (2000:701)

The NQF reflects the nature and quality of all qualifications attainable in South Africa.

Along with these changes, a new curriculum, based on the OBE Model of teaching has been introduced and is currently in the process of being phased into the education system. Figure 2.2 illustrates the Model of OBE Curriculum Design.

Figure 2.2 Model of OBE Curriculum Design



Monica *et al*., (2000:109)

Monica *et al.* (2000:128) highlight that in designing a programme, unit or lesson, educators need to make decisions about the following five components in the Model of OBE Curriculum Design.

- Situation analysis : Situation analysis is an examination of the contextual factors that have a bearing on the programme.

- Outcomes : Outcomes are observable demonstrations of learning that occur at the end of a significant set of learning experiences.

- Learning Content : Learning content is the learning material that is loosely divided into eight learning areas, but linked together in classroom practice by phase organisers and programme organisers.

- Teaching Strategy : Teaching strategy is the methods, activities and media used when the programme is put into practice.

- Assessment : Assessment is the tasks set in order to obtain information about a learner's competence.

Spady (1993:2) believes that OBE is about preparing learners for life, not simply getting them ready for university or employment. This means focusing and organising a school's entire programme and instructional efforts around clearly defined outcomes which learners are expected to demonstrate when they leave school. He states further that in OBE the intended learning results are the start up points in defining the system.

Spady (1993:21–22) outlines the following aims of OBE:

- To create more flexible delivery systems so that learners of different ages are learning co-operatively.

- To replace averaging systems and comparative grading with the concept of culminating achievement.

- To ensure that all learners experience success.

- To avoid a process whereby 'passing' requires a given amount of time to be spent attending a particular class.

- To equip educators to focus more on the learning capabilities of learners and less on covering a given amount of curriculum.

- To focus all instruction on a higher level of learning and to make accessible to all learners the methods used in gifted and talented programmes.

- To place less reliance on norm-referenced standardised tests as indicators of either learner or educator accomplishment.

Olivier and Van Schaik (1998:37–38) state that outcomes based learning signifies the approach whereby the curriculum design process, planning of education, assessment of the learning and advancement of learners is based on the achievement of outcomes. He claims further that since the outcomes based curriculum emphasises an integrated approach to learning, entailing content, competencies and processes, the approach towards learning has significant influence on how and what learners will learn.

Olivier and Van Schaik (1998:39) outline the contrast between the traditional and the outcomes based learning systems as indicated in table 2.3 on page 57.

Table 2.3 Difference between the traditional and the outcomes based learning systems.

Old	New
(a) Rote learning (b) Syllabus is content driven and broken down into subjects (c) Textbook/worksheet-bound (d) Teacher centred (e) Syllabus is rigid and non-negotiable (f) Emphasis on what teacher hopes to achieve (g) Curriculum development process not open to public	(a) Critical thinking, reasoning (b) Learning is process and outcome driven, connected to real-life situations (c) Learner- and outcome-centred (d) Teacher is facilitator (e) Learning programmes are seen as guides (f) Emphasis on outcomes – what learner achieves (g) Wider community involvement is encouraged

Source: Olivier and Van Schaik (1998:39)

At this point, the researcher believes that it is important to differentiate between OBE and Curriculum 2005 which will be discussed in Chapter 4. In this regard Monica *et al.* (2000:102) comment that OBE is a much broader concept than Curriculum 2005. The new school curriculum, Curriculum 2005, is only one way in which OBE manifests itself in South Africa, because OBE is not confined to the school sector only. OBE is entrenched in all types of formal education and training that takes place in this country such as teacher education, nursing studies, medical schools and as in the case of this study, in-service courses.

The foregoing has provided the theoretical foundations of the curriculum models. It is now important to focus on the practical implementation of these models.

2.12.3 TEACHING METHODS OF MATHEMATICS AT THE SENIOR PRIMARY LEVEL.

Prior to describing the different teaching methods that an educator can implement, a viable concept of a teaching method must evolve. In this connection Monica *et al.* (2000:210) maintain that:

> *'A teaching method is a particular technique a teacher uses to help pupils get knowledge which they need.'*

They state further that educators also have to be flexible. From time to time there is need to experiment with different teaching methods.

2.12.3.1 **DEDUCTIVE AND EXPOSITORY METHOD**

Moodley (1997:36) suggests that expository approaches are essentially deductive methods in which facts, concepts, relationships and generalisations are described by the educator or printed in a textbook with a view to learners understanding or assimilating them. In this regard, Dean (1982:78) claims that expository methods transmit information in one direction only, that is, from the educator to the learner. He also provides the following four reasons as to why the expository method is popular with mathematics educators:

- They are mathematically neat and complete as each lesson contains a presentation and explanation of mathematics that leads to a conclusion.
- They boost the educators' self esteem as they are the fountains of knowledge.
- An educator can get satisfaction from presenting a complete syllabus in a sequence of lessons.
- The educators have themselves, often successfully learnt school mathematics in this way and expect their learners to do likewise.

Bell (1978:130–132) in this respect, comments that Ausubel presents a powerful argument that expository teaching was the only efficient way to transmit the accumulated discoveries of countless generations to each succeeding generation. Bell (1978:130–132) also maintains that Ausubel believes that good expository teaching, whereby an educator structures and explains a mathematics topic so that learners can organise the topic and relate it to previous meaningfully learned topics, can result in efficient and effective mathematics learning.

Monica *et al.* (2000:236) in their contribution on expository methods concur that this method can be used to great effect in OBE. The educator is still responsible for the planning and the organisation of classroom activities. While OBE may stress learner centred methods, the educator still needs to explain facts, concepts and generalisations either verbally or in written form. However, they believe that educators can use the expository method in conjunction with other teaching methods that involve learners more actively.

2.12.3.2 **<u>INDUCTIVE AND DISCOVERY METHOD</u>**

Eggen and Kauchak (1988:109) declare that the inductive method is a straight forward but powerful method designed to develop the thinking skills of observation, comparing, finding patterns and generalising while at the same time teaching specific concepts or generalisations. He also states that this method has the intrinsic advantage of promoting high levels of interaction and increased learner motivation.

Furthermore, Stuart (1986:72) comments on the discovery method thus:

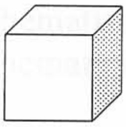
> ***'This method helps to combat the passive lack and listening role of the pupils. They are expected to do their own searching and research and must try to discover the concepts, rules and definitions of matter.'***

Dean (1982:70) in associating the discovery method with mathematics teaching refers to the following four discovery methods:

- <u>Directed discovery</u>

The method of teaching mathematics by directed discovery can be explained by the following example. The educator would have given every learner a copy of the partially completed table as shown in figure 2.3.

Figure 2.3 Partially completed table

SHAPE	NAME OF SHAPE	F NO. OF FACES	V NO. OF VERTICES	E NO. OF EDGES
	Cube	6	8	12
	Tetrahedron			
	Square based pyramid			

Source: Dean (1982:71)

The educator would also have put out on the desks several physical models of nine shapes including the cube, tetrahedron and square based pyramid. The educator will then direct the learners to investigate the number of faces, vertices and edges on these shapes and to fill in six more lines of the table. While the learners are doing this, the educator will walk around the classroom giving instructions to learners who are not certain about the next thing to do. Towards the end of the lesson, the educator will probably go to the chalkboard and write 'Discover a formula to connect the number of faces, vertices and edges. Check that this formula is true for every shape you have used.' At the close of the lesson, learners who have not managed to discover the formula will probably be told to write

$$F + V - E = 2$$

This method contains a small element of discovery and requires learners to be prodded along.

- <u>Guided discovery</u>

The use of this method can again be illustrated by a classroom where the nine geometric shapes are put on the desks, but the learners are not directed stage by stage. The educator starts the lesson by saying, 'Discover some relationships between the faces, vertices and edges of these shapes.' The learners then handle and compare the shapes.

This guided discovery method allows learners to make significant mathematical discoveries. After the start of the guided discovery lesson, the learners have to use their own initiative in making a mathematical investigation so that they are expected to act as mathematicians.

- <u>Exploratory discovery</u>

In the exploratory discovery method, the educator structures the learning activity by providing or approving the objects or ideas which the learners use, but does not give instructions even as to the aim of the lesson. This method enables the educator the opportunity to discover how learners learn when they are not restrained.

- <u>Free discovery</u>

Free discovery comes from the natural curiosity of the learner, about any object or idea. It is not initiated by the educator, but they do have a teaching role to play. The educators must show interest, give encouragement and provide advice if they think that it will help the learner to learn more from the discovery.

Dean (1982:74–75) claims that the use of the discovery method has the following properties:

- an increasing element of learner initiative;
- a reduction in the equality of learners' attainment;
- the educator's role changing from director to advisor;
- the educator's image changing from one who knows everything to one who has to search for information;
- a decreasing efficiency in transmitting knowledge; and,
- an increasing difficulty in assessing and planning progress towards a defined point.

Finally, it can be conceded that any choice of one teaching method above the others will be determined by, the nature of the content to be taught, the readiness of the learners' previous knowledge and the particular abilities of the educator.

Although educationists from time immemorial have attempted to stress the importance of the inquiry or discovery based methods in order for learners to learn effectively, the expository method seems to be the commonly used method in mathematics teaching. Mathematics educators seldom use the discovery method as it is time consuming and educators believe that it is difficult to employ in the primary school. Besides an effective teaching method in improving the quality of learning, there is a strong body of research to suggest that learner achievement can be further enhanced by the consistent and strategic use of specific teaching strategies (Hopkins *et al*., 1996:18). Reference will now be made to selected strategies.

2.13 TEACHING STRATEGIES ASSOCIATED WITH MATHEMATICS

There are many strategies of teaching designed to bring about particular kinds of learning to help learners become more effective. For the purpose of this study the researcher chose to discuss the following four teaching strategies, namely, the use of games, problem solving, groupwork and calculators and computers. The researcher having discussed the OBE Curriculum Model believes that a discussion of the above mentioned strategies is imperative.

2.13.1 THE USE OF GAMES

Coombe and Davis (1995:18) stress that games are used variously as ice-breakers, to introduce new concepts, for the consolidation of ideas, for removing the drudgery from drill and has been seen as important in creating a positive and enthusiastic atmosphere in workshops and classrooms. They also claim that a review of literature on the use of games in classrooms have led to a wide ranging though rhetorical series of arguments for their usefulness.

Coombe and Davis (1995:18) offer the following attributes pertaining to the use of games:

- generates enthusiasm, excitement and the total involvement of learners;
- helps to vary the curriculum;
- generates learner-learner and educator-learner discussion and encourages co-operation;
- are useful devices to help learners to gain new concepts, practice and reinforce skills and develop problem solving strategies;
- requires learners to use trial and error methods, simplify difficult tasks, search for patterns, make and test hypotheses and to prove and disprove conjectures;
- provides a vehicle for many mathematical situations – an external concrete situation in which manipulation makes sense; and,
- can be used by educators to assess learners.

In an OBE workshop held for Grade 7 educators in the Durban South Region from 19 October to 25 October 2000, reference was made to the following three quotations with regard to the usefulness of games in the classroom:

> ***'In games, feedback comes from other children and oneself. Children check each other's thinking and learn that they can figure things out for themselves. When worksheets are used, teachers often have to correct the same errors day after day. The reason is that this feedback is both distant and delayed. In games by contrast immediate feedback comes directly from friends.'***

(Kamii and De Clark, 1985:35)

> *'…whilst playing games children are relaxed and have a good learning disposition. Games which become familiar and loved help create a confident and secure atmosphere in the classroom and may even bring the isolated child into social interaction with other children.*

(Williams and Somer Will, 1982:8)

> *'Students receive positive reinforcement more frequently because, using a learning game in the classroom provides immediacy of feedback to the pupils because each pupil is informed immediately after each game whether he won or lost.'*

(De Vries and Edwards, 1973:308)

In the workshop the following types of games were classified as being useful in the mathematical classroom:

- puzzle-type games
- games to reinforce concepts
- games to practise skill
- games to stimulate mathematical discussion
- games to encourage the use of strategies
- multicultural games
- mental games
- computer games
- calculator games
- collaborative games
- competitive games
- games for emphasising underlying mathematical structures

The workshop also highlighted the following aspects with regard to the use of games in the classroom:

- Games should be chosen and played with a specific purpose in mind, for example, dice games are particularly good for consolidating number bonds. Learners should be aware of these purposes and why they are playing the games: it is not only to have fun!

- Games should be selected according to the needs of the learners. There is no point in playing a game that consolidates the number bonds up to 10, for example, if the learner is quite competent in this area.

- Games should be played at the 'right time', that is, when the ideas or skills involved in the game are being taught or reviewed.

- Games may be used to extend the learner's learning. This may be done by the educator or the learners, with good reasoning, for example, multiply the dice together instead of add, because we are happy with adding and feel we need multiplication practice, it will enhance the learning experience.

- Commercial games such as Snakes and Ladders, Bingo and Maths 24 can be used and adapted for use in the classroom.

- Games should not be overdone, for example, if they are played too often they may become boring and no longer serve their purpose.

- Games should be explained clearly. Explanations can be done by learners as well as educators.

- The importance of learning something from playing the games should be emphasised. For instance, in follow-up or feedback sessions the learners could be encouraged to share what they have learnt.

Although games can be valuable activities for learning mathematics at the senior primary level, Bell (1978:255) believes that games are not an educational panacea and do have the following limitations. These are, *inter alia*: Involvement in games can become too intense. When playing a game results in winners and losers, unsuccessful learners may avoid participating in the game or may participate half-heartedly. Furthermore, the objective of winning may overshadow cognitive objectives and denigrate the value of mathematical objectives.

Playing certain games may encourage inappropriate values such as winning at any price or refraining from co-operation. Among the less tangible limitations of games is the fact that some learners enjoy games to such an extent that any other teaching strategy appears uninteresting when compared to game strategies.

The greatest intangible limitation of games results from the manner in which they are viewed in our society. Games tend to be regarded as diversions and not serious mathematics. Many educators who use games regard them as purposeless diversions. Educators who do use good games to meet sound learning objectives rely too heavily upon games as a source of teaching strategies. Their learners, who have been conditioned to regard games as diversions, may feel that they are not learning any mathematics because the educator is always playing games.

In view of the above it can be conceded that games can be very effective when judiciously selected and used in moderation. Involvement in mathematical games undoubtedly enhances mathematics learning for most learners.

2.13.2 <u>PROBLEM SOLVING STRATEGIES</u>

Ferrucci *et al.* (2001:26) stress that recent studies demonstrate the importance of including mathematical word problems in the primary school to develop learner's understanding of how to apply solution strategies to real-world problems. This coincides with what Copeland (1982:215) meant when he stated that problem solving includes a wide variety of routine and common place functions essential in the day-to-day living of every citizen. Problem solving applies mathematics to the world around us.

Copeland (1982:215) maintains that a full range of problem solving includes:

- traditional concepts and techniques of computation applied to real-world problems;
- the use of mathematical symbolism to describe real-world relationships;
- the use of deductive and inductive reasoning to draw conclusions;
- methods of gathering, organising and interpreting data; drawing and testing inferences; communicating results; and,
- the visualization and use of spatial concepts related to problem solving.

Van Der Horst and McDonald (1997:139) provide the following advantages of using problem solving as a teaching strategy:

- it provides a challenge for the learners;
- it engages learners actively in learning;
- it helps learners to develop new knowledge and to feel responsible for their own learning;
- it shows learners that mathematics can be viewed as ways of thinking and doing things that make sense;
- it develops critical thinking skills;
- it keeps learners' natural curiosity alive;
- it helps them to make informed judgements;
- it gives learners the opportunity to apply their knowledge and see that the knowledge has some real-world applications;
- it helps learners to integrate the knowledge they gain from the different subjects;

- it engages them in learning long after the formal lesson is over; and,
- the familiar learner question "Why do we need to know this?" is often replaced with "What do we need to know?" or "What do we need to find out?"

Bell (1978:313–314) comments that the techniques for problem solving involve the following steps:

Step 1 : Presenting a problem in a general form. It needs to be emphasised that while this study pertains to primary school learners who are in the main in the concrete stage of intellectual development nothing prevents the educators from extending these learners. This will involve the educators using their discretion in providing examples that the learners are ready to handle.

Step 2 : Restating the problem so that it is solvable. The following set of questions can be of use in formulating a solvable restatement of a problem:

- Does the problem make sense?
- Is the problem worthwhile or interesting?
- Do I understand the problem?
- Is the problem too general?
- What does the problem mean?
- What is known?
- What is unknown?
- Is there enough information in this statement of the problem?
- Can the problem be stated in a more meaningful way?

- Can the problem be broken into sub-problems?

Step 3 : Formulate alternative hypotheses and procedures for attacking the problem. The following strategies assist in carrying out this step:

- What is given, that is, what do we know?
- What is to be found?
- What activities might lead to new information?
- What speculations appear to be reasonable?
- What procedures can be used to solve this problem?

Step 4 : Involves the testing of hypotheses and carrying out procedures to obtain solutions to problems. This provides the actual solution to each problem that is solved.

Step 5 : Involves the evaluation of the solution.

Van Der Horst and McDonald (1997:144) stress that motivation is a key element to problem solving. Unless learners want to solve the problem and believe that they have a chance of success, they are unlikely to persist and therefore are unlikely to learn so that they can achieve the solution. Motivation can be reduced to learners requiring to know why they are learning whatever it is that they are learning and they need to see some value in this learning. This can be attributed to problem solving leading to purposeful and useful learning. In conclusion it must be acknowledged that :

> ***'… the importance of problem solving in mathematics and the fascination that mathematical problem solving holds for many people have been illustrated throughout the history of mathematics and mathematical education.'***

(Bell, 1978:308)

2.13.3 GROUPWORK

An important aspect of reconstructing education in South Africa is the transformation of classroom practices to include approaches to learning and teaching which are 'learner centred and non-authoritarian' and encourage an active participation of learners in the learning process. One possible approach is small groupwork which is beginning to be used more widely in mathematics classrooms in South Africa (Brodie, 1995:7).

Brodie (1995:7) argues that as a learner centred practice, small groups are expected to create time and space for individual learner participation in discussion and activities and, hence, for the construction of knowledge. Interaction with different points of view may increase possibilities for conceptual development. As a democratic process small groups provide learners with opportunities to learn from and value their peers' ideas and experiences.

In addition, Brodie (1995:7) believes that small groups also remove the educator from most of the learners' discussion. Research in classrooms has shown that certain kinds of educator control over the discourse and knowledge generated in the classroom can be detrimental to learning. For example, educators tend to ask mainly questions to which they already know the answers. While such questions may be an appropriate means for assessing learners' knowledge, they also have the effect of encouraging learners to try to guess what the educator is thinking, rather than to express their own ideas.

Peer groups are expected to provide more equality in interaction and to allow learners more control over the learning situation and the knowledge developed. For example, they may have more opportunities to ask their own questions and to answer genuine questions from their peers about their developing knowledge.

However, Brodie (1995:12) warns that the educator can and should be a powerful enabling influence, mediating both interaction and conceptual development in small groupwork. Mediating implies closer educator direction and guidance. In this regard, Bell (1978:354) comments that the most important function of the educator during small groupwork is to observe the activities and progress of each group and keep learners informed about the strengths and weaknesses of their procedures. The educator's role is thus that of monitor and facilitator. Facilitator in this context will call for educators to allow learners to develop and express their own ideas.

Bell (1978:360–361) mentions the following problems educators may encounter when working with small groups and recommends the following suggestions to counteract these problems:

- At times groups may become polarized into two competitive factions, each one of which attempts to impose its will upon the other. Educators need to remind learners that the purpose of the group activity is to inquire into the nature of mathematical principles and not to win a debate.

- Groups may become unresponsive due to reluctance to discuss mathematical concepts or not understanding the task. The educator can temporarily become a member of the group and get the discussion started through questions and suggestions

- Groups may become unproductive due to being unable to stay on the topic. The educator can usually find the source of a group's statement by observing the group members' activities for a few minutes, then offer suggestions to facilitate progress towards the objectives of the lesson.

2.13.3.1 <u>SUMMATION</u>

Even though a primary objective of the grouping method is to help learners become independent inquirers, carefully planned activities, constant monitoring of learners' groupwork and judicious participation within groups are a necessary part of an educator's role in learner centred learning strategies. Since the educator has less control of a group activity, even more careful planning and anticipation of learner difficulties must be carried out when the groupwork method is being used.

2.13.4 COMPUTERS AND CALCULATORS IN THE PRIMARY SCHOOL

The researcher believes that of the most recent developments that have important implications for mathematics education, is the calculator and computer. These technological developments are urgent because computers and calculators are so important in business and everyday life and growingly more in education and will become even more so, as greater numbers of learners and young people use them. They are also important, because the technology is available, in use, and has potential to effect major changes in the teaching and learning of mathematics, because some people have fear that learning basic mathematics will be undermined. The full potential of the calculator, however, cannot be realised without a change in both teaching styles and educators' conceptions about their use. Groves and Cheeseman (1993:21) argue that apart from the calculator being used to just check answers, its most important use is to be found in the following:

- helping children to decrease computation time and effort in order to concentrate on the core of a problem and to enable performance with large and messy numbers;

- facilitating the exploration of numbers and operations with numbers;

- encouraging inquisitiveness and creativity through experimentation; and,

- developing estimation and mental computation skills by checking reasonableness and exploring features of the calculator itself and the advantages of its use in different situations.

