MOLEPO, JACOB MAISHA

THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

PhD UP 1997

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THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

by

JACOB MAISHA MOLEPO
PTC, DES, BPhil(Ed), MEd

submitted in partial fulfilment of the requirements for the degree of

PHILOSOPHIAE DOCTOR
(SUBJECT DIDACTICS)

in the

DEPARTMENT OF DIDACTICS
FACULTY OF EDUCATION
UNIVERSITY OF PRETORIA

SUPERVISOR
PROF J.G. MAREE

JOINT SUPERVISOR
PROF P.M. KACHELHOFFER

Pretoria April 1997

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- My Creator, for all the wisdom He gave me through this task.

---oooOooo---

THE LORD IS MY SHEPHERD

Psalm 23

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ABSTRACT

THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

by

JACOB MAISHA MOLEPO

DEGREE : Philosophiae Doctor (Didactical Pedagogics)

This research has established that the rural communities regard mathematics as an important subject that can play a role in developing them socio-economically. The project has revealed that the parents and teachers in the rural areas, together with former mathematics students concur on the value of mathematics in the job market. It is generally believed that students who passed mathematics at high school level or beyond are able to get employment with ease and contribute positively to the development of their communities.

The research has found significant interest of the involved members of the community in mathematics activities and policy formation in rural mathematics curriculum development. A need was expressed for urging rural parents and nurturing their interest in what and how their children learn in mathematics.

It was further revealed that a notable amount of awareness of mathematics in the rural environment exists which the rural people perceive and practice on a daily basis. There was a common feeling amongst rural people that this should be used as the basis for the development of abstract concepts which would be better understood by students.

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The attitude of the rural people toward mathematics