However, Groves and Cheeseman (1993:22) also warn that the training of basic mathematical skills and abilities should not be replaced by the premature use of the calculator.

With regard to the use of computers, Kaput (1992:533) highlights several constraints such as, an insufficient number of computers, limited access to software and inadequate preparation of educators that restrict the use of this device. Nevertheless, computers have the following to offer:

- they can be used in conjunction with all parts of the constructive learning process, when embedded in a classroom culture where there is communication and co-operation;

- they can be used in the practising of skills in a way that incorporates understanding or in simulations that enhance concept building; and,

- they can provide learners with new tools for learning in an exploratory environment.

It can be conceded that while the potential of the calculators and computers for enhancing learning in mathematics can be demonstrated, it remains the crucial task of the mathematics educator to develop the use of these technological devices in their teaching. The standard of mathematics education should be the guideline and not the technical limitations and possibilities.

2.14 CONCLUSION

This chapter opened with relevance to theory in providing a theoretical framework. This was followed by the researcher establishing a framework for INSET. Thereafter, the objectives of INSET were discussed, followed by a discussion of the INSET Models. The researcher then provided a brief overview of the theory of change.

It was against this background that the researcher discussed the theoretical constructs of mathematics at the senior primary level with the intention of providing a framework for mathematics education. The framework will enable mathematics educators to cope with the changing needs of mathematics education at the senior primary level.

The next chapter opens with a brief review of the history of mathematics followed by a presentation of the evolution of mathematics teaching and INSET provision of educators of mathematics in primary schools in a selected developed country.

CHAPTER THREE

HISTORICO-COMPARATIVE STUDY OF THE INSET PROVISION OF MATHEMATICS EDUCATORS AT THE SENIOR PRIMARY LEVEL IN A SELECTED DEVELOPED COUNTRY

3.1 INTRODUCTION

There is no doubt that the various activities of today have their forerunners in history. Many facets of mathematics that will assist the educators in understanding the present can be gained by a study of the past. This chapter therefore begins with a brief review of the history of mathematics. The fundamental objective of this strategy is to provide the mathematics educator with an appreciation of the subject, thereafter leading to the effective teaching of the subject.

This is followed by a presentation of the INSET provision of mathematics educators at the senior primary level in England. It is believed that in advocating the principles of educational borrowing, the researcher would be able to analyse and evaluate England's experience for South Africa in general and KZN in particular.

A study of the INSET provision of mathematics educators in a developing country would have been invaluable to this study. It would have enabled the researcher to show to what extent the format and strategies of INSET provision vary between a developed and a developing country. However, numerous attempts to gain information proved fruitless and time consuming. Hence, a sub-section encapsulating the INSET provision of mathematics educators in the senior primary phase in a developing country was excluded in this study.

3.2 HISTORY OF MATHEMATICS

As was mentioned earlier in this chapter, the intrinsic value of the history of mathematics for the educator is undoubted. Furthermore, it provides the mathematics educator with a broader view of the subject. In view of the above statements a brief review of the history of mathematics will now be provided.

All primitive civilisations developed concepts of number and measure as soon as trade progressed beyond the process of barter. Almost 6 000 years ago the Sumerians were using a numeration system based on the number ten referred to as the denary system. They also used a system based on the number sixty referred to as the sexagesimal system (Fitzjohn and Weber, 1990:1162). The knowledge gained solved basic problems of agriculture and social organisation.

The flooding in Babylon and Egypt demanded seasonal surveys of land, the techniques of which led to geometry. Political, commercial and religious pressures to build palaces, ships, temples and tombs stimulated the further development of geometry (Fitzjohn and Weber, 1990:1162-1163).

The Greeks established mathematics as a rigid study, placing mathematical argument on a logical basis so that prepositions, previously not self-evident, could be deduced from basic assumptions. The golden age of Greece produced mathematical beauty that afterwards lay dormant for centuries.

After the decline of the ancient world, advances in mathematics took place largely within Asian and Arabic civilisations. By the year 900, Muslim scholars began to build on what they acquired in terms of Arabic versions of Greek and Indian mathematical works. Thus, mathematicians expanded the Hindu decimal positional system of arithmetic from whole numbers to include the decimal fractions (Webb, 1998:2).

The Renaissance in Europe saw greatly revived interest in mathematics. Arabic texts were translated and studied and a great deal of Greek mathematics was rediscovered through Arabic translations. From the fifteenth century to the nineteenth century, the development of mathematics was an entirely Western European phenomenon (Webb, 1998:2).

As trade spread, the need for standardised units increased. The earlier systems were all based on convenience: for example, parts of the body were used for measuring length, the working capacity of oxen for area, stones for weight and skins for volume. In 1791 the French devised the metric system based on the metre.

International trade has now forced most of the Western World to adopt the metric system of measurement.

In summarising, it will suffice to say that mathematics knowledge in the modern world is advancing at a faster rate than ever before. This could be attributed to the demands of modern science, technology, industry and commerce. While the computer has made possible the solution of several long-standing problems in mathematics, new and equally challenging problems continue to arise.

The researcher will now examine the INSET provision of mathematics educators at the senior primary level in England. This will serve as a model for a developed country.

3.3 THE INSET PROVISION OF MATHEMATICS EDUCATORS AT THE SENIOR PRIMARY LEVEL IN ENGLAND

3.3.1 HISTORICAL BACKGROUND

Social utility controlled the curriculum since the Elementary Education Act of 1870. This Act by W.E.Forster, the Vice-President of the Committee of Council, made provision for universal elementary education. Education aimed at the conquest of illiteracy through a curriculum limited to formal studies with learners learning by heart and complying to silence, orderliness and conformity to rule. The emphasis on the curriculum was learners' attainment in reading, writing and arithmetic (Choat, 1980:16).

Arithmetic was organised along class lines with extreme thoroughness. Textbooks were few, closely printed and packed with lengthy and involved examples. They were written for educators rather than children and their authors assumed that educators would give elaborate oral demonstrations and detailed explanations of each new stage of learning.

The value placed on prowess in arithmetic was so great that almost half of the school day was given to working exercises, the transcription of figures from the board or listening to explanations of how new answers had been obtained. Education in most schools remained geared to the principle of rote learning. This arrangement offered educators the prospect of improved examination results and therefore better salaries.

With regard to the development of INSET in this period, Bagwandeen (1991:253) characterises INSET of educators as comprising single lectures or short series of lectures as those given in 1873 and 1874 at the College of Perceptors by Professor Joseph Payne. The lectures were occasionally supplemented by group discussions.

Bagwandeen (1991:253) in referring to Henderson (1978:24) reports that in the early years of the twentieth century INSET received a major stimulus. The Board of Education provided a third year of study through one year supplementary courses for educators with two years of PRESET. Accompanying these courses, short vacation courses mainly for educators in the rural areas were organised by the Board of Education. In addition Local Education Authorities (LEAs), Universities and other bodies provided short summer courses, part-time courses and series of lectures in the winter term for educators (Bagwandeen, 1991:253).

It was not until the Hadow Report in 1931 that educational change attracted attention. For the purpose of this study the INSET provision of mathematics educators at the senior primary level will be discussed in distinct periods, namely, the period between 1930 – 1950, 1950 – 1970 and 1970 to the present.

3.3.2 INSET PROVISION OF MATHEMATICS EDUCATORS IN ENGLAND 1930 - 1950

The deliberations of these two decades although interrupted by the war years, prepared the way for the development and publications of the later years both in relation to primary education and mathematics. With regard to INSET these two decades set the scene for many of the post-war developments.

The apparent serenity of the primary education scene was disturbed by the Hadow Report. Consideration will now be given to this report.

3.3.2.1 THE HADOW REPORT (1931)

The Consultative Committee of the Primary Schools, chaired by Sir William Hadow, had challenged some traditional curriculum patterns in its report presented in 1931:

> ***'The traditional view, still widely held, that memory is especially strong in young children and that the primary stage is pre-eminently the time for a great deal of routine work, requires large qualification. Reliance should be placed at this stage not only on mechanical memory, but also on that aspect of memory that is assisted by reasoning and understanding. The power of reasoning in children between the ages of 7 and 11 appears to be more highly developed than is generally supposed. We are of the opinion that the curriculum of the primary school is to be thought of in terms of activity and experience rather than knowledge to be acquired and facts to be stored.'***

(Addison, 1981:13)

Addison (1981:13) claims that these recommendations required the educator to relate the organisation of teaching situations to the learning needs of the learners; individual work and group activity were to be combined with traditional class teaching. However, although the heavy responsibility imposed on the educator to be imaginative, adaptable and creative was recognised, the importance of INSET became apparent later as the implications of the new ideas emerged. Addison (1981:13–14) levelled the following criticism pertaining to the report:

- References to mathematics in the report were very brief.
- Some extracts were revealing since they indicated that the synthesis between the child-centred experience theme of the

general curriculum and the content of the arithmetic syllabus had still to be more fully explored.

- Computational accuracy and practical exploration were both advocated but the reader is left with a sense of unresolved tension between these aims.

In March 1942 Lord Butler, President of the Board of Education, appointed a Committee under the Chairmanship of the Vice-Chancellor of Liverpool University, Lord McNair, to investigate the sources of supply and methods of recruitment and training of educators and youth leaders (Bagwandeen, 1991:253). With regard to INSET the McNair Committee recommended that educators be granted at least a sabbatical term on full pay after five years of consecutive teaching. It also proposed the establishment of an area training service to provide both PRESET and further professional training. In addition consideration was given to Schools or Institutes of Education established by Universities to exercise influence upon education on a partnership basis with Colleges (Bagwandeen, 1991:254). Bagwandeen (1991:254) stipulates further that these Schools or Institutes of Education which were subsequently established, positively stimulated INSET.

With regard to wartime measures of social reconstruction, Matthews (1992:6) considered the 1944 Education Act to be the first. Brief consideration will now be given to this Act.

3.3.2.2 THE 1944 EDUCATION ACT

Bailey (1992:67) echoes that while the 1944 Education Act reformed the whole structure of education in England, it made no reference to curriculum matters save for religious and physical education. Nevertheless, he claimed that the Act opened the way for curriculum innovation. The 1944 Education Act, states Matthews (1992:6), required each local authority to ensure that in their area there are sufficient schools for providing the following:

- Primary education that is defined as full time education suitable to the requirements of junior learners up to the age of 12.

- Secondary education that is defined as full time education suitable to the needs of senior learners in the age group 12 – 19.

This Act, argues Matthews (1992:6), catered for the capabilities of all learners rather than for just an elitist few.

3.3.3 INSET PROVISION OF MATHEMATICS EDUCATORS IN ENGLAND 1950 - 1970

When the Russians launched the first Sputnik in 1957 the Western World viewed this development with grave concern. Up until then the countries of the West had rather patronisingly regarded the Union of Soviet Socialist Republics (USSR) as a backward giant of a nation, hopelessly engaged in trying to educate its largely peasant people to achieve the technological advantages of its more favoured European neighbours (Moon, 1986:147). This formerly retarded nation had outstripped its European neighbours in finding scientists and mathematicians of a very high calibre.

In order to keep up with the USSR at all costs, the first step was to change the name of the subject. Almost overnight the word arithmetic disappeared from the timetable, being replaced by that much more glamorous term: Mathematics (Moon, 1986:147).

A reassessment of the study of science and mathematics soon followed. In England, the Nuffield Mathematics Teaching Project began in September 1964. Moon (1986:122) remarks that this date could be seen as marking the beginning of the English response to the international movement for mathematics reform at the primary level. Pretorius (1976:105) claims that it was due to the interest that the Nuffield Foundation showed in mathematics that there was a quickening in the pace of curriculum development in the early sixties. Since the Nuffield Project dominated the development of mathematics teaching and INSET provision for a decade or more, it requires further attention.

3.3.3.1 THE NUFFIELD PROJECT

The Nuffield Project's main aims were to stimulate interest in mathematics and develop methods of teaching the subject more efficiently to learners from five to thirteen years. The theme of the project was that the curriculum should be taught in terms of activity and experience, rather than knowledge to be acquired and facts to be stressed.

Incentives to the project creation were the results of the research work of psychologists such as Jean Piaget and Jerome Bruner. Most important of all, the Nuffield attitude was perfectly in line with the general acceptance of learner centred education which emphasised individual expression, inhibitedness by too rigid subject barriers as being incorrect and the importance of learners discovering for themselves (Pretorius, 1976:63).

Emphasis was placed on structural apparatus while the task of the educator was to create a learning situation in which the learners were able to use their own creativity to construct their own concepts. The lessons begin with free play with the structural apparatus followed by games involving rules leading to activity involving verbalizing and writing. The essence of this approach was that learners should work at their own pace, make their own discoveries and think for themselves. This would also occur in an atmosphere where there would be little in the way of controlled direction.

Mathematics teaching was conducted through the use of syllabi by educators rather than through the offer to schools of teaching material utilizing structural material and guides, which could be adapted and modified as educators saw fit. Educators were also invited to make their own contributions towards improved mathematics teaching. This attitude emphasised the evolving nature of mathematics teaching and the need for educators to adapt to changing circumstances.

In 1964 and 1965 LEAs were invited by the Schools Council to volunteer for participation in the Nuffield Project. A condition of participation by the LEAs was the provision of teachers' centres containing large workrooms with appropriate storage space and rooms for meetings and seminars. This was essential, as the INSET of educators was an integral part of the Nuffield programme. The centres were seen as the best means of training the educators, disseminating the trial material and publicising the results (Pretorius, 1976:68).

The project generated within fourteen selected pilot areas representing communities throughout England, Wales and Scotland. The local centres became resource centres in relation to the primary school curriculum as a whole. In 1966, sixty-five new areas were included. Altogether 2 200 schools, 13 000 educators and 500 000 learners were involved in the project.

Over two hundred centres were eventually active where educators discussed, modified, amplified and adapted the Nuffield materials, so that the project involved the educators as well and not just a central team. Ten regions were formed to coordinate the activities of the LEAs. These regions arranged local meetings, ranging in length from one day to a conference lasting a week. Within each region there was a great deal of activity, courses, exhibitions and above all discussions. A certain amount of aftercare was carried out. This included holding the occasional national conference and updating some of the educators' guides (Pretorius, 1976:68).

Moon (1986:68) outlines the following merits of the Nuffield Project in respect to mathematics:

- Learners were more alert and ready to think for themselves.
- Their powers of reasoning were more developed and this showed in other subjects as well.
- Learners have learnt to work together quietly, each contributing their share in the discovery or in applying a technique.
- Learners of all levels of ability could successfully solve the problems set if these were carefully selected.
- The more intelligent, creative learner could often discover other relationships in the situation.
- The less intelligent learner found satisfaction in the practical aspect itself and in the mastery of the technique required.

The following criticisms of the Nuffield Project with respect to mathematics were highlighted by Moon (1986:83):

- The mathematical achievements of the learners were difficult to assess because the project did not lend itself to the traditional methods of testing.

- The basic number of skills, for example, bond-work was seen as being done insufficiently and was questioned by the public in general.

- Group activity appealed to the extrovert personality and was seen as a method inhibiting some learners.

- It required inspired hard work on the part of the educators, firstly, in devising the problems and secondly, in checking the progress of each learner. Major drawbacks experienced by the organisers have been due to lack of dedication on the part of the educators or to recently qualified, inexperienced educators.

The project ended officially in September 1971. Ernest (1989:9) considers the main characteristics of the decade of the 1960s with respect to mathematics as:

- The broadening of the mathematics curriculum to include new topics, both pure and applied.

- Curriculum development projects in mathematics, such as the Nuffield Project, at the primary school level.

- Progressive teaching methods, including discovery learning and the beginnings of interest in problem solving and mathematical investigations.

Ernest (1989:9) stipulates that the 1960s could be seen as a starting point in relation to innovations in the teaching of mathematics over the next few decades. With regard to the development of INSET of educators in England in the 1960s, Mkhize (1989:24-25) outlines the following:

- The increase in the number of teachers' centres and the prospect of the school-leaving age raised brought about some important developments in INSET in that more educators attended INSET courses.

- The centres served as venues for professional interchange of information, ideas and innovations and for the exhibition of teaching and learning resources.

- Television emerged as an INSET medium.

- A substantial number of non-graduate educators enrolled in the Open University for degrees like Bachelor of Education (B.Ed.) and higher degrees like Masters in Education (M.Ed.).

- There was greater emphasis on school-based INSET.

3.3.4 MATHEMTICS TEACHING AND INSET PROVISION IN ENGLAND 1970 - PRESENT

By the mid 1970s a public reaction to innovation programmes in education had set in. Sovchik (1989:6) points out that 'back to basics' became a rally cry among many critics of education. The Schools Council decided that it was time to take a look at mathematics teaching in the primary school. The main aims of the Schools Council were to find out how far the various changes that were lumped together under the umbrella title of modern mathematics had penetrated schools, to pin point any difficulties, to look at mathematics attainment and standards and to present educators with an overall picture of what was happening (Ward, 1979:10).

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3.3.4 MATHEMTICS TEACHING AND INSET PROVISION IN ENGLAND 1970 - PRESENT

By the mid 1970s a public reaction to innovation programmes in education had set in. Sovchik (1989:6) points out that 'back to basics' became a rally cry among many critics of education. The Schools Council decided that it was time to take a look at mathematics teaching in the primary school. The main aims of the Schools Council were to find out how far the various changes that were lumped together under the umbrella title of modern mathematics had penetrated schools, to pin point any difficulties, to look at mathematics attainment and standards and to present educators with an overall picture of what was happening (Ward, 1979:10).

In 1972 the Primary School Mathematics Evaluation Studies Project was established. The first few months of the project were spent obtaining a general impression by talking to learners, educators, advisors, lecturers and people concerned with curriculum development in mathematics. According to Ward (1979:11-12), the project found general agreement on the following matters:

- Since the mid 1960s, there had been a gentle swing of the pendulum away from some aspects of modern mathematics, both in content and method. Learners in some cases had been hampered by weaknesses in their basic skills of computation.

- There had been a renewed emphasis on instant recall of addition and subtraction of facts and on learning tables.

- Concern was raised over two very different types of schools – the small hard core of rigidly traditional schools and the few progressive schools where too many ideas were taken up too quickly.

With regard to INSET, Bagwandeen (1991:256) mentions that during the 1970s doubts about the quality and effectiveness of much traditional INSET began to be expressed. He claims further that resources to support INSET provision were in short supply and those made available were not always deployed to full advantage. Courses were designed to benefit individual educators. Furthermore, the traditional formats of INSET courses were incapable of providing adequately for the different school contexts in which educators were working (Bagwandeen, 1991:257).

This review sketched the background to the conditions that existed with regard to INSET when in 1971 the James Committee under the Chairmanship of Lord James was formed to consider the education and training of educators. The thinking of the James Committee was governed by two principles. Firstly, that their proposals should be capable of speedy implementation. Secondly, that the status and independence of both the teaching profession and Colleges of Education should be enhanced.

While the Committee made 133 recommendations, the main issue was that the education and training of educators should fall into three cycles. The first concerned the personal education of the student, the second the pre-service education and the third the in-service education. Highest priority was to be given to the expansion of the in-service cycle. The Committee recommended that every seven years all educators would have 12 weeks paid leave for in-service education and a national network of professional centres would be set up for this purpose. According to Bagwandeen (1991:257) there can be no doubt that the James Committee Report held the promise of being a most powerful catalyst in the development of teacher education and INSET in England. Bagwandeen (1991:258) makes reference to the following possibilities offered by the James Committee Report:

- It advocated the necessity of life-long education.
- It came down on the side of voluntary participation by educators.
- It offered a solution to a long-standing weakness of the career arrangements for serving educators.
- It suggested that INSET is a critical factor in education because knowledge, society and educators are all subject to continuous change.

The James Committee had hoped that the urgency with which they had produced their report would be matched by an equal urgency in decision-making by the government. As the James Committee Report proved highly polemical, a lengthy period of consultation was initiated. This resulted in a Government White Paper, Education: A Framework for Expansion (Bagwandeen, 1991:260). Bagwandeen (1991:260) indicates that the James Committee and the White Paper did little to advance a meaningful policy for INSET.

In the 1980s there was a rapid increase in INSET in various directions (Mkhize, 1989:25). Bagwandeen (1991:260) in referring to Whittaker (1982:27) and Lewis (1984:7) suggests that the emphasis on INSET could have resulted from the cutbacks in initial training at this time in England.

School focused INSET became the key to INSET provision in England. School principals and LEAs had begun to recognise that the basis of success for INSET lay in the individual school and its staff (Bagwandeen, 1991:260).

With regard to the development of mathematics teaching, the most important event in the 1980s was the publication of the Cockcroft Committee Report. Ernest (1989:2-3) highlighted the following significant issues and recommendations made by the Cockcroft Report:

- Recognition of the importance and the potential of microcomputers and electronic calculators for the teaching of mathematics.

- Acknowledgement that the learning of mathematics involves more than basic knowledge of facts, skills and procedures. It also crucially involves conceptual structures, the general strategies of problem solving and attitudes to and the appreciation of mathematics.

- Acknowledgement that successful learning requires a range of teaching styles at all levels, including discussion, problem solving, mathematical investigation, appropriate practical work, in addition to the more traditional approaches of exposition and the practice and reinforcement of skills.

- A powerful critique of the traditional forms of school assessment in mathematics at age 16, which for a great many learners focused more on failure than on mastery and success. Associated with this is a further critique of the nature and demands of the mathematics curriculum for the below average attaining learner.

- Recognition of the inadequacy of much of the teaching in schools due to the insufficient training and preparation of many educators in mathematics, and the use of non-specialists to teach mathematics.

- Recognition of the necessity for curriculum leadership in school mathematics at all levels, including the coordination of mathematics in primary and middle schools, and a recognition of the complex demands of this role, and that of the Heads of mathematics Departments in secondary schools.

- Recognition of the importance of mathematics in the world of work and in society in general, tempered with knowledge of many adults' ignorance and fear of mathematics. More generally, there was an acknowledgement of the importance of broader social issues and contexts for the teaching of mathematics in a number of ways, especially with regard to gender and the issue of the under-achievement of girls in mathematics.

Ernest (1989:4) maintains that, perhaps, the most important development in the teaching of mathematics in the 1980s had been the widespread recognition and adoption of the range of teaching styles endorsed by the Cockcroft Report. Ernest (1989:4) provides the following opportunities that mathematics teaching at all levels should include:

- Exposition by the teacher.

- Discussion between educator and learners and between learners themselves.

- Appropriate practical work.

- Consolidation and practice of fundamental skills and routine.

- Problem solving, including the application of mathematics to everyday situations.

- Investigational work.

With regard to the development of mathematics in the 1990s, Ernest (1989:7) questioned whether there would be further reaction in the 1990s against what was seen as progressive of the 1980s. While he maintained that such a reaction was possible, he also claimed that several new factors would suggest that mathematics education was not doomed to replay history. Ernest (1989:10) outlines the following new factors:

- There is a new realism. Those involved in education accept their accountability to parents and authorities as a matter of fact.

- The desired outcomes of education have been redefined to include more than the basics. Employees and authorities agree that in addition to literacy and numeracy school leavers need presentation, communication and decision-making skills, and the ability to solve problems, to participate in teamwork and to work co-operatively. These are the skills addressed by contemporary mathematics teaching at its best.

- The mathematics educator has become increasingly professionalised with an all-graduate entry to the profession. Teacher education requires four years of advanced study for an honours degree in education, or a three-year B.A. or B.Sc. followed by one year of study for a Postgraduate Certificate of Education (PGCE).

- Mathematics education has also become more professionalised, as the growth of mathematics teaching and research journals since the 1960s indicate. The volume and standards of research on the teaching of mathematics have both risen and practitioners are better informed of its results and of the justification for contemporary practice.

Ernest (1989:10) states further that:

> ***'Provided the mathematics teaching community sustains and enlarges those aspects of accountability, justification and professionalism, there should be no reason for the pendulum to swing against current innovation.'***

At this juncture it is also important to note that the most important development of the 1980s and the 1990s for the teaching of mathematics has been the advance and spread of the products of the new technology. These include the electronic calculator, the microcomputer and interactive video systems, as well as video recorders, programmable robots such as the Turtle and other devices (Ernest, 1989:12).

The significance of these products will undoubtedly influence the mathematics curriculum in two ways – on the contents and in the modes of teaching and learning. With regard to the impact on the content of mathematics curriculum, the universal adoption of new technological products means that knowledge, familiarity and competence in using those resources is a required part of mathematics education.

With regard to the effect of the new electronic technology on the modes of teaching and learning mathematics, the educator is no longer the sole arbiter of truth. Although they can be used in a variety of ways, the new electronic resources encourage an exploratory approach (Ernest, 1989:13).

Having discussed at length the development of mathematics teaching in this period, it is important to now consider the support which can and should be provided to enable those who teach mathematics to develop and extend their professional skill. Biggs and Shaw (1995:217–226) highlight the following points which they believe justify support for mathematics educators:

- All those who teach mathematics use continuing support throughout their careers in order to be able to develop their professional skills an so maintain and enhance the quality of their work.

- School-based in-service support for educators is of fundamental importance.

- The effectiveness of school-based support depends upon the leadership of mathematics coordinators or Heads of Department, hence, it is essential that they themselves should receive support and training.

- The training of coordinators and Heads of Department is likely to contribute most quickly and effectively to the overall improvement of mathematics teaching and should be given top priority.

- It is necessary for those who teach mathematics to have an opportunity to meet other mathematics educators.

- Adequately resourced centres could play a vital role in improving the teaching of mathematics.

- Every effort should be made to encourage membership of the professional mathematical associations and that the associations themselves should do as much as possible to develop their local activities.

- The long-term effectiveness of in-service courses can be greatly diminished unless there is suitable follow-up.

The extent to which these recommendations are implemented is important. It will depend upon the response of those who teach mathematics and the central or local government.

In order to gain information on mathematics teaching and INSET provision at present in England, the researcher contacted Sharon Rampersad, presently a mathematics educator in the senior primary phase in England. The researcher requested that the respondent provide a brief overview of mathematics teaching and INSET provision in England at present. The following represents the respondent's response.

- The latest development in mathematics teaching is the release of The National Numeracy Curriculum. This curriculum was introduced to upgrade the teaching and learning of mathematics in the primary school. In order to implement this new curriculum it was compulsory that all primary school mathematics educators undergo retraining.

- Every mathematics educator is also provided with a National Numeracy Curriculum Pack, which is produced by the Central Government. This pack contains a syllabus, lesson plans, mathematical vocabulary, worked out examples, mental exercises and so on. The pack must be displayed in the classroom at all times.

- A mathematics lesson in the allocated hour per day could follow the following format:

  Mental teaching (25 minutes)
  Written exercise (±15 minutes)
  Plenary (10 minutes)

  This format serves as a guide and is left to the discretion of the educator.

- Audio-visuals are common teaching tools for educators learning to teach mathematics effectively. It displays how mathematical topics could be successfully taught using available resources.

- School focused INSET is seen as the key to INSET provision. All primary schools have a subject leader, a mathematics coordinator who is responsible for mathematics teaching and learning in the school. Mathematics coordinators closely monitor teaching techniques in the classroom. Mathematics educators are monitored on a weekly basis. Feedback is provided and a discussion ensues. Negative feedback results in a demonstration lesson. Mathematics coordinators also ensure that all classrooms are equipped with mathematical apparatus like calculators, geoboards, angle measures, graph paper, square-lined paper, scales, clocks, dices and so on.

- Local boroughs also play a key role in the provision of INSET. Every borough provides their respective schools with a year-plan with regard to INSET courses. Educators are required to select courses that they believe would enhance their ability to teach mathematics effectively. In attending INSET courses that incorporate the different aspects of mathematics teaching, educators are instilled with a greater degree of confidence in their teaching. The basic aim of these courses is to inculcate in the mathematics educator the necessity to use the numeracy hour to uplift the level of mathematics teaching and learning. Supply educators are provided to substitute mathematics educators attending INSET courses. Supply educators also have access to these INSET courses.

Having reflected on the present, the researcher felt it would assist this study to make reference to a way forward in mathematics teaching. Matthews (1992:85) believes that the way forward into the 21st century can be summed up under the following alphabetical headings:

A for assessment, both diagnostic and prescriptive. Educators must access each individual learner in order to prevent mismatch of mathematical tasks. They must also have evaluated their own aptitude for the mathematics they are teaching, by an outside assessor.

B for balance. The work presented to learners must have a balance between acquiring concepts, learning skills and facts and undertaking investigative work. A balance of choice of structural apparatus and educational software must be decided by the school so that the learning of mathematics is not over-dependent on the limitations of only one or two manufacturers' dreams of mathematical salvation.

C for communication. It is important for the educator to communicate satisfactorily with all learners and for learners to communicate their mathematical findings to each other as well as to the educator. Parents should play their role in communication so that they are aware of and in sympathy with the mathematics their children are learning and the way in which learning is taking place. Above all, perhaps the most important communication is that which must take place between one educator and the next regarding each learner's level of mathematical attainment, whether by written records or verbally.

3.4 CONCLUSION

This chapter opened with a brief review of the history of mathematics. This, it is believed, would provide the mathematics educator with an appreciation of the subject, consequently leading to effective teaching of the subject.

The balance of the chapter provided a catalogue of facts and information tracing the development of mathematics teaching and INSET provision in England. In advocating the principles of educational borrowing the researcher firmly believes that the initiatives presently being undertaken in South Africa in general and in KZN particularly could be influenced by this study, indicating the development of mathematics and INSET provision in England over the years. In examining and evaluating England's experience, the following is of relevance and significance to this study:

- It became clear in this chapter that high priority is accorded to the expansion and improvement of INSET to ensure the quality of effective mathematics teaching.

- This chapter underscored the great role attached to the INSET needs of educators as one of the key factors affecting educational change.

- Evident in this chapter was the commitment of the government in terms of the various commissions that were appointed to investigate INSET resulting in recommendations that would lead to effective mathematics teaching.

- A range of courses was outlined in this chapter, designed to update, refresh and improve the competency of the already trained mathematics educators.

- School focused INSET was seen as the key to INSET provision. School principals recognised that the basis of INSET is the individual school and the mathematics educators.

- Evident in this chapter was the increased need for teachers' centres. This served as venues for professional interchange of information, ideas and innovations and for exhibitions of teaching and learning resources.

In concluding this chapter, it is true to say that South Africa is presently undergoing changes in its education system. This is apparent when one looks at the new Outcomes Based Education system. The extent to which the development of mathematics teaching and INSET provision in England over the years influence the initiatives presently being undertaken in South Africa will depend upon those who teach mathematics and those who are responsible for the provision of INSET for senior primary mathematics educators. In the next chapter, the INSET needs of educators of primary school mathematics with particular reference to senior primary mathematics in KZN will be reviewed.

CHAPTER FOUR

THE INSET OF MATHEMATICS EDUCATORS OF PRIMARY SCHOOLS IN KWAZULU-NATAL

4.1 INTRODUCTION

This chapter begins with a general overview of the INSET of educators in KZN and mathematics in the primary schools prior to 1994. This serves as a background to the INSET of educators with particular reference to mathematics in the primary school in KZN in the post 1994 period which constitutes the main thrust of this research. The reason for this chronological division is due largely to the researcher's view that with the shift in political power in 1994, came many changes in education and in order to place these changes into proper context, reference must be made to the past.

4.2 A GENERAL OVERVIEW OF THE INSET OF EDUCATORS IN KWAZULU-NATAL PRIOR TO 1994

In order to place the INSET of educators in KZN prior to 1994 into perspective, it is imperative to state that the education system which existed prior to 1994 in South Africa was organised on a differentiated racial basis resulting in separately administered education systems. Due to government policy, five separate Education Departments existed in KZN. These were, the KwaZulu Department of Education and Culture (KZDEC), the Department of Education and Training (DET), the Natal Education Department (NED), the Department of Education and Culture:House of Delegates (HOD) and the Department of Education and Culture:House of Representatives (HOR).

Reference will now be made to these Education Departments reflecting the INSET of educators among the different Departments. In this section the researcher referred primarily to the following sources, Mkhize (1989 : 38-66), Bagwandeen (1991 : 273-480), Hofmeyr (1991 : 299-307) and Pather (1995 : 245-326). The aforementioned sources provide detailed studies of INSET for educators in the period prior to 1994.

4.2.1 INSET IN THE KWAZULU DEPARTMENT OF EDUCATION AND CULTURE (KZDEC)

The KZDEC was established in 1972. Preceding this period Black education was controlled by the Department of Bantu Education. The education of Blacks was shared between the KZDEC and DET in KZN.

With regard to formal INSET in the KZDEC, Bagwandeen (1991:301) refers to Dhlomo (1979:182) who indicated that while everything possible was done in KZN to afford Black educators the opportunities for INSET, not all of them were able to attend such courses. It was against this background that all teacher education institutions that existed under the control of the KZDEC were to be equipped with INSET facilities thus playing a dual role as PRESET and INSET centres.

Subsequently, the KZDEC established the Umlazi In-Service Training Centre. Mkhize (1989:61) outlines the following main objectives of the in-service courses at the centre:

- to upgrade educators' skills and techniques;
- to increase the educators' knowledge content-wise in subjects of their speciality;
- to train leaders of the circuit, so that they could in turn train educators in the circuit;
- and, to invite organisations to run courses on critical subjects such as mathematics, physical science and biology.

Follow-up in some circuits were conducted to ascertain how educators who have attended INSET courses conducted the courses in the circuit. However, due to various problems the centre was subsequently closed.

The Umlazi College for Further Education was established in 1983 (Mkhize, 1989:60). The college provided upgrading courses for educators through correspondence, organised outreach programmes and provided ongoing seminars and workshops throughout the year (Bagwandeen, 1991:322).

With regard to non-formal INSET, subject committees were established by the Department to promote INSET. Furthermore, a Departmental Projects Forum to coordinate Non-Governmental Organisation (NGO) activities was established in 1990. The Department also published a bi-monthly journal entitled "Fundisa" which was circulated to all schools. In the main, the journal concentrated on education news, informing the educators and the public on developments in the KZDEC. Educators were also requested to submit constructive criticisms which could lead to enhancing the professional growth of educators.

In addition to departmental INSET, the Black teacher organisations also provided INSET through conferences, seminars and subject interest groups. Black educators could also study either as part-time or full-time students at various universities.

4.2.2 INSET IN THE DEPARTMENT OF EDUCATION AND TRAINING (DET)

In terms of formal INSET, Superintendents of Education attached to regional offices visited schools and conducted INSET courses for educators at regional and circuit level (Bagwandeen, 1991:311). Hofmeyr (1991:301-304) highlighted the following initiatives mounted by the DET to upgrade educators' qualifications:

- the establishment of 51 adult education centres where educators were offered instruction to help them obtain a standard ten certificate;
- further training courses, part-time or full-time for diplomas or degrees at Colleges of Education and Universities;
- the use of modern technologies such as micro-teaching, interactive video and modular, competency based approaches.

Hofmeyr (1991:302-303) also indicated the following that was provided by the DET with regard to improving teaching competency:

- subject-direct INSET courses of one to three weeks a year at the College for Continuing Training at Soshanguve;
- "Project Alpha" which assisted educators in specific subjects;

- teachers' centres where educators voluntarily received instruction and encouragement from colleagues;
- subject-related INSET courses provided by Subject Advisors in the regions.

With regard to non-formal INSET, the DET supported various NGO INSET programmes. The "Educamus" was published ten times a year containing articles on methodology and general professional matters such as conditions of service or departmental policy on education.

As was mentioned previously, the Black teacher organisations also provided INSET programmes in addition to departmental INSET. Black educators of the DET could also study either as full-time or part-time students at various universities.

4.2.3 INSET IN THE NATAL EDUCATION DEPARTMENT (NED)

Emphasis on INSET in white education dated back to the 1970s. The first College of Education for Further Training was established in Pretoria and teachers' centres were started (Hofmeyr, 1991:298).

In terms of formal INSET, curriculum-related INSET was generally provided to upgrade subject knowledge, teaching and didactic skills. Bagwandeen (1991:286) describes the activities organised by the NED as ranging from one-day orientation courses, *ad hoc* seminars, one-day regional seminars to major courses of three to five days duration. INSET was provided through a period of induction for the new educators and general education orientation for other experienced educators provided by management or other members of staff in the school. Superintendents of Education also visited schools and provided INSET regarding content, method, departmental examination requirements and so on (Bagwandeen, 1991:287).

With regard to non-formal INSET subject committees played a vital role. In addition to a range of functions relating to the development of the subject, subject committee members also promoted education development through INSET. In doing so, a committee functioned as an agent of change and renewal, ensuring that educators kept abreast of new developments in order to improve their competencies (Pather, 1995:291). There were no special publications to promote INSET, however, depending on the type of INSET, bulletins and guides were published. General articles on education were published in the "Neon" (Pather, 1995:301).

In addition to departmental INSET, various teacher organisations and their respective subject societies or associations as well as institutions of higher learning provided INSET. Educators could also elect to pursue studies for higher degrees or advanced diplomas either as full-time or part-time students at various universities.

4.2.4 INSET IN THE DEPARTMENT OF EDUCATION AND CULTURE:HOUSE OF REPRESENTATIVES (HOR)

The main priority in INSET in this Department was the upgrading of educators' qualifications. Other priorities were specialised to improving competencies and skills in specific areas.

In terms of formal INSET, Superintendents served as primary INSET agents. They visited schools and provided assistance where required. Activities were mainly curriculum-related and courses varied in length and duration.

Subject Advisors offered INSET courses as the need arose on a one- to-one basis or by withdrawing educators from a cluster of schools. Individual attention was given to educators after an evaluation visit. If a number of educators was visited, the Subject Advisors drew up a list of common problems and met all the educators concerned (Pather, 1995:319). Regional INSET courses were held when there were changes in the curriculum.

In terms of non-formal INSET, Pather (1995:318) comments that no departmental subject committees were established. There were neither any special publications to promote INSET.

In addition to departmental INSET, the organised teaching profession and institutions of higher learning provided INSET for Coloured educators. Upgrading of educators' qualifications were undertaken through part-time correspondence study or full-time study at various universities.

4.2.5 INSET IN THE DEPARTMENT OF EDUCATION AND CULTURE:HOUSE OF DELEGATES (HOD)

In terms of formal INSET, Bagwandeen (1991:480) mentions that the primary objective of INSET for Indian educators was to improve professional qualifications through the provision of full-time study and part-time correspondence courses. Bagwandeen (1991:426-480) provided an in-depth study with regard to the upgrading programmes provided by this Department.

Superintendents were responsible for organising refresher, extension and conversion courses. These courses were intended to provide educators with the opportunity of becoming acquainted with the most recent developments in their subjects and changes to the syllabi. The courses were designed with a view to solving problems relating to a school or groups of schools as well as updating educators in their specialised discipline. Bagwandeen (1991:467) describes these courses as being orientated towards the professional growth of educators.

Bagwandeen (1991:469) echoes the sentiment that a significant departmental initiative with regard to INSET was the establishment of councils, societies, committees and associations on a regional basis. Such organisations were created through the co-operation between Superintendents of Education and the educators. Classroom-based problems were solved at grassroot-levels through these organisations. Educators were also responsible for various publications relating to their subject.

With regard to non-formal INSET, Pather (1995:306) claims that the Teachers' Centres Working Document entrenched the policy. Pather (1995:306) states further that the six centres which were situated in Chatsworth, Durban Central, Phoenix, Tongaat, Stanger and Pietermaritzburg responded to and satisfied the professional needs of the educators and gave expression to the belief that teacher education was not a terminal process but a continuum of pre-service and in-service training. Bagwandeen (1991:471) reiterates that the plenitude of newsletters, publications and reports from the various centres underscored the phenomenal contribution made by these centres in the field of INSET. Allied to these publications was the "Education Bulletin", an official departmental publication which fulfilled the intended purpose of enhancing INSET.

In addition to departmental INSET, the organised teaching profession also provided INSET for the educators. Bagwandeen (1991:473) mentions that the Association's annual conferences, publications and establishment of subject societies were cardinal vehicles for INSET from a non-departmental perspective. Educators could also study either as part-time or full-time students at various universities.

4.2.6 **<u>SUMMATION</u>**

An overview reflecting the INSET of educators among the different Education Departments clearly indicates that all the Departments employed strategies to improve the professional competence and academic qualifications of the educators in their employ. This served as an attempt to improve the quality of education imparted in schools. However, it could be argued that improvement in academic qualification need not necessarily lead to better teaching. On completion of an academic degree or courses, educators were regraded and were remunerated accordingly. This could have served as an incentive to most educators upgrading themselves academically. Nevertheless, it must be stated that prior to 1994, the Education Departments offered INSET and central to this provision of INSET was the consensus that INSET is vitally important and pivotal to the concept of life-long education of educators, the enhancement of professional competence, the improvement of the repertoire of classroom skills, personal development, the development of a positive attitude to change and the fostering of a culture of learning (Pather, 1995:428).

At this point it is also important to state that due to the limited funds that the South African Government allocated for general educational needs, some responsibility for INSET had shifted to

Non-Governmental Organisations (NGOs). This leads to the next sub-section which will briefly outline the contributions of some of the NGOs prior to 1994.

4.3 THE CONTRIBUTIONS OF NON-GOVERNMENTAL ORGANISATIONS (NGOs) TOWARDS INSET PRIOR TO 1994 IN KWAZULU-NATAL

A vast number of NGOs made crucial contributions to INSET. Bagwandeen (1991:330) refers to a host of researchers who have made comprehensive surveys of the activities of NGOs in South Africa. Pather (1995:178-200) refers to NGO projects that were active in promoting INSET in KZN. Due to this vast array of information, the researcher for the purpose of this research, chose to outline the contributions of the following NGOs pertaining particularly to mathematics teaching in the primary schools in KZN.

- The Toyota Teach Primary Schools Project was launched in 1992 and coordinates the INSET programmes of several NGOs. The target groups are educators in the Durban South area. Attention is given to the cognitive development and the improving of the teaching of mathematics, science and English in the primary school. The contributions of this NGO will be discussed more extensively in the latter part of this chapter.

- Teacher Opportunity Programmes (TOPS) provided mathematics, science and English INSET programmes for primary school educators. These programmes were aimed at developing numeracy, literacy and basic technical skills in primary schools. In addition, educators received tuition to complete the requirements for the Senior Certificate. The emphasis of the programmes was on the methodology and the production of curriculum materials relevant to Black schools. These programmes, however, have ceased to exist.

- The Research and Development in Mathematics, Science and Technology (RADMASTE) project, which was attached to the University of Witwatersrand, promoted science and mathematics through research, INSET development of resources and educator guides. This project does not exist at present.

- The Shell Science and Mathematics Resource Centre Educational Trust was formed in 1985 and was also referred to as the Centre for the Advancement of Science and Mathematics Education (CASME). It was based at the University of Natal in Durban. One of the fostering activities of CASME was to provide in-service training programmes for mathematics educators. Botha (1989:45) mentions that although the course was designed to answer the needs of secondary school educators, INSET services have also been provided for mathematics educators in primary schools. Programmes focused on problems of teaching, including methods of teaching, curriculum construction, selection of textbooks, corrective teaching, the psychology of learning mathematics and science and methods of assessing learners' progress (Botha, 1989:45). These programmes do not exist at present.

Pather (1995:181) refers to Bot's (1986) research which claimed that NGO INSET programmes have been found to be more innovative and successful than those offered by Education Departments. One of the reasons given for the success is that educators were involved in the planning and design of the courses.

Having considered the INSET of educators in the different Education Departments and the contributions of NGOs in KZN prior to 1994, the researcher will now give consideration to mathematics in the primary school prior to 1994. This will place the sub-sections to follow into perspective.

4.4 MATHEMATICS IN THE PRIMARY SCHOOL PRIOR TO 1994

The Third International Maths and Science Study (1996), coordinated in South Africa by the Human Sciences Research Council reveals the legacy of mathematics and science in the primary school. Forty -five countries were involved in the research project. South African learners scored the lowest of all the participating countries in both the subjects. South Africa's scores were based on a racially and geographically representative sample of 5 301 standard five (grade seven) and 4 491 standard six (grade eight) learners who took the tests at 114 and 137 schools respectively. In the mathematics component the South African learner managed to answer only 24% correctly, as opposed to the world average of 55% (Arnott *et al.* 1997:7).

The researcher being a mathematics educator in the primary school for the past 16 years attributed these results to a combination of poor teaching and outdated mathematics curricula. The most serious charge that could have been laid at the door of Fundamental Pedagogics which dominated apartheid education was that it discouraged the following qualities regarded as essential for sustainable development:

- risk taking;
- a sense of adventure;
- curiosity;
- a critical and questioning attitude;
- self motivation and reflection;
- inventiveness and independence of mind; and,
- creativity and innovation.

Instead the mathematics curriculum handed down to educators for implementation was experienced as very prescriptive, content-heavy, detailed and authoritarian with little space for education initiative. Educators concentrated on completing every section in the mathematics syllabus and consequently were unable to build up affective and cognitive structures of understanding mathematics. In practice the mathematics teaching and learning process was characterised by learner passivity, rote learning, content-orientation, rigidity of syllabus and chalk and talk presentations. Christie (1997:112) aptly characterised the teaching and learning as:

> ***'…. relatively low participation, high selection system of comparatively poor quality for the majority of the learners.'***

The mathematics curricula had little relevance to the lives and aspirations of learners. Moreover, it accounted for a pervasive lack of critical and creative thinking.

Interactive mediated learning and teaching styles needed to be developed as such approaches are particularly important for the teaching of mathematics where curiosity and intellectual risk taking are essential. More than that, learner centred mediated and interactive strategies are vital to the demystification of mathematics which have developed an aura of unintelligibility and remoteness from the daily lives of the learners.

It can be assumed that against this background there would be a strong desire to create a new school mathematics experience which includes rather than excludes, is relevant and connected to the everyday lives of learners and has the potential to empower learners mathematically. This leads the researcher to the next sub-section on the changes in mathematics in the post 1994 period.

4.5 MATHEMATICS IN THE PRIMARY SCHOOL IN THE POST 1994 PERIOD

In 1997, the National Department of Education marked the break from the apartheid curriculum with the announcement of a new ambitious curriculum that signalled the comprehensive curriculum change in post apartheid South Africa. Curriculum 2005 (C2005), so called because it was envisaged that it would be completely implemented and practised by all compulsory school grades by the year 2005. C2005 was built around the philosophical principles of Outcomes Based Education. This new emphasis on outcomes instead of input, on learner centredness instead of educator centredness and on activity learning instead of passive learning, signalled a revolutionary new way of teaching and learning in South Africa.

4.5.1 CURRICULUM 2005's KEY CHANGES AND ITS IMPACT ON MATHEMATICS IN THE PRIMARY SCHOOL

C2005 was marketed as the major policy that would foster the integration of education and training, promote human resource development and refocus from 'education for compliance' to 'education for democratic participation' (Osman and Kirk, 2001:175). In breaking from the apartheid curriculum, C2005's key changes were:

- New educators' beliefs and teaching approach: New pedagogical assumptions were advocated, such as, that all learners can succeed at a pace allowed by the individual and that learning takes place best during discovery and learner activity (Spady and Schlebusch, 1999:29). For the mathematics educator teaching would be more learner centred, activity based and flexible. This implies that educators would have a more facilitative role and that they would make use of a variety of teaching and assessment strategies. Furthermore, the mathematics teaching and learning processes would be designed from ambitious generic outcomes which would focus on learners being able to demonstrate proficiency in particular, pre-determined knowledge, skills and values. Overarching all mathematics teaching would be the development of critical outcomes such as critical and creative thinking, teamwork and efficient organisational skills.

- New organisational structures: The syllabi has been replaced by the Policy Document. The Policy Document is phase specific and not grade specific and although it replaces the syllabi, it is not content-based, that is, content is no longer prescribed for the educator. The Policy Document thus serves as a guide for mathematics teaching.

The traditional discipline orientated subjects were to be phased out to make way for eight learning areas as indicated in table 4.1 on page 109. The learning area pertaining to mathematics was initially called numeracy and mathematics. After many hours of deliberations the Learning Area Committees (LACs) changed this to mathematical literacy, mathematics and mathematical sciences. Brodie (1997:3) outlines the following reasons for the change:

- numeracy is too narrow to capture the variety of skills that a mathematically literate person needs;

- mathematics as a term on its own is too narrow to capture all the aims of teaching mathematics in a school;
- as mathematics educators we should be aiming to equip learners with mathematical skills that they might need to function effectively in the world (mathematical literacy); and,
- as mathematics educators we should also be providing foundations for further study in mathematics and related areas, particularly the mathematical sciences.

Table 4.1 THE EIGHT LEARNING AREAS

LEARNING AREA	CONTENT
Languages, Literacy and Communication	Literacy, South African Official Languages, Classical Languages, Modern Languages
Mathematical Literacy, Mathematics and Mathematical Sciences	Numeracy, Mathematics and Statistics
Natural Sciences	Integrated Studies, Biological Sciences, Physical Sciences, Agricultural Sciences, Engineering
Technology	Technology Education, Information Technology, Technical Education, Applied Arts and Sciences
Arts and Culture	Visual, Expressive and Performing Arts, Music Education, Movement, Oracy Studies
Human and Social Sciences	Geography, History, Democracy Education Development Studies, World Ethics and Belief Systems, Utility and Social Services
Life Orientation	Health Education, Career Guidance, Life-Long Learning Skills, Inter and Intra-personal Development, Religious Studies, Physical Education
Economic and Management Sciences	Economic Education, Financial Management, Business Education including Entrepreneurship, Public Management

Source: Handout in workshop (2001)

The terms, aims and objectives, have been replaced by critical outcomes and specific outcomes. The critical outcomes are defined as: cross-curricular, broad, generic outcomes that inform all teaching and learning. Their purpose is to lead to the development of conceptual skills and understanding that transcend the specific, gradually developing the learner's capacity to transfer learning from one context to another (Brodie, 1997:30).
Brodie (1997:30-31) maintains that all teaching and learning in schools should ultimately aim towards the following critical outcomes. A learner should be able to:

- Identify and solve problems, which display that responsible decisions, using critical and creative thinking have been made.
- Work effectively with others as a member of a team, group, organisation or community.
- Organise and manage oneself and one's activities responsibly and effectively.
- Collect, analyse, organise and critically evaluate information.
- Communicate effectively using visual, mathematical and a language skill in the modes of oral or written presentation.
- Use science and technology effectively and critically show responsibility towards the environment and health of others.
- Demonstrate an understanding of work as a set of related systems by recognising that problem solving contexts do not exist in isolation.

Part of the LACs task was also to develop specific outcomes that reflect and give meaning to the aforementioned critical outcomes. Specific outcomes are termed specific because they are derived from and specified for particular learning areas. Specific outcomes define the skills, abilities, competencies and values, which are to be developed through various learning programmes at schools.

Van Der Horst and McDonald (1997:57) outline the following specific outcomes of the mathematical literacy, mathematics and mathematical sciences learning area. Learners should be able to:

- demonstrate understanding about ways of working with mathematics;

- manipulate number patterns in different ways;
- demonstrate understanding of the historical development of mathematics in various social and cultural contexts;
- critically analyse how mathematical relationships are used in social, political and economic relations;
- measure with competence and confidence in a variety of contexts;
- use data from various contexts to make informed judgements;
- describe and represent experiences with shape, space, time and motion, using all available senses;
- analyse natural forms, cultural products and processes as representations of shape, space and time;
- use mathematical ideas, concepts, generalisations and thought processes; and,
- use various logical processes to formulate, test and justify conjectures.

The promises and possibilities with which C2005 was introduced, brought excitement and hope for a better teaching and learning future. However, the researcher, being a practising educator witnessed the frustration and confusion colleagues suffered at the hands of C2005 due to the following factors:

- short linear and rigid cascade training provided by the Department of Education;
- the complexity of the curriculum design;
- the arcane language of C2005; and,
- the tightness of the implementation schedule of C2005.

The aforementioned factors provide strong evidence that curriculum change is indeed complex and while educators play a critical role in curriculum change it is of paramount importance that attention is paid to whether and how educators make sense of and practise the curricular changes in the classroom. This leads to the argument that when educators are required to change their curriculum practises, INSET must be seen as the vehicle through which these changes can be implemented. Consideration will now be given to the needs and requirements for the successful implementation of INSET in South Africa.

4.6 THE NEEDS AND REQUIREMENTS FOR INSET IMPLEMENTATION IN SOUTH AFRICA

Hofmeyr (1994:35) is of the firm belief that teacher development is one of the most vital components of education reconstruction because educators are the most critical and expensive education resource. Hofmeyr (1994:35) further believes that South Africa's biggest challenge in teacher development lies in the area of INSET and considers the following INSET needs:

- reorientation of all educators to new goals and values;
- preparing educators to cope with curriculum change;
- upgrading of unqualified or under-qualified educators;
- management training for senior staff at schools;
- language development of educators;
- retraining in scarce or new subjects;
- training in new teaching and learning methods.

The challenges of providing for all these varied needs is enormous when one takes into account the qualitative challenge of providing effective INSET that results in improved teaching and learning in the classroom. According to Hofmeyr (1994:37) the successful implementation of INSET in South Africa will require the following to be in place:

- A national policy framework that links PRESET and INSET in a continuum of teacher development.
- A separate long-term budget must be allocated for INSET. This will finance the national priorities, provide grants for school focused INSET on a compensatory basis and allow for state contracts with NGOs and private agencies for INSET services.
- Available INSET agencies will have to be utilized to deliver INSET on the scale required; the public sector and NGOs will have to be involved.

Hofmeyr (1994:37) states that the approach will have to be eclectic: school focused wherever possible, but in conjunction with courses and district-level workshops. Both distance and contact education will have to be used to reach the educators involved. Radio and television programmes, workbooks, peer learning groups, visits by INSET Advisors and mentor educators in the school can be used to very good effect. Furthermore, a phase stepwise implementation would ensure successful INSET provision (Hofmeyr, 1994:38).

Having considered Hofmeyr's needs and requirements for the successful implementation of INSET in South Africa, consideration will now be given to the INSET of primary school educators with particular reference to mathematics teaching in the Department of Education and Culture:KZN.

4.7 THE INSET OF PRIMARY SCHOOL MATHEMATICS EDUCATORS IN THE DEPARTMENT OF EDUCATION AND CULTURE:KWAZULU-NATAL

In order to place this aspect into perspective it is imperative to state that with the demise of apartheid in 1994, the five separately administered Education Departments in KZN discussed in the beginning of this chapter amalgamated to form a single department now referred to as the Department of Education and Culture:KZN

(KZNDEC). To glean information with respect to the nature of INSET provided by the Department, the researcher contacted P.Mfeka, the Subject Advisor of mathematics in the primary schools.

4.7.1 **FORMAL INSET**

According to Mfeka (2002) the absence of a national or provincial INSET policy or clearly articulated and documented published objectives results in INSET provision being directed and guided by the Subject Advisor's job-description. They are expected to maintain regular contact and develop a policy document. Mfeka (2002) is of the firm belief that the following major factors influence the effective provision of INSET in the KZNDEC:

- Lack of funding by the government of the day for education. Adequate funding would enable a planned sequence of INSET programmes or courses for senior primary mathematics educators.

- Lack of human resource. Mfeka (2002) stressed that greater emphasis is placed on secondary school mathematics due to the exit level of learners. The neglect of primary school mathematics is clearly evident in the unequal distribution of human resources in terms of Subject Advisors of mathematics at provincial level. Table 4.2 on page 115 reflects the appointment of Subject Advisors of mathematics in KZN.

Table 4.2 Appointment of Subject Advisors of Mathematics in KZN

REGION	SUBJECT ADVISORS	
	SECONDARY SCHOOLS	PRIMARY SCHOOLS
North Region	4	1
South Region	5	0
Port Shepstone	1	0
Pietermaritzburg	3	1
Ladysmith	4	1
Vryheid	0	0
Ulundi	2	0
Empangeni	4	0
TOTAL	**23**	**3**

Source: Mfeka (2002)

Mfeka (2002) claims that the unequal distribution of Subject Advisors affects the effective provision of INSET of senior primary mathematics educators. Mfeka (2002) believes that in developing an infrastructure for INSET, the KZNDEC should make provision for the utilization of educators, college and university lecturers and other educationists as consultants. Educators would benefit from the varied experience of experts in the mathematics field.

In introducing curricular changes, the KZNDEC uses the Cascade Model of training. This involves training national facilitators, who train provincial facilitators, who train district facilitators, who in turn train educators. The training programmes consist of short courses to minimize the disruption of the culture of teaching and learning at schools.

4.7.2 <u>**NON-FORMAL INSET**</u>

With regard to non-formal INSET a major breakthrough is the formation of District and Circuit Support Structures which is referred to in KZN Circular 92 of 2001 (Mfeka:2002). The core function of these structures is to develop learning programmes, which are central to the successful implementation of C2005. In addition, educators in the mathematical literacy, mathematics and mathematics sciences have the opportunity of networking and interacting with each other to discuss matters of common interest in respect of their learning area. Teachers' centres also provide adequate resource centres for educators. In addition, the KZNDEC supports the initiatives of the Maths Centre for Primary Teachers (MCPT) and the Toyota Teach Primary Schools Project with respect to the INSET of mathematics educators in the primary schools in KZN.

4.7.3 NON-DEPARTMENTAL INSET

In addition to departmental INSET, the teacher organisations also provide INSET through workshops, seminars, conferences and publications. Educators could also study either as full-time or part-time students at various universities. Furthermore, educators have the opportunity of becoming members of the Association of Mathematics Education of South Africa (AMESA) which provides a forum for all concerned with the teaching of mathematics at all levels of education.

4.8 A REVIEW OF THE INSET OF MATHEMATICS EDUCATORS IN THE PRIMARY SCHOOLS IN KWAZULU-NATAL IN THE POST 1994 PERIOD

The researcher concurs with Hofmeyr (1994:37) that a national policy framework and a separate long-term budget are essential for the successful implementation of INSET. The Subject Advisor of mathematics, Mfeka (2002), clearly outlined that the absence of a national or provincial policy or clearly articulated and documented published objectives, further exacerbated by inadequate funds hinder the provision of effective INSET of educators of mathematics in KZN. Additional human resources in terms of Subject Advisors could also prove central to the successful implementation of INSET of mathematics educators.

With regard to the Cascade Model of training, the researcher's personal experiences showed that District trainers did not understand the principles of C2005 themselves thus resulting in their not using these principles in their own methodology of training. Even after loaded crash courses, mathematics educators still felt incapable and insecure about C2005. Taylor and Vinjevold (1999:57) maintain that after a few months of practise, false clarity seemed to prevail. Educators would often confidently testify of how they are mastering C2005 in their classrooms, while the on-site research showed very little change from traditional practises. Many simply reproducing the lessons presented at training workshops without understanding the underlying learning theories (Taylor and Vinjevold, 1999:230).

The KZNDEC must acknowledge that training programmes were inadequate, top-down and rigid, losing sight of educators' experiences and existing professional insights. Lack of follow-up courses is also disappointing, especially considering Green's (2001:137) discovery that many educators do not have the high level of intellectual vigour required to understand C2005, and that not understanding it can only contribute to their sense of inadequacy. With respect to the formation of District and Circuit Support Structures, the researcher, being a member of the mathematical literacy, mathematics and mathematical sciences committee often finds that meetings need to be postponed due to poor attendance. Poor attendance could be attributed to the venue and time being unsuitable for educators or educators displaying apathy towards teacher development due to the lack of motivation or incentives.

The KZNDEC could provide incentives for attendance at INSET courses in the form of certificates of attendance. The KZNDEC should recognise these certificates for service awards or eligibility for promotion. Substitute educators could also be provided to enable mathematics educators to attend INSET courses during school hours.

Educators who are committed and dedicated to the profession may pursue higher qualifications or upgrade their academic qualifications while many educators will require intrinsic incentives to study further. The KZNDEC should consider incentives in the form of salary increments or enhanced eligibility for promotion to motivate educators to study further. At present upon completion of a degree or diploma educators are given a one off payment which many educators regard as dismal in respect to tuition fee expenditure. The KZNDEC needs to provide incentives to motivate educators to enrol at universities. In view of the aforementioned criticisms levelled at the Department of Education and Culture:KZN and due to the limited funds allocated for educational needs, some responsibility for INSET shifts to NGOs. A discussion will be provided on the contributions of relevant NGOs.

4.9 THE CONTRIBUTIONS OF NON-GOVERNMENTAL ORGANISATIONS (NGOs) TOWARDS THE INSET OF MATHEMATICS EDUCATORS OF PRIMARY SCHOOLS IN KWAZULU-NATAL

The emergence over the years of independent INSET projects in South Africa should be seen as an attempt by the private sector to get more involved in education and curriculum innovation or change and to attempt to redress the educational deficiencies and lack of opportunities in a system which was entrenched with unequal and differentiated education for decades (Botha, 1989:1). In order to glean information on the contribution of NGOs towards the INSET of senior primary mathematics educators, the researcher was successful in contacting the project managers of the following NGOs which will be discussed further.

- The Toyota Teach Primary Schools Project
- The Maths Centre for Primary Teachers (MCPT)

4.9.1 THE TOYOTA TEACH PRIMARY SCHOOLS PROJECT

The rationale behind the establishment of this project is the belief that an improvement in the quality of primary school educators in the Umlazi and Umbumbulu areas would render learners to benefit from subsequent education in the academic, technical and vocational fields (Graham-Jolly, 1994:43). To achieve the project's objectives an effective partnership between other NGOs and tertiary institutions had been established. The project presently headed by Lesley Davy extends to 50 schools and approximately 85 educators.

The project also offers educators an opportunity to obtain an Advanced Certificate in Education: Primary School Competencies (Further Diploma in Education) which is accredited by the University of Natal. Contact sessions are presented at the Toyota Teach offices in Prospecton. The Advanced Certificate in Education: Primary School Competencies is completed part-time over two years. Modules include:

- Language and Learning
- Principles of Teaching Competencies
- Mathematics Education (Senior Primary or Junior Primary)
- Science Education (Senior Primary or Junior Primary)
- Technology or Environmental Education

The aim of improving the educator's academic qualification is to bring about school improvement, so that learning can be enhanced through better teaching and school management. The project is also committed to whole school development in the primary schools.

In addition, facilitators visit schools and work with the management, staff and learners to improve teaching and learning by:

- Offering management support and training at schools.

- Providing support areas in:
  Language, Literacy and Communication
  Mathematics
  Natural Science
  Technology
  Environmental Education
  Teaching strategies with the aim of improving classroom practice.

- Conducting regular workshops on topics of current interest.

According to Lesley Davy, the project manager, the following problems and difficulties were identified in the Toyota Teach schools:

- Educators are not able to teach certain mathematical concepts.
- There is a lack of qualified mathematics educators in the schools.
- There is a negative attitude on the part of learners towards mathematics, as mathematics is seen as a difficult subject. This could be attributed to a lack of a concrete foundation in mathematics teaching and learning.
- Poor approaches and methods of teaching mathematics. The chalk talk method is used, resulting in learners not being able to discover mathematics by themselves.
- The written test is being utilized as the only strategy to assess learners' mathematical knowledge.

It is against this background that the project hopes to achieve its aim of improving teaching and learning through improving the educator's qualification and classroom practice. By working with the management, staff and learners, the commitment to the whole school development will be fulfilled.

4.9.2 THE MATHS CENTRE FOR PRIMARY TEACHERS (MCPT)

This project was launched in 1998 and is funded by the Zennex foundation. It is currently headed by Thami Mhlobo and is based at Vukuzakhe High School in Umlazi. The target groups are educators in the Lower Tugela, Stanger and Inanda areas. The project funds the INSET programmes in each area for a period of three years.

The programme consists of workshops, class visits and each school is supplied with a kit consisting of the necessary resources for improved mathematics teaching and learning. At the beginning of the year, a year plan containing workshop dates is provided to schools. Educators are then workshopped on teaching strategies with the aim of improving classroom practice. Practical lessons are conducted and reviewed at the workshops to enable educators to identify and solve common problems experienced in mathematics teaching. Furthermore, the workshops also serve as common ground for mathematics educators to meet, form links and discuss ideas.

In terms of follow-up, classroom visits are conducted by facilitators to gauge whether educators are implementing what they have learnt at workshops. In addition, common tests are set by facilitators to gauge learners' progress. Class visits and tests assist the facilitators to plan their future workshops, which is based on common problem areas.

Mhlobo (2002) claims that the success of the project has been phenomenal since its launch, as drastic improvement in the teaching and learning of mathematics has been witnessed in the areas in which the project has been and is being conducted. Furthermore, educators have also remarked that the project has instilled a sense of confidence in them, resulting in mathematics teaching and learning becoming more enjoyable.

4.10 CONCLUSION

This chapter opened with a general overview of the INSET of educators in KZN and mathematics in the primary schools prior to 1994 which served as a background to the discussion of the INSET of educators with particular reference to mathematics in the primary school in the post 1994 period. It can be concluded that the past decade has brought tremendous change, which led to educational reform. Its success will depend on a commitment from everyone involved in education.

In the next chapter an empirical investigation on the INSET of senior primary mathematics educators will be discussed. A questionnaire (See Appendix H) was used as the vehicle to conduct a survey amongst mathematics educators in the senior primary phase in primary schools in KZN with the objective of obtaining data and feedback on INSET with respect to mathematics.

CHAPTER FIVE

EMPIRICAL INVESTIGATION OF THE INSET OF EDUCATORS OF PRIMARY SCHOOL MATHEMATICS IN KWAZULU-NATAL

5.1 INTRODUCTION

In attempting to investigate the INSET of primary school mathematics educators in KZN, the researcher utilized the strategy of qualitative research methodology related to an empirical investigation to gather information. As there was no available instrument which could be applied to a sample of respondents representative of the senior primary mathematics educators in KZN, the researcher developed a questionnaire (See Appendix H) to elicit the necessary data relevant to INSET and primary school mathematics.

The descriptive survey method was used in this study as it uses the process of "observation" by means of a questionnaire followed by the systematic organisation and description of data. Furthermore, the questionnaire is viewed as an appropriate, economical and convenient data gathering device in research which can also be used to elicit responses from respondents at a distance. The questionnaire also caters for anonymity which ensures honest responses.

5.2 DEVELOPMENT OF THE QUESTIONNAIRE

A questionnaire was developed incorporating aspects of INSET and senior primary mathematics teaching gleaned from literature research as well as from the researcher's personal experience as a senior primary mathematics educator. In designing the questionnaire, cognisance was also taken of the process of implementation of the new curriculum (C2005) resulting in an increasing awareness for improved INSET.

5.3 CHOICE OF LOCALE

The study region comprised the eight regions in KZN (See Map on page 124). The study was restricted to schools under the control of the KwaZulu-Natal Department of Education and Culture: KZN (KZNDEC).

5.4 STRUCTURE OF THE QUESTIONNAIRE

The questionnaire comprised sections A, B and C. Section A comprised personal particulars of respondents. These details form an integral part of this research as they affect special circumstances of educators such as:

- Mathematics educators, in particular (married females) have special requirements in terms of INSET course timing and attendance.
- Younger mathematics educators differ from experienced mathematics educators in terms of their INSET needs.

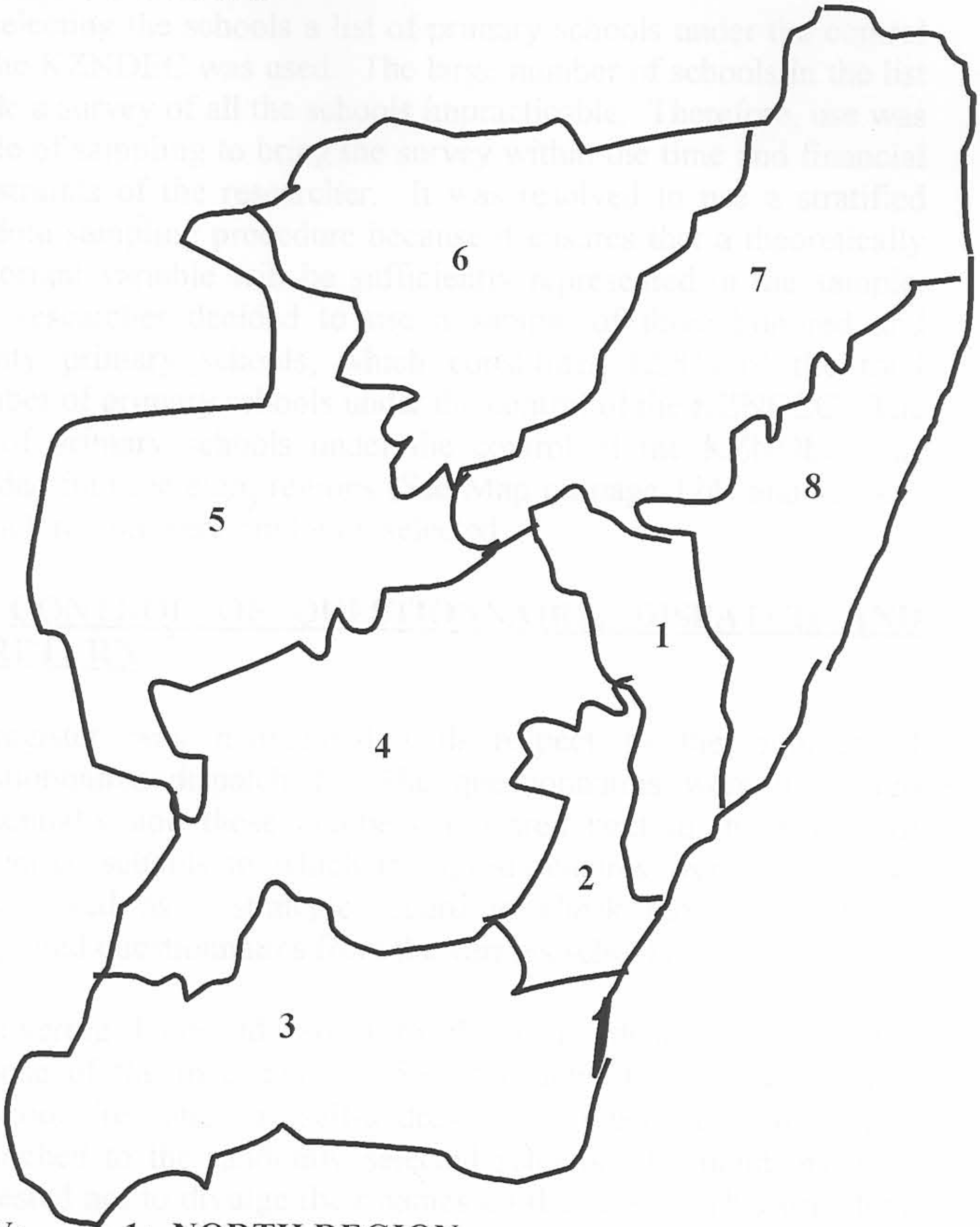
Section A involved questions which included such areas as gender of respondent, age, mathematics teaching experience and mathematics qualification.

Section B comprised questions pertaining to the respondent's school. These details were seen as vital in determining the level of school-based INSET. Questions ranged from location of school to supervision in mathematics teaching and mathematics committee meetings.

Section C comprised questions emphasising the nature, scope and needs for the INSET of senior primary mathematics educators. Questions included aspects such as the importance of INSET, reasons for INSET, attendance at INSET courses, relevance of INSET courses, timing of INSET courses and respondents teaching methods, use of aids and teaching strategies in mathematics.

A glossary of terms used in the questionnaire was included (See Appendix G). This was deemed as essential in assisting respondents in their interpretation of questions in which these terms were used. The telephone number of the researcher was also furnished in the questionnaire in the event of any queries.

MAP OF KWAZULU-NATAL SHOWING THE EIGHT KZNDEC REGIONS



KEY:
- **1: NORTH REGION**
- **2: SOUTH REGION**
- **3. PORT SHEPSTONE**
- **4. PIETERMARITZBURG**
- **5. LADYSMITH**
- **6. VRYHEID**
- **7. ULUNDI**
- **8. EMPANGENI**

5.5 SAMPLING PROCEDURE

In selecting the schools a list of primary schools under the control of the KZNDEC was used. The large number of schools in the list made a survey of all the schools impracticable. Therefore, use was made of sampling to bring the survey within the time and financial constraints of the researcher. It was resolved to use a stratified random sampling procedure because it ensures that a theoretically important variable will be sufficiently represented in the sample. The researcher decided to use a sample of three hundred and twenty primary schools, which constitutes 12,8% of the total number of primary schools under the control of the KZNDEC. The list of primary schools under the control of the KZNDEC was divided into the eight regions (See Map on page 124) and schools in each region were randomly selected.

5.6 CONTROL OF QUESTIONNAIRE, DISPATCH AND RETURN

A register was maintained with respect to the number of questionnaires dispatched. The questionnaires were numbered sequentially and these numbers appeared next to the names of respective schools to which the questionnaires were dispatched. This served as a strategic record to check the return of the completed questionnaires from the various schools.

A covering letter addressed to the respondent explaining the purpose of the investigation (See Appendix F), together with a questionnaire and a self-addressed stamped envelope was dispatched to the randomly selected schools. Respondents were requested not to divulge their names on the return. This was done as anonymity will ensure honest responses. Schools that did not return questionnaires timeously were contacted telephonically to expedite the return of completed questionnaires. Table 5.1 on page 126 indicates the response rate to questionnaires.

Table 5.1 Response rate to questionnaires

Institutions	No. Dispatched	No. Returned	Percentage Returned
Random sample of primary schools under the control of the KZNDEC	320	237	74%

Understandably, all the questionnaires dispatched to schools were not completed and returned assumably for numerous reasons. The return constituted a 74% response. Bagwandeen (1991:489) points out in referring to Ary *et al.* (1972:171) and Govender (1990:66) that a percentage of 70% returns of questionnaires is sufficient to validate research findings. The 74% return from respondents therefore, is enough to validate the findings of this investigation.

5.7 ANALYSIS AND INTERPRETATION OF DATA

The necessary information from the questionnaires was extracted. Thereafter, the researcher requested the expertise of K.Govender, a computer programmer, to prepare a special programme to analyse the data. In the analysis process the data was subjected to frequency distributions and tabulation statistical analysis.

5.7.1 PERSONAL PARTICULARS OF RESPONDENTS

5.7.1.1 GENDER OF RESPONDENTS (Q.1)

Table 5.2 Gender of respondents

GENDER	FREQUENCY	PERCENTAGE
MALES	78	32,9
FEMALES	159	67,1
	N = 237	100

Figure 5.1 Gender of senior primary mathematics educators

The bar graph below shows the distribution of senior primary mathematics educators in KZN according to gender.

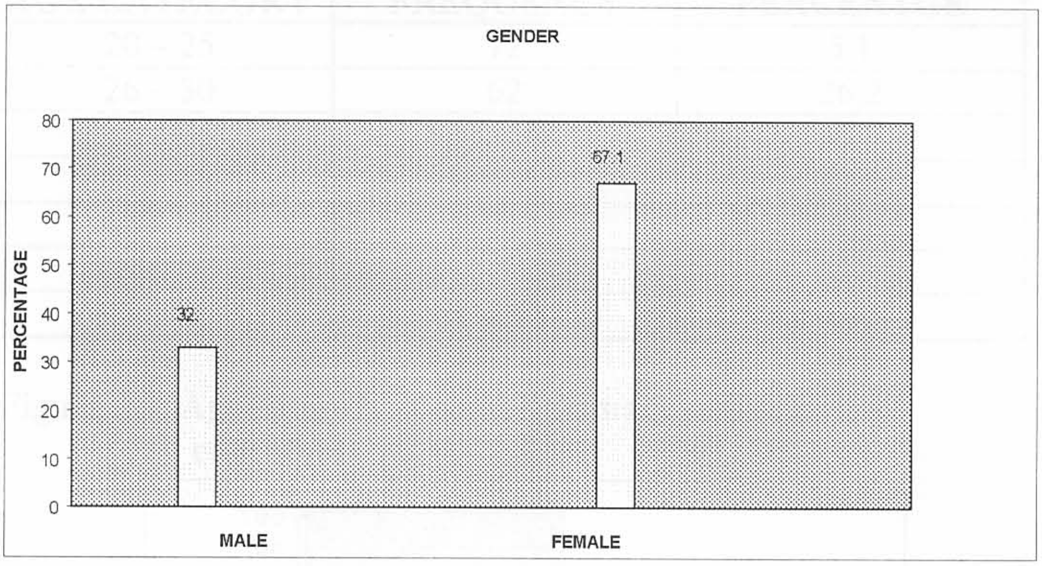


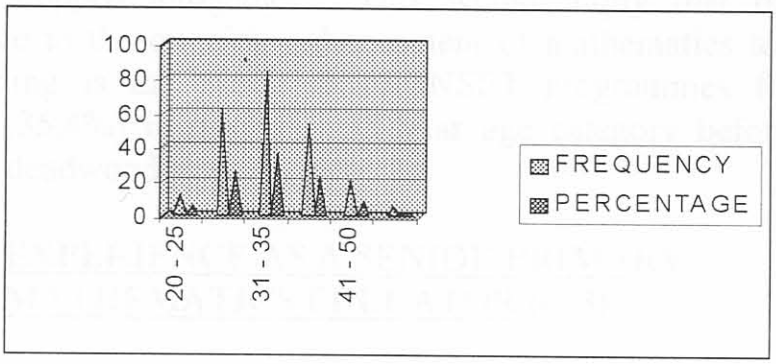
Figure 5.1 reveals that the majority (67,1%) of the respondents are females. Family obligations will affect the participation of educators, particularly in the case of married females, in the various INSET programmes provided for senior primary mathematics educators. Although this research did not specifically question the marital status of the respondents, drawing from the researcher's personal experiences, it can be safely assumed from comments made by married female mathematics educators at courses offered by the KZNDEC that attendance at these courses constitute an added burden. This would imply that planners of INSET courses for senior primary mathematics educators must ensure that the courses are well structured and organised so that they are not viewed as a waste of valuable time. In addition, INSET providers should also consider providing creche facilities to ensure the effective participation of educators accompanied by children at INSET courses after school hours.

5.7.1.2 **AGE OF RESPONDENTS (Q.2)**

Table 5.3 Age category of senior primary mathematics educators

AGE CATEGORY	FREQUENCY	PERCENTGE
20 – 25	12	5,1
26 – 30	62	26,2
31 – 35	84	35,4
36 – 40	53	22,3
41 – 50	21	8,9
Over 50	5	2,1
	N = 237	100

Figure 5.2 Age category of senior primary mathematics educators



The majority (35,4%) of the senior primary mathematics educators are in the age category of 31 – 35 years. In this regard, the researcher concurs with Pather (1995:422) referring to Evans (1989:10-15) that mid-career professionals may be prone to demotivation (boredom, loss of enthusiasm, diminished job interest) and levelling of performance. This can be exacerbated by stress created by changing family composition, pre-occupation with personal and family concerns, loss of the experience of success and growing isolation (Pather, 1995:422). The researcher firmly believes that this can be assumably applicable to the 31 – 35 year old senior primary mathematics educators in KZN.

Figure 5.3 Continuum of mid-career types

Key member → Contributor → Stable and Stagnant → Deadwood

Source: Pather, 1995:423

Pather (1995:423) explains this continuum of mid-career types as: at one end of the continuum are key members, educators who are engaged in self-renewal activities and who sustain both their enthusiasm and performance at exceptional levels. Contributors constitute the second group of educators who are solid, reliable participants in INSET programmes.

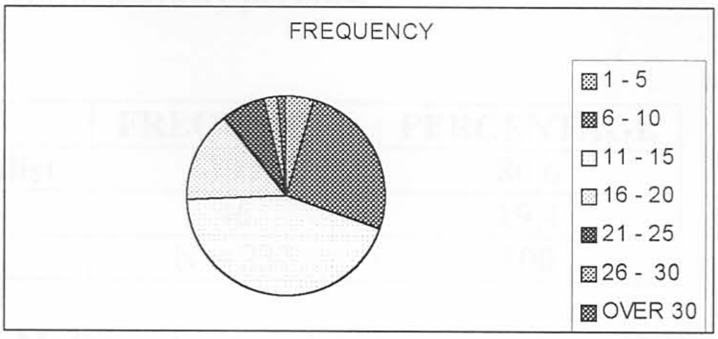
In contrast to the key members and contributors are the stable and stagnant and the deadwood. These educators' professional growth possibly stopped altogether. This would imply that of vital importance to the ongoing enhancement of mathematics teaching and learning is the provision of INSET programmes for this majority (35,4%) in the 31 – 35 year age category before they reach the deadwood stage.

5.7.1.3 <u>EXPERIENCE AS A SENIOR PRIMARY MATHEMATICS EDUCATOR</u> (Q.3)

Table 5.4 Experience as a senior primary mathematics educator

Experience in years	Frequency	Percentage
1 – 5	11	4,6
6 – 10	61	25,7
11 – 15	104	43,9
16 –20	35	14,8
21 – 25	18	7,6
26 – 30	5	2,1
Over 30	3	1,3
	N = 237	100

Figure 5.4 Experience as a senior primary mathematics educator



With respect to senior primary mathematics educators with 1 to 5 years' experience (4,6%), INSET providers must realise that positive attitudes to life-long learning and the need to update oneself through INSET should be developed and entrenched in the first few years of teaching. If this is promoted efficiently mathematics educators will not have to rely on knowledge and training gained in the PRESET period. In this context the KZNDEC needs to develop a policy framework which links PRESET and INSET in a continuum of teacher development. The development of such a policy will undoubtedly result in improved mathematics teaching and learning.

The survey also reveals that the bulk of the senior primary mathematics educators have 6 to 20 years of teaching experience (84,4%). Opportunities must be provided to assist these educators to reflect on their teaching experiences and more importantly to integrate their teaching experiences with updated knowledge of changes in mathematics teaching and learning.

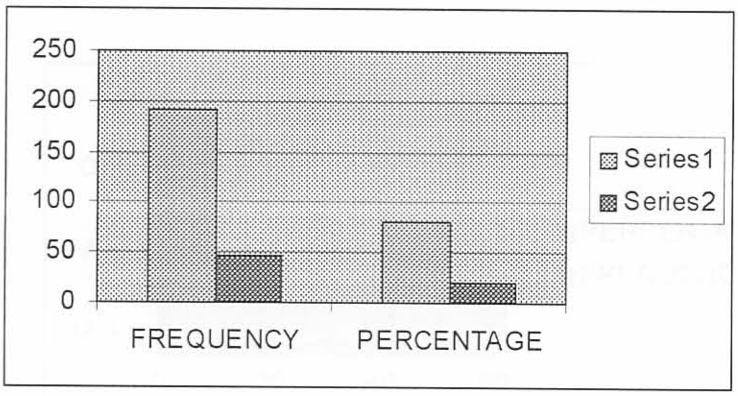
The decrease in the number of educators with teaching experience over 26 years (3,4%) could be attributed to the large number of educators in this category that have accepted the severance package. INSET providers could utilize these educators to share their wealth of expertise in INSET courses planned for senior primary mathematics educators.

5.7.1.4 SPECIALISATION IN MATHEMATICS (Q.4)

Table 5.5 Mathematics Specialist

	FREQUENCY	PERCENTAGE
Non-Specialist	191	80,6
Specialist	46	19,4
	N = 237	100

Figure 5.5 Mathematics Specialist



Statistics in Table 5.5 indicate that 191 (80,6%) of the senior primary mathematics educators are non-specialist. This would imply that the KZNDEC needs to see INSET courses or programmes as a priority for the improvement of the delivery of quality mathematics teaching in the senior primary phase. The KZNDEC could also provide an incentive in the form of salary increments for educators to undergo formal upgrading of their qualifications in mathematics so as to ultimately reach a level of specialisation in senior primary mathematics.

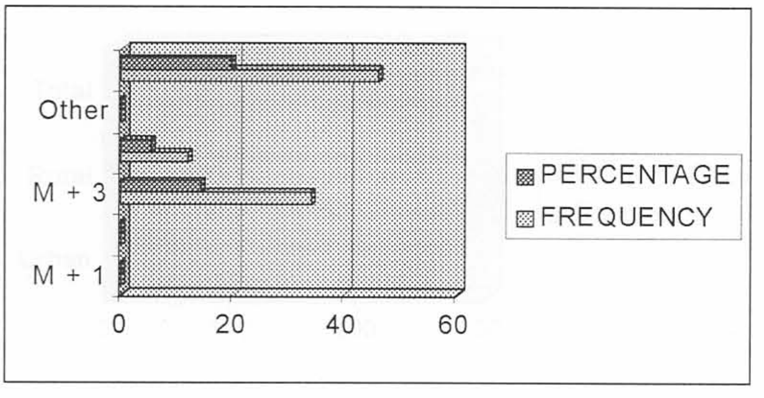
5.7.1.5 QUALIFICATIONS IN MATHEMATICS AS SPECIALISATION (Q.5)

The 19,4% specialists in mathematics had the following qualifications:

Table 5.6 Qualifications in mathematics as specialisation

QUALIFICATION	FREQUENCY	PERCENTAGE
M + 1	0	0
M + 2	0	0
M + 3	34	14,3
M + 4	12	5,1
OTHER	0	0
TOTAL	46	19,4

Figure 5.6 Qualifications in mathematics as specialisation



Prior to 1994 the Education Departments concentrated on the upgrading of unqualified or under-qualified educators. Upon completion of a diploma, degree or courses, educators were re-graded resulting in a salary increment. It could be assumed that this policy may have served as an incentive for some educators to upgrade their qualifications while others may have upgraded their qualifications because of their dedication and commitment to the profession.

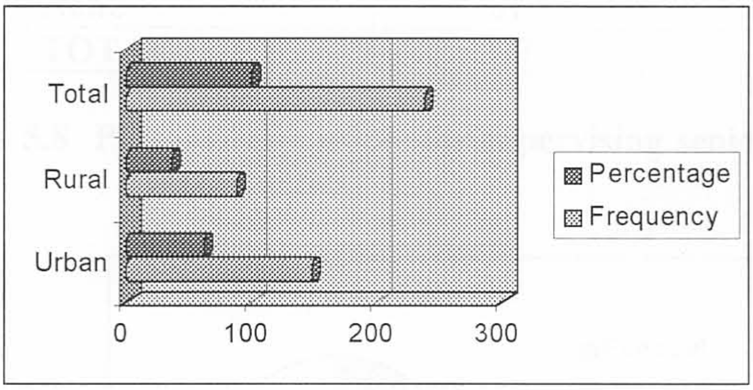
Since the policy of re-grading has ceased many educators may require intrinsic incentives in the form of salary increments or enhanced eligibility for promotion to upgrade their qualification. The KZNDEC needs to seriously consider providing mathematics educators with these incentives to undergo formal upgrading of their qualification resulting in an enhanced mathematics teaching and learning environment.

5.7.1.6 **LOCATION OF RESPONDENT'S SCHOOL (Q.6)**

Table 5.7 Location of respondent's school

Location of School	Frequency	Percentage
Urban	149	62,9
Rural	88	37,1
Total	237	100

Figure 5.7 Location of respondent's school



Problems associated with transportation, long distances and costs incurred may discourage participation of senior primary mathematics educators from rural schools (37,1%) in INSET courses or programmes. The KZNDEC needs to consider linking up with NGOs and other consultants involved in outreach programmes designed to offer INSET to senior primary mathematics educators outside the urban areas. The KZNDEC could also provide incentives in the form of salary increments and promotion opportunities to specialised mathematics educators in the urban areas to enable them to relocate to rural schools. Their expertise in the rural schools will undoubtedly enhance the mathematics teaching and learning in the rural areas.

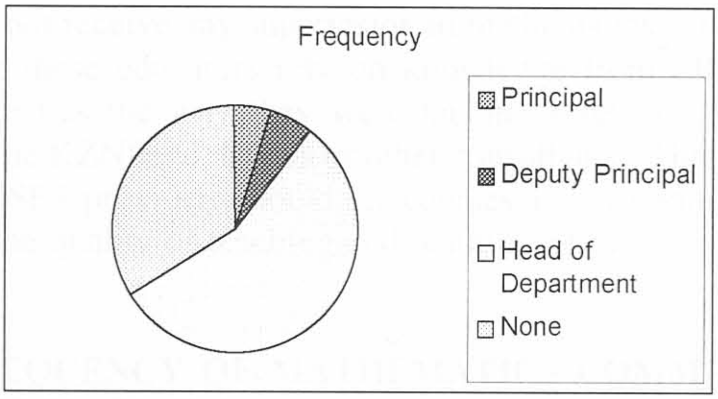
5.7.2 **SCHOOL FOCUSED INSET**

5.7.2.1 **PERSONS RESPONSIBLE FOR SUPERVISING MATHEMATICS IN THE SENIOR PRIMARY PHASE IN SCHOOLS (Q.7)**

Table 5.8 Persons responsible for supervising senior primary mathematics

Person Responsible	Frequency	Percentage
Principal	12	5,0
Deputy Principal	13	5,5
Head of Department	131	55,3
None	81	34,2
TOTAL	237	100

Figure 5.8 Persons responsible for supervising senior primary mathematics



The purpose of supervision is an interactive process that promotes professional growth through co-operation and reciprocal relationships between the senior primary mathematics educator and the person supervising mathematics. An examination of the statistics reveal that 156 (65,8%) senior primary mathematics educators receive supervision in mathematics from respective members of management. Of critical importance to the effective supervision of mathematics in the senior primary phase are the following:

- Members of management attending mathematics orientation courses, workshops and seminars on a regular basis to update their knowledge on the supervision of mathematics.

- Members of management holding meetings and discussion session with mathematics educators in the school on a regular basis.

- Members of management playing a central role as researcher, innovator and developer so that they can contribute to the improvement of mathematics teaching and learning.

- Members of management organising school focused INSET projects in mathematics.

- Members of management networking with other school's management staff.

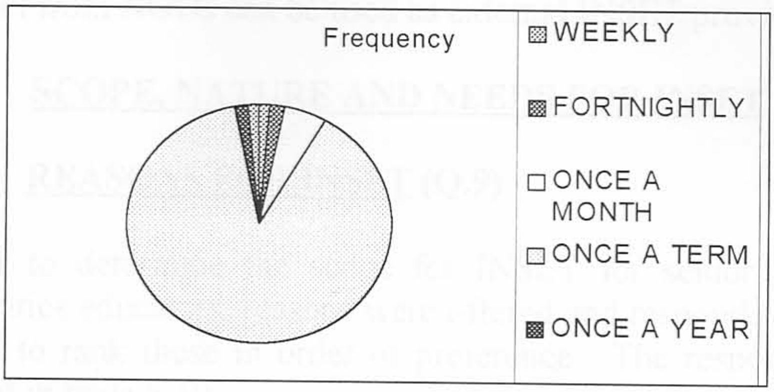
Statistics in table 5.8 also indicate that 81 (34,2%) mathematics educators do not receive any supervision in mathematics. It can be assumed that these educators rely on knowledge from PRESET, teach mathematics the way they were taught or rely on INSET provided by the KZNDEC, NGOs or other consultants. This would imply that INSET providers should see courses and programmes as a priority if the quality of teaching and learning of mathematics is to improve.

5.7.2.2 FREQUENCY OF MATHEMATICS COMMITTEE MEETINGS (Q.8)

Table 5.9 Frequency of mathematics committee meetings

Options	Frequency	Percentage
Weekly	3	1,3
Fortnightly	5	2,1
Once a Month	12	5,1
Once a Term	210	88,6
Once a Year	4	1,6
Not at All	3	1,3
TOTAL	237	100

Figure 5.9 Frequency of mathematics committee meetings



Majority (98,7%) of the respondents indicated that mathematics committee meetings are conducted at their schools. The possible reason may be that the general feeling is that mathematics is an important subject and needs to be discussed at intervals.

These mathematics committee meetings provide an opportunity for the senior primary mathematics educators to discuss and determine a major part of their collective INSET needs on an ongoing basis within the context of their institution. This strengthens the concept of life-long learning and will ultimately lead to the improvement of the quality of mathematics teaching and learning. In planning activities in response to the changing needs of mathematics, a sense of ownership by the senior primary mathematics educators is encouraged. Such ownership ensures the success of INSET and will also contribute to greater commitment to INSET by senior primary mathematics educators.

The researcher acknowledges that senior primary mathematics educators attending INSET courses and programmes organised by the KZNDEC come from different school environments and experiences. In this context, these educators will require further support at schools to ensure that the programmes they participated in are successful. It is at these committee meetings that, jointly, mathematics educators may integrate innovations into the existing school programmes.

Though these committee meetings depend on the school's human resources, there is a need to acknowledge the importance of external assistance. Subject Advisors of primary school mathematics, consultants such as lecturers from universities or personnel from NGOs can be used as external INSET providers.

5.7.3 SCOPE, NATURE AND NEEDS FOR INSET

5.7.3.1 REASONS FOR INSET (Q.9)

In order to determine the scope for INSET for senior primary mathematics educators, reasons were offered and respondents were required to rank these in order of preference. The responses are indicated in table 5.10.

Table 5.10 Rank order of preference of reasons for INSET for senior primary mathematics educators

REASONS FOR INSET	FREQUENCY PRIORITY				TOTAL
	1	2	3	4	
For self-empowerment in mathematics through networking with colleagues teaching senior primary mathematics	228	9	0	0	**237**
Improve competency as a senior primary mathematics educator so that learners will perform better academically	201	20	16	0	**237**
Need to be away from the daily routines of school	0	0	0	237	**237**
Update knowledge of recent trends and changes in senior primary mathematics	235	2	0	0	**237**

Key: 1 indicates the highest priority
4 indicates the lowest priority

Senior primary mathematics educators do not consider the need to be away from the daily routines of school as a priority for INSET as 0% ranked this reason as being first. Noteworthy on the other hand are the other reasons ranked as first which clearly indicate a general agreement by senior primary mathematics educators on the primary aims of INSET activities.

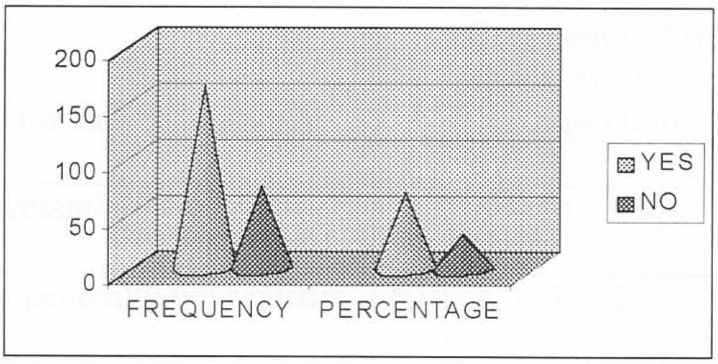
The survey also reveals that the senior primary mathematics educators acknowledge that the very nature of teaching demands commitment, keeping abreast of developments, improving one's skills and competencies, maintaining a high professional standing and providing quality education. More importantly, is the realisation that central to the nature of teaching demands is the recognition of the need for personal response and involvement in INSET.

5.7.3.2 **ATTENDANCE AT INSET COURSES, SEMINARS, WORKSHOPS FOR SENIOR PRIMARY MATHEMATICS EDUCATORS AT CIRCUIT/DISTRICT LEVEL (Q.10)**

Table 5.11 Table summarising the respondents attendance at INSET courses, seminars or workshops

	Frequency	Percentage
YES	163	68,8
NO	74	31,2

Figure 5.10 Respondents' attendance at INSET seminars, workshops and courses



This survey indicates that 163 (68,8%) mathematics educators attended INSET courses, workshops and seminars which implies the majority realise the importance of INSET courses in the enhancing of mathematics teaching and learning. It may also be assumed that while many senior primary mathematics educators attend INSET courses, workshops and seminars because of their dedication and commitment to the profession, others may require motivation in the form of certificates of attendance. Furthermore, these certificates should be recognised for service awards or eligibility for promotion. Senior primary educators should also be allowed to accumulate credits through attendance at INSET courses. These credits could be linked to salary increments. These incentives may appeal to educators and motivate them to attend INSET courses. In addition, senior primary mathematics educators whose salaries are low could be motivated to attend INSET courses at venues which are a distance from their schools if the KZNDEC pays them a travel and subsistence allowance.

5.7.3.3 REASONS FOR NON-ATTENDANCE AT INSET COURSES, WORKSHOPS AND SEMINARS (Q.11)

In order to determine the possible reasons as to why 74 (31,2%) senior primary mathematics educators did not attend INSET courses, workshops and seminars, reasons were offered and respondents were required to rank these in order of preference. The responses are indicated in table 5.12.

Table 5.12 Rank order of preference of reasons for not attending INSET courses, workshops and seminars and workshops

Reasons for non-attendance	Frequency: Most important to least important				
	1	2	3	4	TOTAL
INSET irrevelant/unnecssary	2	6	10	56	74
Approaches generally not realistic	62	7	3	2	74
Other commitments precluded participation	4	6	5	59	74
Travelling/venues posed a major problem	54	12	6	2	74

KEY: 1 indicates the highest priority
2 indicates the lowest priority

Approaches generally not realistic at INSET courses offered for senior primary mathematics educators constituted a major problem for the 74 (31,2%) educators. The researcher acknowledges that the conditions, facilities, resources, qualifications and experiences of educators participating in INSET programmes varies from school to school. However, in curriculum-related courses in which Education Department officials explain syllabus changes, teaching methods and organisational changes in the school and even when a common problem is addressed, inadequate account is taken of the different school contexts. Course leaders are often accused of being unaware of the realities in the classroom. Hence, they do not provide strategies that are relevant and potentially effective in the classroom. This would suggest that the KZNDEC in developing an infrastructure for INSET for senior primary mathematics educators, provision should be made for the utilization of educators, college and university lecturers and other educationists as consultants. Mathematics educators would benefit from the varied experience of experts.

Some educators who have excelled in the classroom using innovative and successful teaching methods can serve as INSET course leaders. Others who have tested teaching methods through action research can also individually or as team members offer INSET. This would have the following implications for senior primary mathematics educators:

- They can learn from colleagues job-related and job-embedded skills and practices.

- Educators as course leaders with necessary expertise remain aware of realities in the classroom. They will take into account the different school contexts from which educators come.

- Potentially effective and relevant strategies would be provided which could successfully be applied in the classroom thus increasing the confidence of the mathematics educator.

- Follow-up would be possible, as the educators with the necessary expertise will be easily available.

Travelling to INSET venues also posed a problem for the 74 (31,2%) educators. Organisers of INSET courses must ensure that venues are selected which will cause the least amount of inconvenience in respect of travelling distance.

Other reasons postulated and responses speak for themselves and need no further elaboration. It is suggested that educational authorities regard these responses as challenges to develop an infrastructure that would motivate all senior primary mathematics educators to attend INSET courses.

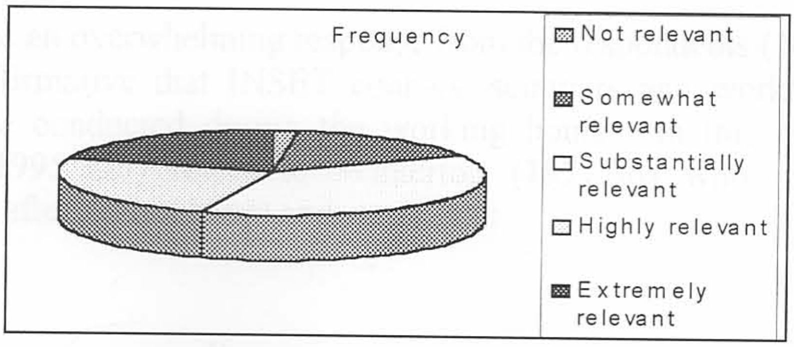
5.7.3.4 RELEVANCE OF INSET COURSES, SEMINARS AND WORKSHOPS ATTENDED (Q.12)

In order to determine the contributions of INSET to the needs of educators the 163 (68,8%) of the senior primary mathematics educators rated the INSET courses, seminars, workshops attended.

Table 5.13 Rate of relevance of INSET courses, seminars and workshops attended

Rate of Relevance	Frequency	Percentage
Not relevant	3	1,3
Somewhat relevant	25	10,5
Substantially relevant	62	26,2
Highly relevant	40	16,9
Extremely relevant	33	13,9
TOTAL	163	68,8

Figure 5.11 Rate of relevance of INSET courses, seminars and workshops attended



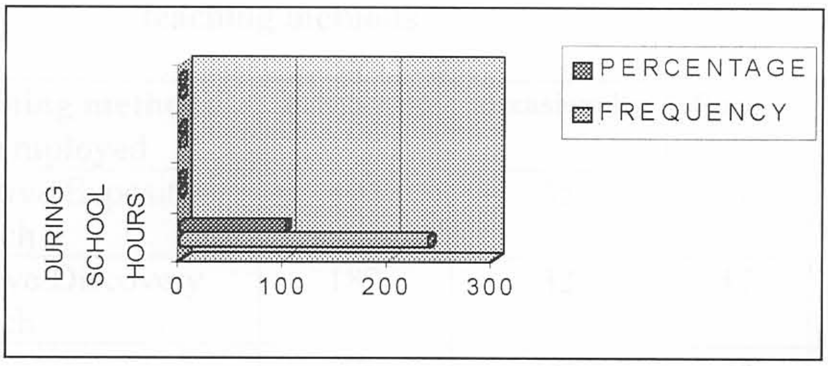
Only 1,3% of the respondents considered INSET courses, seminars and workshops for senior primary mathematics educators as not relevant, while 10,5% considered them somewhat relevant, 26,2% substantially relevant, 16,9% highly relevant and 13,9% extremely relevant. Thus, it is apparent that courses, seminars and workshops are considered important by the majority of respondents as they contribute positively to the INSET needs of those attending them.

5.7.3.5 TIME WHEN INSET COURSES, SEMINARS AND WORKSHOPS SHOULD BE CONDUCTED (Q.13)

Table 5.14 Time when INSET courses, seminars and workshops should be conducted

TIME	FREQUENCY	PERCENTAGE
During school hours	237	100
After school hours	0	0
During school vacations	0	0
During weekends	0	0
TOTAL	237	100

Figure 5.12 Time when INSET courses, seminars and workshops should be conducted



There was an overwhelming response from the respondents (100%) in the affirmative that INSET courses, seminars and workshops should be conducted during the working hours. In this regard Pather (1995:356) refers to Winterton (1977:36) who rejects activities after school hours and states that:

'If we are really serious about our quest for quality education then we must get serious about designing opportunities for teacher growth into the educational day.'

Furthermore, Pather (1995:356) equates the willingness to provide time for INSET to the importance that is attached to quality teaching. In analysing the problem of release time of senior primary mathematics educators during school hours for INSET activities the researcher is of the firm belief that this can become reality if the KZNDEC adheres to the following:

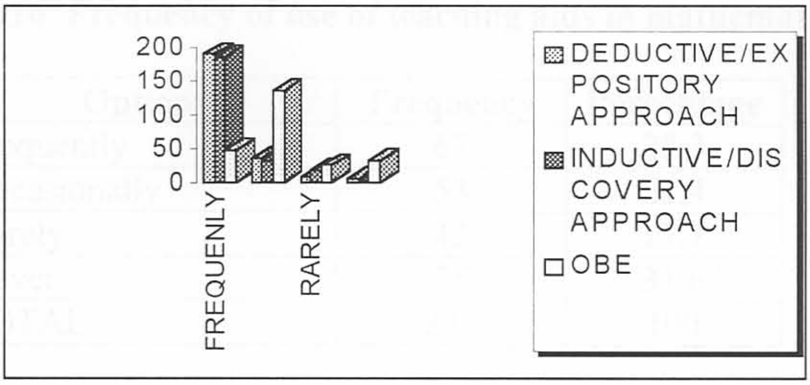
- Five days are added to the school calendar for INSET activities. On these days learners do not attend school.
- The provision of substitute educators in the event of senior primary mathematics educators attending INSET activities during school hours.

5.7.3.6 TEACHING METHODS USED BY SENIOR PRIMARY MATHEMATICS EDUCATORS (Q.14)

Table 5.15 Frequency distribution table of mathematics teaching methods

Teaching methods employed	Frequently	Occasionally	Rarely	Never
Deductive/Expository approach	191	35	6	5
Inductive/Discovery approach	187	32	17	1
OBE	45	137	24	31

Figure 5.13 Teaching methods used by senior primary mathematics educators



The above reflects that the expository or deductive method and inductive or discovery methods are frequently used by majority of the educators while the OBE approach is occasionally used. The following reasons could be given for this:

- Educators feel more comfortable using the deductive and inductive methods because they have been tried and tested over the years and educators have mastered these approaches.

- Educators feel less adequate to use the OBE method because of lack of knowledge of the method, lack of resources to use the method or the method has not been phased in at their schools.

- The OBE method may not be suitable for the mixed ability groups or large numbers in their classes.

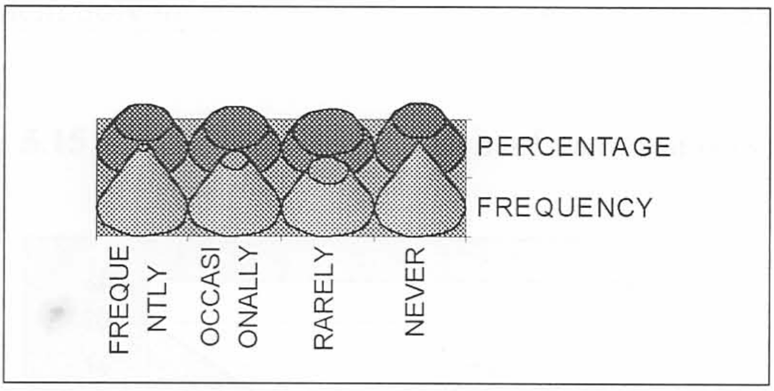
Curriculum reform aimed at altering teaching methods, are reliant on educators having high quality learning opportunities to make sense of it. Having been trained in a particular way and having internalised and routinised a particular approach to teaching over a number of years, educators experience uncertainty, apprehension, ambivalence and inertia. This provides strong evidence that INSET should be used as a vehicle to introduce curriculum reform aimed at altering senior primary mathematics educators teaching methods.

5.7.3.7 **USE OF TEACHING AIDS IN MATHEMATICS (Q.15)**

Table 5.16 Frequency of use of teaching aids in mathematics

Options	Frequency	Percentage
Frequently	67	28,3
Occasionally	53	22,4
Rarely	42	17,7
Never	75	31,6
TOTAL	237	100

Figure 5.14 Frequency of use of teaching aids in mathematics



The majority of educators, namely, 75 (31,6%), indicated that they never used teaching aids when teaching mathematics. This could be due to:

- Educators' 'misconceptions' that mathematics teaching does not warrant the use of teaching aids.
- Accessibility of teaching aids is difficult.
- Time constraints do not permit the use of teaching aids. Educators believe that they have limited time to teach many mathematical concepts.

Teaching aids enhance mathematics lessons. Hence, mathematics educators need to use a variety of teaching aids. Where there is an absence of electricity educators can use charts, pictures, posters, work-books in their lessons. Furthermore, where accessibility is a problem, educators should link up with other schools where teaching aids are accessible.

5.7.3.7 TEACHING STRATEGIES USED BY SENIOR PRIMARY MATHEMATICS EDUCATORS (Q.16)

Table 5.17 Frequency distribution table of mathematics teaching strategies

Teaching Strategy Employed	Frequency	Percentage
Chalk and Talk	203	85,7
Games	78	32,9
Group Work	155	65,4
Problem Solving	91	38,4

Figure 5.15 Frequency distribution of mathematics teaching strategies

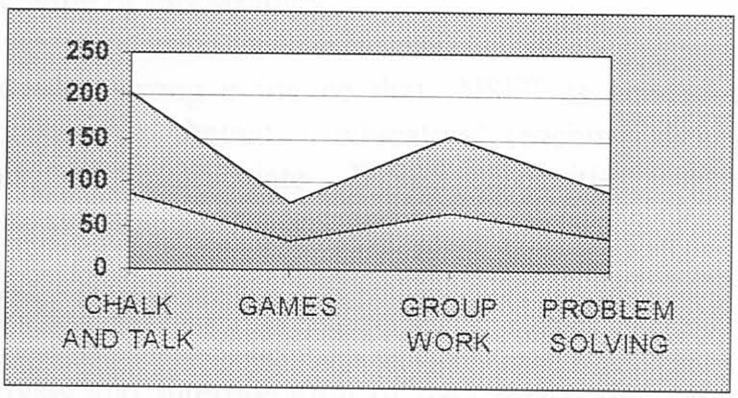


Table 5.17 reflects the range of strategies used by the senior primary mathematics educators. Strategies such as chalk and talk and group work are used by educators in both rural and urban schools. However, problem solving seemed to be used more in urban rather than rural schools. This could be due to the following:

- Educators use the chalk and talk strategy frequently because they feel adequate with this strategy. They remain in control while learners continue to be passive. Least disturbances occur in the class and the educator can cover adequate subject matter.

Since educators are so comfortable with this strategy they become resistant to change.

- Educators that do use the groupwork strategy feel that it leads to effective mathematics teaching since the numbers in classes are too large.

- Educators that do not use the groupwork strategy attribute it to the noise factor. These educators believe that learners cannot work quietly in groups. This could also be attributed to the 'misconception' that learning only takes place when learners are quiet.

- Educators, especially in the rural areas feel threatened to use the problem solving strategy because they feel inadequate in problem solving skills.

- Educators in rural areas also shy away from the use of games in mathematics teaching, which could be due to their lack of knowledge of this strategy.

This provides strong evidence that INSET is needed to develop senior primary mathematics educators' teaching strategies. The provision of appropriate INSET activities will enhance mathematics teaching and learning.

5.8 CONCLUSION

The analysis and interpretation of data reveal that senior primary mathematics educators realise the importance of keeping abreast with the development of mathematics and acknowledge the need for INSET. What is of concern is the level and scale of provision of INSET for senior primary mathematics educators. This survey has identified and highlighted areas that could provide pointers for future INSET provision. The key role players in the KZNDEC ought to look into these pointers if the quality of mathematics teaching and learning is to be improved in the senior primary phase in schools.

Conclusions arising from the study of INSET of primary school mathematics educators with reference to KZN and recommendations are discussed in the next chapter. This could also be considered as points of departure for further research and investigation.

CHAPTER 6

FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

The findings, conclusions and recommendations of this study have particular relevance for the senior primary mathematics educator and Educational Authorities of mathematics education. The findings have shown that central to the importance of mathematics is the consensus that INSET is vital and pivotal to the ongoing enhancement of mathematics teaching and learning in the senior primary phase in KZN. Educational Authorities cannot afford to ignore the importance of INSET and need to give it high priority. This can be made possible, *inter alia,* by effecting the recommendations provided in this study.

6.2 SUMMARY OF THE STRUCTURE OF THE STUDY

This study comprised of six chapters. Chapter One provided the background to the study. Chapter Two presented a theoretical and conceptual framework which is critical to the study.

In Chapter Three a scan of the evolution of mathematics teaching and the INSET of senior primary mathematics educators in England was undertaken. Chapter Four comprised an analysis of INSET of educators with particular reference to mathematics in the primary schools in KZN.

The results of an empirical investigation, through a detailed questionnaire filled in by senior primary mathematics educators in the Department of Education and Culture: KZN, was presented and discussed in Chapter Five. Chapter Six comprised findings, recommendations and a conclusion based on the literature survey and the empirical investigation.

6.3 SUMMARY OF MAJOR FINDINGS

The analysis of data from the questionnaire yielded the following findings in respect of:

6.3.1 FINDINGS PERTAINING TO PERSONAL PARTICULARS OF SENIOR PRIMARY MATHEMATICS EDUCATORS

- The survey revealed that 67,1% of the educators teaching senior primary mathematics are females.
- Majority (35,4%) of senior primary mathematics educators are in the age category of 31 – 35 years.
- The bulk (84,4%) of senior primary mathematics educators have 6 – 20 years of experience in teaching mathematics.
- Presently, there are only 19,4% of senior primary mathematics specialists. Precisely 80,6% of senior primary mathematics educators are non-specialists.
- The survey also revealed that 62,9% of the primary schools are situated in the urban areas.

6.3.2 FINDINGS PERTAINING TO SCHOOL FOCUSED INSET

- The survey reveals that 65,8% senior primary mathematics educators receive supervision in mathematics from respective members of management.
- 98,7% of the respondents indicated that mathematics committee meetings are conducted in their schools.

6.3.3 FINDINGS PERTAINING TO THE SCOPE, NATURE AND NEEDS FOR INSET

- Senior primary mathematics educators acknowledged that the very nature of teaching demands commitment, keeping abreast of developments, improving one's skills and competence, maintaining a high professional standing and providing quality mathematics education.

- 68,8% of senior primary mathematics educators attend INSET courses.
- Approaches generally not realistic at INSET courses and travelling to INSET venues constituted a major problem for 31,2% of the senior primary mathematics educators that did not attend INSET courses.
- The majority (98,7%) of the senior primary mathematics educators rated the relevance of INSET courses, seminars and workshops attended as somewhat relevant to extremely relevant.
- 100% of the respondents indicated that INSET courses, seminars and workshops should be conducted during school hours.
- The survey reflected the expository or deductive method and inductive or discovery method as frequently used teaching methods in senior primary mathematics teaching.
- The survey also revealed that the OBE approach is occasionally used.
- The majority (31,6%) of the senior primary mathematics educators indicated that they never used teaching aids when teaching mathematics.
- The chalk and talk, groupwork and games teaching strategies seemed to be popular among the senior primary mathematics educators.
- The problem solving strategy posed a threat to 38,4% of the senior primary mathematics educators.

The overall findings acknowledge the need for INSET. These findings also have implications for further research as well as strategies to be implemented to address the INSET needs of senior primary mathematics educators.

6.4 RECOMMENDATIONS

Emanating from the literature survey, study of a developed country, the status quo of INSET for senior primary mathematics educators in KZN and the empirical investigation the researcher suggests the following as recommendations for the INSET of senior primary mathematics educators. The following recommendations are illustrative of the kind of strategies that may be utilized to improve the teaching and learning of mathematics.

6.4.1 INSET POLICY

For the INSET of senior primary mathematics educators to be successful there is a need to establish a national and provincial policy for INSET. The researcher is of the firm belief that the most direct way of raising the quality of learning and teaching is through a comprehensive reform and redirection of INSET. The facilities of education in universities, colleges and technikons, the NGO sector and some subject organisations and educators have been responsible for an array of innovative INSET programmes, many of which involved professional development and educator empowerment. There is a need for an evaluation of these INSET practices and the role of the Department of Education in the formulation of a revitalised, properly accredited INSET policy.

It is recommended that such a policy be determined at a national level after obtaining concurrence with provincial education authorities and teacher organisations. By determining such a policy on a consultative and consensus basis, the national Department of Education should also ensure that financial provision for INSET is made.

Policy determined at national level can be more effective if it is considered within the national strategic framework of the Reconstruction and Development Programme (RDP 1994:7-11). If each of the nine provincial education authorities determine their own general INSET policy, problems can arise, especially for accreditation or priorities set by the RDP can be bypassed to satisfy less important needs. The possibility of different interpretations of INSET can also compound the problem for effective INSET for senior primary mathematics educators.

With regard to INSET, general guidelines are provided in the RDP discussion document (1994:7-8). The development of human resources is one of the five key programmes of the RDP. The RDP (1994:8) also emphasises life-long education. Guided by the broad principles, and the guidelines set by the RDP, the following is recommended as an overarching policy for INSET. The national Department of Education, in recognising that INSET is a major vehicle for human resource development, will take responsibility for the broad national policy development and financing of the service. Each provincial Department of Education will develop INSET policy, regulations and guidelines and manage the service within the broader policy for INSET.

6.4.2 INCENTIVES FOR THE INSET OF SENIOR PRIMARY MATHEMATICS EDUCATORS

Appropriate incentives need to be explored to increase participation rates in INSET programmes for senior primary mathematics educators. It is recommended that a functional model of INSET be developed by the Department of Education where courses including senior primary mathematics be recognised for salary increment and promotion purposes, after the completion of a pre-determined number of courses. Certificates should be issued to educators which would be of benefit to educators.

6.4.3 SCHOOL FOCUSED INSET FOR SENIOR PRIMARY MATHEMATICS EDUCATORS

For the effective provision of INSET, school focused INSET for senior primary mathematics educators should be established. Pather (1995:432) maintains that the most cost-effective structure that is appropriately located to effect change through INSET is the school.

Principals, Heads of Department and senior primary mathematics educators are valuable resources for establishing needs, serving as role models, peer group coaches and key linkages critical to the capacity building and developing of mathematics teaching. The principal and staff can undertake periodic whole school reviews and offer INSET on a developmental basis.

Bolam (1980:89) argues that the increasing attention paid to the role of the school in INSET has to a large extent arisen from dissatisfaction with traditional approaches to INSET. Individual educators attend these externally planned and provided courses and find it too theoretical or too general and are unable to implement its recommendations in their schools because of the particular circumstances that prevail in their schools. The response to this dissatisfaction, is the provision of school focused INSET, which is more directly focused upon the needs, tasks and problems of particular schools.

6.4.4 METHODS OF INSET COURSES FOR SENIOR PRIMARY MATHEMATICS EDUCATORS

The methods adopted for INSET courses for senior primary mathematics educators can determine the effectiveness of the INSET. INSET courses can take any one of a number of forms that vary from distant education to conferences. The duration of courses may also vary considerably and may be as short as a single session or sessions held over a month, term or year. Some of the methods that can be used are the following:

- Formal lectures: There are possibly two main types, one where the lecture is followed by questions from the participants and the other, where a group discussion follows the lecture.

- Group discussion or seminars: It is usual for these discussions to be led by specialists or experts in the field of mathematics. A series of discussions may be arranged frequently. It is desirable that the groups are small in order to facilitate discussion and the exchange of ideas.

- Working groups: The groups will consist of a few mathematics educators with the specific purpose of exploring topics related to the mathematics curriculum and classroom practices. The participants are involved in practical work and the experimentation of methods and materials. The word 'workshop' is commonly used to describe the activities of these working groups.

- Demonstration lessons: Senior primary mathematics educators are given the opportunity of observing and discussing demonstrations of mathematics lessons. Lessons may be recorded on video tape and discussed at INSET courses.

- Informal discussion meetings: This need not be used extensively. However, the aim is for the arrangement of informal meetings between senior primary mathematics educators from various schools where professional discussions are held.

- Tutorial instruction: Individual senior primary mathematics educators are visited in their schools. While this is the ideal one-to-one teaching situation, extensive use cannot be made of this time-consuming expensive method. It can, however, be used in follow-up work, where senior primary mathematics educators who have attended INSET courses are visited by other educators who attended the course or the course leader. This may be referred to as the working party approach.

All of the methods discussed emphasise a participative approach. It is recommended that these methods be explored. These methods will enable senior primary mathematics educators to highlight their problems and share ideas involving mathematics teaching thereby increasing the effectiveness of INSET for senior primary mathematics educators.

6.4.5 THE VALUE OF TEACHERS' CENTRES TO THE INSET OF SENIOR PRIMARY MATHEMATICS EDUCATORS

Teachers' centres can contribute to an improved INSET for senior primary mathematics educators. They act as exciting brokers for new ideas and as networks for personnel. These centres must be located at convenient points so that maximum use can be made of them. They should:

- provide the necessary venues for the varying methods of INSET for senior primary mathematics educators;

- provide up-to-date resources for the teaching of mathematics; and,
- publish articles and journals relevant to the teaching of mathematics.

This study has revealed that the senior primary mathematics educators in rural schools need the most amount of assistance. It is therefore recommended that there is an urgent need to establish teachers' centres in areas that will service these rural mathematics educators.

6.4.6 UPDATING OF SENIOR PRIMARY MATHEMATICS EDUCATORS

Pivotal to the INSET of senior primary mathematics educators is the need for these educators to update their in-depth knowledge of mathematics and the teaching of mathematics. The following recommendations will assist senior primary mathematics educators to update themselves:

- The purchasing of updated textbooks on both mathematical content and methodology for the school library.
- The reading of mathematics journals such as Pythagoras.
- Becoming members of mathematics committees and associations such as AMESA.
- Participating in workshops and seminars and submitting articles on the teaching of senior primary mathematics on a regular basis.
- Attending conferences, seminars, workshops and orientation courses organised for senior primary mathematics educators.

6.5 RECOMMENDATIONS FOR FURTHER RESEARCH IN THE INSET OF SENIOR PRIMARY MATHEMATICS EDUCATORS

As a critical constituent of the INSET of senior primary mathematics educators, further research in the teaching of senior primary mathematics should be undertaken. The following areas of study are suggested:

- An evaluation of the degree of supervisory support accepted by senior primary mathematics educators.

- An analysis of the resistance of senior primary mathematics educators to the uses of a variety of teaching strategies.

- The conceptions and beliefs that in-service senior primary mathematics educators hold about teaching and learning mathematics.

- Determine the nature and scope of Curriculum 2005 in the teaching of senior primary mathematics.

6.6 CONCLUSION

A holistic conclusion of the INSET of primary school mathematics educators would inevitably be that ultimately the task of INSET in its totality is to offer the primary school mathematics educators further guidance and keep them abreast with the developments in mathematics teaching. Furthermore, it will provide an opportunity to add to personal knowledge or skills already acquired in mathematics teaching, adopt to curricular changes, develop special knowledge of mathematics following initial training, find out more about ways in which learners learn mathematics and acquire guidance in learner evaluation. The INSET of primary school mathematics educators will extend their professional competence leading ultimately to a greater sense of confidence in mathematics teaching.

In this chapter the findings, recommendations and conclusion of the INSET of senior primary mathematics educators was outlined. It is hoped that consideration will be given to the recommendations made in this research so as to contribute positively to the INSET needs of primary school mathematics educators. Undoubtedly, these recommendations will constitute a challenge to primary school mathematics educators and educational authorities. However, all it will require is determination, vision, good planning and management.

BIBLIOGRAPHY

Addison AF 1981 ***Developing Mathematical Thinking***. Wesley Publishers Ltd., London.

Arnott A *et al*. (Eds) 1997 ***Mathematics and Science Teachers: Demand, Utilization, Supply and Training in South Africa***. Edu Source, Cape Town.

Ashley MJ and Mehl M C 1987 ***Inset in South Africa: Issues and Directions***. Teacher Opportunity Programmes, Johannesburg.

Bagwandeen DR 1991 ***In-Service Education and Training (INSET) for Indian Education in the Republic of South Africa***. Ph.D. Thesis, University of Pretoria, Pretoria.

Bagwandeen DR 1999 ***A Study of the Provision of Distance Education for the Upgrading and Improvement of the Qualifications of Teachers in the Province of KwaZulu-Natal***. D.Ed. Thesis, University of South Africa, Pretoria.

Bagwandeen DR and Louw W J 1993 ***The Theory and Practice of In-Service Education and Training for Teachers in South Africa***. J.L.Van Schaik Academic, Pretoria.

Bailey P 1992 Geography and the National Curriculum. In: ***The Geographical Journal***, 58(1):67.

Behr AL 1980 ***Psychology and the School***. Butterworth Publishers (Pty.) Ltd., Durban.

Bell FH 1978 ***Teaching and Learning Mathematics in Secondary Schools***. Brown Publishing Company, New York.

Bell L 1991 The Provision of Professional Development for Teachers. In: Letiche JC *et al*. (Eds) ***The Practitioner's Power of Choice in Staff Development and In-Service Training***. Swets and Zetlinger BV, Amsterdam.

Biggs E and Shaw K 1995 ***Maths Alive: Inset Mathematics for the National Curriculum Key Stages 1, 2, 3***. Cassell, London.

Bogdan RC and Biklen SK 1982 ***Qualitative Research for Education: An Introduction to Theory and Methods***. Allyn Bacon, Boston.

Bolam R 1980 In-Service Education and Training. In: Hoyle E and Megarry J (Eds) ***World Yearbook of Education 1980: Professional Development of Teachers***. Kogan Page, London.

Botha PMC 1989 ***The Shell Science Centre in Education***. Shuter and Shooter (Pty.) Ltd., Pietermaritzburg.

Brodie K 1995 Small Groupwork, Teaching and Learning. In: ***Pythagoras: Journal of the Association for Mathematics Education of South Africa,*** December, 41.

Brodie K 1997 A New Curriculum: Reflecting on Outcomes in Progress. In: ***Pythagoras: Journal of the Association for Mathematics Education of South Africa,*** August, 43.

Cane B 1969 ***In-Service Training: A Study of Teachers' Views and Preferences***. National Foundation for Educational Research in England and Wales, Slough.

Charles AF 1973 Psychological Controversies in the Teaching of Mathematics. In: Crosswhite FJ *et al.* (Eds) ***Teaching Mathematics: Psychological Foundations***. Jones Publishing Company, Ohio.

Choat E 1980 ***Mathematics and the Primary School Curriculum***. National Foundation for Educational Research Publishing Company Ltd., Berks.

Christie P 1997 Globalisation and the Curriculum: Proposals for the Integration of Education and Training. In: Kallaway P *et al.* (Eds) ***Education After Apartheid. South African Education in Transition***. Inta, Cape Town.

Connell WF *et al.* 1967 ***Readings in the Foundations of Education.*** Routledge and Kogan Paul, London.

Coombe J and Davis ZD 1995 Games in the Mathematics Classroom. In: Davis ZD (Ed) ***Exploring Mathematics Teaching and Teacher Education***. The Copy Shop, Rondebosch.

Copeland RW 1982 ***Mathematics and the Elementary Teacher***. MacMillan Publishing Company Inc., New York.

Darling-Hammond L 1997 School Reform at the Crossroads: Confronting the Central Issues of Teaching. In: ***Educational Policy***, 11 (2):151-166.

Dean PG 1982 ***Teaching and Learning Mathematics***. Woburn Press, London.

Eggen PD and Kauchak DP 1988 ***Strategies for Teachers: Teaching Content and Thinking Skills***. Prentice-Hall, New Jersey.

Elliot J 1984 ***A Practical Guide to Teaching and Learning***. Maskew Miller Longman, Cape Town.

Ernest P 1989 ***Mathematics Teaching: The State of the Art***. The Falmer Press, London.

Ferrucci B *et al.* 2001 Achieving Understanding in Solving Word Problems. In: ***Pythagoras: Journal of the Association for Mathematics Education of South Africa***, April, 54.

Fitzjohn S and Weber B (Eds) 1990 ***The New Joy of Knowledge Encyclopedia***. Oriole Publishing Ltd., London.

Graham-Jolly M 1994 'Project Co-operation: The Experience of the Toyota Teach Primary School Project.' In: Levy S ***Projects Speak for Themselves: Science and Mathematics Education in Transition***. Shuter and Shooter, Pietermaritzburg.

Graves NJ 1977 ***Geography in Education***. Heinemann Educational Books Ltd., London.

Green L 2001 Taking Teachers Seriously. In: ***Perspectives in Education***, 9(2):129-140.

Groves S and Cheeseman J 1993 'Young Children's Number Concepts – The Effect of Calculator Use on Teacher Expectations.' In: Atweh B *et al.* (Eds) ***Contexts in Mathematics Education***. Proceedings of the 16th Annual Conference.

Hargreaves A 1994 ***Changing Teachers, Changing Times***. Cassell, London.

Henning J 1984 The Curriculum and Geography. In: ***The South African Geographical Journal***, 66(1):3-15.

Hewton E and Jolly M 1991 ***Making Time for Staff Development***. University of Sussex, Brighton.

Hobden SD 1999 ***The Beliefs of Pre-Service Teachers About Mathematics Teaching and Learning***. Unpublished M.Ed. Dissertation, University of Natal, Durban.

Hofmeyr J 1994 In-Service Training for Teachers is a Critical and Cost Effective Area for Reconstruction in Education. In: ***DSA in Depth***. Creda Press (Pty.) Ltd., Johannesburg.

Hofmeyr JM 1991 ***Policy Change in South African Education: The Roles of the Private Sectors in In-Service Teacher Education***. Ph.D. Thesis, University of Witwatersrand, Johannesburg.

Hopkins D *et al.* 1996 ***Improving the Quality of Education for All: Progress and Challenge***. Fulton Publishers, London.

Joyce B 1980 The Ecology of Professional Development. In: Hoyle E and Megarry J (Eds) ***World Yearbook of Education 1980: Professional Development of Teachers***. Kogan Page, London.

Kaput JJ 1992 Technology and Mathematics Education. In: Grouws D (Ed) ***Handbook of Research on Mathematics Teaching and Learning***. NCTM, Reston.

Katzin L *et al.* 2000 The Attitudes of Grade One and Two Learners' Parents Towards Curriculum 2005. In: ***Journal of Education and Training,*** 21(2):1-12. University of Pretoria, Pretoria.

KwaZulu-Natal Department of Education and Culture 1996 ***Provincialised Interim Core Syllabus and Guide for Mathematics Senior Primary Phase***. Government Printers, KwaZulu-Natal.

KwaZulu-Natal Department of Education and Culture 2001 ***Circular No. 92 of 2001***. Ulundi, KwaZulu-Natal Government Service.

Matthews J 1992 The Present State of Primary Mathematics in Schools in the United Kingdom. In: Morris R and Arora MS (Eds) ***Moving into the 21st Century***. Unesco, France.

McMillan JH and Schumacher S 1993 ***Research in Education: A Conceptual Introduction***. Harper Collins College, New York.

Mkhize MG 1989 ***The Professional and Academic Upgrading of Black Teachers in Natal and KwaZulu***. Unpublished M.Ed. Thesis, University of Durban-Westville, Durban.

Monica J *et al.* 2000 ***Teaching-Learning Dynamics: A Participative Approach for OBE***. Heinemann Higher and Further Education (Pty.) Ltd., Johannesburg.

Moodley M 1992 Teaching-Learning Mathematics: What Counts. In: Presmeg NE and Njisane RA (Eds) ***Mathematics Education for In-Service and Pre-Service Teachers***. Shuter and Shooter (Pty.) Ltd., Pietermaritzburg.

Moodley S 1997 ***A Didactical-Pedagogical Investigation into the Problems of Teaching Geography in Senior Primary Schools in KwaZulu-Natal***. Unpublished M.Ed. Dissertation, University of Pretoria, Pretoria.

Moon B 1986 ***The 'New Maths' Curriculum Controversy: An International Study***. The Falmer Press, London.

Nichols ED and Behr MJ 1982 ***Elementary School Mathematics and How to Teach It***. CBS College Publishing, London.

Njisane RA 1992 Constructivism. In: Moodley M and Presmeg NE (Eds) ***Mathematics Education for In-Service and Pre-Service Teachers***. Shuter and Shooter (Pty.) Ltd., Pietermaritzburg.

Olivier C and Van Schaik JL 1998 ***How to Educate and Train Outcomes Based Education***. JL Van Schaik Publishers, Pretoria.

Orton A and Cassell GW (Eds) 1994 ***Issues in Teaching Mathematics***. Wesley Publishers Ltd., London.

Osman R and Kirk J 2001 Teaching as Agents of Change: A Teaching and Learning Experience Through and About Change. In: ***Perspectives in Education,*** 19(1):172-180.

Pather G 1984 ***The Role of Teachers Centres in the Professional Development of Teachers. A Comparative Critical Perspective***. Unpublished M.Ed. Dissertation, University of Natal, Durban.

Pather G 1995 ***An Investigation into the Management of In-Service Education and Training (INSET) in the Natal-KwazZulu Region.*** Ph.D. Thesis, University of Natal, Durban.

Postlethwait SN *et al.* 1977 ***Exploring Teaching Alternatives***. Burgess Publishing Company, Minneapolis.

Pretorius JJ 1976 ***A Study of Some Recent Developments in Primary Education in England***. Unpublished M.Ed. Dissertation, University of Natal, Durban.

Reconstruction and Development Programme 1994 ***White Paper: Discussion Document***. CTP Book Printers, Cape Town.

Sebolai ME 1995 ***Staff Development and Training of Teachers by Means of Distance Education***. Unpublished M.Ed. Dissertation, University of Pretoria, Pretoria.

Skemp R 1989 ***Mathematics in the Primary School***. Routledge, London.

Sovchik R 1989 ***Teaching Mathematics to Children***. Harper Collins Publishers Inc., New York.

Spady W 1993 ***Outcomes Based Education***. Australian Curriculum Studies Association, Canberra.

Spady W and Schlebusch A 1999 ***Curriculum 2005: A Guide for Parents***. Tafelberg Press, Cape Town.

Stuart JF (Eds) 1986 ***Didactics: An Orientation for First Year Students***. MacMillan Publishing Co., Johannesburg.

Taylor N and Vinjevold P 1999 ***Getting Learning Right: Report of the President's Education Initiative Research Project***. Jet, Johannesburg.

Van Den Berg DJ 1978 ***A Pedagogical Study of the Black Man's Mathematical Ability***. Human Science Research Council, Pretoria.

Van Der Horst H and McDonald R 1997 ***Outcomes Based Education***. Kasigo Publishers, Pretoria.

Walklin L 1990 ***Teaching and Learning in Further and Adult Education***. Stanley Thornes Publishers Ltd., London.

Wallace SD 1974 ***A Critical Examination of Aspects of Selected Overseas Primary School Mathematics Projects and their Possible Contribution to the Teaching of Mathematics in the Primary Schools of Natal***. Unpublished M.Ed. Dissertation, University of Natal, Durban.

Ward M 1979 ***Mathematics and the 10 Year Old***. Evans Brothers Ltd., London.

Watkins R 1973 ***In-Service Training: Structure and Content.*** Ward and Lock, London.

Webb J 1998 What's the Use of Mathematics. In: ***Pythagoras: Journal of the Association for Mathematics Education of South Africa,*** August, 46.

Wideen MF and Andrews I 1987 ***Staff Development for School Improvement: A Focus on the Teacher***. The Palmer Press, New York and Philadelphia.

Appendix A

16 August 2001

The Education Department
COMASTE Educational Centre
P.O.Box 67496
Nairobi

Information required on the In-Service Education and Training (INSET) needs of educators of primary school mathematics in Kenya

I am currently studying for a M.Ed. degree in the Department of Teaching and Training at the University of Pretoria. The title of my research topic is:

The In-Service Education and Training (INSET) needs of educators of primary school mathematics.

The outcome of my research will benefit not only primary school mathematics educators but also those involved in the supervision of primary school mathematics.

In an attempt to glean information on the INSET of primary school mathematics educators in a developing country, I shall be much obliged if information on the following points could be made available to me. This information constitutes an integral part of my research.

1. A historical background to general senior primary school education in Kenya.
2. The evolution of mathematics teaching/mathematics learning in the senior primary phase in primary schools in Kenya (Changes in aims,/objectives, content, methods, etc. over the years)
3. Status of mathematics educators in the senior primary phase in Kenya (e.g. qualifications)
4. Government policy/objectives with respect to In-Service Education and Training (INSET) of primary school mathematics educators.
5. Are Colleges of Further Training Centres for INSET provided for primary school mathematics educators. If so, name them and briefly indicate what they provide and the level of success.
6. What kind of activities does the Education Department organise for primary school mathematics educators (long-term award bearing, short-term intensive courses, one day orientation, etc.)

7. When are educators expected to attend these INSET programmes? (During school time, weekends, holidays, etc.)
8. How many mathematics educators are reached annually?
9. Are educators participating in these programmes, paid travelling and subsistence expenses?
10. Who is responsible for decisions regarding these INSET courses/objective/methods, etc.?
11. How are these courses evaluated?
12. Are follow-ups provided?
13. Please indicate the acts/commissions etc. that were responsible for the changes in the mathematics curriculum, mathematics teacher training, INSET provision.
14. Any general information with regard to mathematics teaching in the primary school and INSET provision in Kenya will be appreciated.

Yours faithfully

Naidoo

R.NAIDOO (Mrs)
306 Hadlow Place
100 Ronald Road,
Montclair, 4004

Fax No.: (031) 9024534

Appendix B

16 August 2001

The Education Ministries Office
P.O.Box M45
Ministries
Akkra

Information required on the In-Service Education and Training (INSET) needs of educators of primary school mathematics in Ghana

I am currently studying for a M.Ed. degree in the Department of Teaching and Training at the University of Pretoria. The title of my research topic is:

The In-Service Education and Training (INSET) needs of educators of primary school mathematics.

The outcome of my research will benefit not only primary school mathematics educators but also those involved in the supervision of primary school mathematics.

In an attempt to glean information on the INSET of primary school mathematics educators in a developing country, I shall be much obliged if information on the following points could be made available to me. This information constitutes an integral part of my research.

1. A historical background to general senior primary school education in Ghana.
2. The evolution of mathematics teaching/mathematics learning in the senior primary phase in primary schools in Ghana (Changes in aims,/objectives, content, methods, etc. over the years)
3. Status of mathematics educators in the senior primary phase in Ghana (e.g. qualifications)
4. Government policy/objectives with respect to In-Service Education and Training (INSET) of primary school mathematics educators.
5. Are Colleges of Further Training Centres for INSET provided for primary school mathematics educators. If so, name them and briefly indicate what they provide and the level of success.
6. What kind of activities does the Education Department organise for primary school mathematics educators (long-term award bearing, short-term intensive courses, one day orientation, etc.)

7. When are educators expected to attend these INSET programmes? (During school time, weekends, holidays, etc.)
8. How many mathematics educators are reached annually?
9. Are educators participating in these programmes, paid travelling and subsistence expenses?
10. Who is responsible for decisions regarding these INSET courses/objective/methods, etc.?
11. How are these courses evaluated?
12. Are follow-ups provided?
13. Please indicate the acts/commissions etc. that were responsible for the changes in the mathematics curriculum, mathematics teacher training, INSET provision.
14. Any general information with regard to mathematics teaching in the primary school and INSET provision in Ghana will be appreciated.

Yours faithfully

Naidoo

R.NAIDOO (Mrs)
306 Hadlow Place
100 Ronald Road,
Montclair, 4004

Fax No.: (031) 9024534

Appendix C

16 August 2001

The Education Department
Block 5A
Federal Secretariat Complex
Shehu Shagari Way
Abuja
Nigeria

Information required on the In-Service Education and Training (INSET) needs of educators of primary school mathematics in Nigeria

I am currently studying for a M.Ed. degree in the Department of Teaching and Training at the University of Pretoria. The title of my research topic is:

The In-Service Education and Training (INSET) needs of educators of primary school mathematics.

The outcome of my research will benefit not only primary school mathematics educators but also those involved in the supervision of primary school mathematics.

In an attempt to glean information on the INSET of primary school mathematics educators in a developing country, I shall be much obliged if information on the following points could be made available to me. This information constitutes an integral part of my research.

1. A historical background to general senior primary school education in Nigeria.
2. The evolution of mathematics teaching/mathematics learning in the senior primary phase in primary schools in Nigeria (Changes in aims,/objectives, content, methods, etc. over the years)
3. Status of mathematics educators in the senior primary phase in Nigeria (e.g. qualifications)
4. Government policy/objectives with respect to In-Service Education and Training (INSET) of primary school mathematics educators.
5. Are Colleges of Further Training Centres for INSET provided for primary school mathematics educators. If so, name them and briefly indicate what they provide and the level of success.

6. What kind of activities does the Education Department organise for primary school mathematics educators (long-term award bearing, short-term intensive courses, one day orientation, etc.)
7. When are educators expected to attend these INSET programmes? (During school time, weekends, holidays, etc.)
8. How many mathematics educators are reached annually?
9. Are educators participating in these programmes, paid travelling and subsistence expenses?
10. Who is responsible for decisions regarding these INSET courses/objective/methods, etc.?
11. How are these courses evaluated?
12. Are follow-ups provided?
13. Please indicate the acts/commissions etc. that were responsible for the changes in the mathematics curriculum, mathematics teacher training, INSET provision.
14. Any general information with regard to mathematics teaching in the primary school and INSET provision in Nigeria will be appreciated.

Yours faithfully

Rnaidoo

R.NAIDOO (Mrs)
306 Hadlow Place
100 Ronald Road,
Montclair, 4004

Fax No.: (031) 9024534

Appendix D

KAMALINEE PRIMARY SCHOOL

Ref:

P.O.Box 20
Isipingo
4110

Michela Road
Lotus Park
4111

THE GOVERNING BODY
"LIVE,LEARN,LOVE"

16 August 2001

Chief Regional Director
Department of Education and Culture
Private Bag X54330
Durban
4000

REQUEST TO CIRCULATE QUESTIONNAIRES TO MATHEMATICS EDUCATORS AT PRIMARY SCHOOLS

I am currently studying for a M.Ed degree in the Department of Teaching and Training at the University of Pretoria. The title of my research topic is:

The In-Service Education and Training (INSET) needs of educators of primary school mathematics.

The outcome of my research will benefit not only primary school educators but also those involved in the supervision of mathematics.

I shall be much obliged if you will kindly grant me necessary permission to circulate questionnaires to schools under your control. The questionnaire and analysis thereof constitutes an integral part of my research.

Yours faithfully

Rnaidoo

R.NAIDOO
Persal No.: 11005564

PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATAL
PROVINSIE KWAZULU-NATAL

DEPARTMENT OF EDUCATION AND CULTURE
UMNYANGO WEMFUNDO NAMASIKO
DEPARTEMENT VAN ONDERWYS EN KULTURE

DURBAN SOUTH REGION | ISIFUNDA SASENINGIZIMU NETHEKU | DURBAN SUID STREEK

Address : Malgate Building
Ikheli: 72 Stanger Street
Adres: Durban
4001

Private Bag :
Isikhwama Seposi : Private Bag X54330
Privaatsak : Durban
4000

Telephone : (031) 3270911
Ucingo :
Telefoon :
Fax : (031) 3270244

Enquiries : D.M. Moodley
Imibuzo : 3270278
Navrae :

Reference :
Inkomba :
Verwysing :

Date : 2001-10-12
Usuku :
Datum :

Appendix E

Mrs R. Naidoo
Kamilinee Primary School
P.O. Box 20
Lotus Park
4111

PERMISSION TO CONDUCT RESEARCH

Your letter dated 16 August 2001 in respect of the above matter has reference.

Kindly be informed that permission is granted for you to conduct the research subject to the following:

1. The schools which participate in the project would do so on a voluntary basis.

2. Access to the schools you wish to utilise is negotiated with the principal concerned by yourself.

3. The normal teaching and learning programme is not to be disrupted.

4. The confidentiality of the participants is respected.

5. A copy of the thesis/research is lodged with the Regional Chief Director through my office on completion of your studies.

I wish you all the success in the research you are undertaking.

Kind regards.

D.M. MOODLEY
ACTING DIRECTOR : EDUCATION SUPPORT SERVICES

Appendix F

<u>12 October 2001</u>

Research questionnaire on In-Service Education and Training (INSET) needs of educators of primary school mathematics

Currently there is an increasing awareness for the improved INSET of primary school mathematics educators. This could be attributed to the educational initiatives presently being undertaken in South Africa.

In order to obviate mathematics teaching in the primary school from degenerating into a situation which would render it inconsequential to many of its learners, constructive planning to initiate change and reflect change through INSET must be manifested. Pre-Service Education and Training (PRESET) serves only as preparation for the entry into the teaching profession and cannot last the whole teaching career. INSET is thus necessary for the primary school mathematics educator's continuing education. INSET will equip the primary school mathematics educators with the tools they require for their educational obligations.

The researcher is presently studying for a M.Ed degree in the Department of Teaching and Training at the University of Pretoria. The title of the research topic is: ***The In-Service Education and Training (INSET) needs of educators of primary school mathematics.*** The outcome of this research will not only benefit the primary school mathematics educators in KwaZulu-Natal but also those involved in the supervision of mathematics. In addition, the analysis of the responses to the questionnaire will also facilitate the evaluation and improvement of existing INSET programmes of primary school mathematics educators.

In order to ensure that the research is representative of a broad spectrum of primary school mathematics educators in KwaZulu-Natal the questionnaire should be completed by the senior primary mathematics educators of the school. Schools were selected in terms of a stratified random sampling procedure.

Thank you for your co-operation and the questionnaire is completely anonymous therefore names of respondents must not be furnished.

Please find enclosed a stamped self-addressed envelope which will be used to return the completed questionnaires. Completed questionnaires must be returned not later than 12 November 2001.

Once again your kind co-operation is sincerely appreciated.

R.NAIDOO
(Researcher)

Telephone: (031)9024534 (W)
(031)4623363 (H)

Appendix G

Glossary of terms used in the questionnaire

INSET - In-Service Education and Training courses, workshops, seminars and programmes for continuing education and professional development of senior primary mathematics educators

REQV - Relevant Education Qualification Value – refers to the criteria used in the Department of Education in evaluating qualifications for employment purposes

M+1 ($REQV_{11}$) - Matriculation plus one year of initial teacher training in senior primary mathematics

M+2 ($REQV_{12}$) - Matriculation plus two years of initial teacher training in senior primary mathematics

M+3 ($REQV_{13}$) - Matriculation plus three years of initial teacher training in senior primary mathematics

M+4 ($REQV_{14}$) - Matriculation plus four years of initial teacher training in senior primary mathematics

OBE - Outcomes Based Education incorporating the principles of Curriculum 2005

Appendix H

QUESTIONNAIRE: ***THE IN-SERVICE EDUCATION AND TRAINING (INSET) NEEDS OF PRIMARY SCHOOL MATHEMATICS EDUCATORS.***

SECTION A: PERSONAL PARTICULARS

Please tick the appropriate block.

1. Sex

M	F
O1	O2

2. Age

20-25	26-30	31-35	36-40	41-50	Over 50
O1	O2	O3	O4	O5	O6

3. Years of experience in the teaching of mathematics in the senior primary phase

1-5	6-10	11-15	16-20	21-25	26-30	Over 30
O1	O2	O3	O4	O5	O6	O7

4. Did you specialise in senior primary mathematics at tertiary level?

YES	NO
O1	O2

5. If YES, which of the following did you complete?

Diploma specialising in:	
Senior primary mathematics (M+1) ($REQV_{11}$)	O1
2 Year senior primary mathematics (M+2) ($REQV_{12}$)	O2
3 Year senior primary mathematics (M+3) ($REQV_{13}$)	O3
4 Year senior primary mathematics (M+4) ($REQV_{14}$)	O4
Other (Specify)	O5

6. Location of school

URBAN	RURAL
O1	O2

SECTION B: SCHOOL FOCUSED INSET

7. Who is responsible for the supervision of senior primary mathematics in your school?

PRINCIPAL	DEPUTY PRINCIPAL	HEAD OF DEPARTMENT	NONE
O1	O2	O3	O4

8. How frequently are senior primary mathematics committee meetings held?

WEEKLY	FORT-NIGHTLY	ONCE A MONTH	ONCE A TERM	ONCE A YEAR	NOT AT ALL
O1	O2	O3	O4	O5	O6

SECTION C: SCOPE, NATURE AND NEEDS FOR INSET

9. Rank in order of preference your reasons for the INSET of senior primary mathematics educators. 1 indicates the highest priority and 4 indicates the lowest priority

For self improvement in mathematics through networking with colleagues teaching senior primary mathematics	O1
Improve competency as a senior primary mathematics educator so that learners will perform better academically	O2
Need to be away from the daily routines of school	O3
Update knowledge of recent trends and changes in senior primary mathematics	O4

10. Did you attend INSET courses, seminars or workshops for senior primary mathematics educators at Circuit/District level?

YES	NO
O1	O2

11. If you have not attended any INSET courses, workshops or seminars for senior primary mathematics educators, rank the following reasons that would explain your decision.
1 is the most important and 4 is the least important.

INSET irrelevant/unnecessary	O1
Approaches, etc. generally not realistic	O2
Other commitments precluded participation	O3
Travelling to venues posed a major problem	O4

12. If you have attended INSET courses, workshops or seminars for senior primary educators, how relevant did you find them?

Not relevant	O1
Somewhat relevant	O2
Substantially relevant	O3
Highly relevant	O4
Extremely relevant	O5

13. When do you think INSET for senior primary mathematics educators should be offered?

During school hours	O1
After school hours	O2
During school vacations	O3
During weekends	O4

14. Indicate to what extent the following methods are used by you in the teaching of senior primary mathematics.

TEACHING METHODS	FREQUENTLY O1	OCCASIONALLY O2	RARELY O3	NEVER O4
Deductive or Expository Approach				
Inductive or Discovery Approach				
Outcomes Based Approach				

15. How often do you use teaching aids when you teach senior primary mathematics?

Frequently	O1
Occasionally	O2
Rarely	O3
Never	O4

16. Which of the following teaching strategies do you use when teaching senior primary mathematics?

Chalk and talk	O1
Games	O2
Groupwork	O3
Problem solving	O4

Thank you for completing the questionnaire.
Kindly post the questionnaire in the stamped, self-addressed envelope provided.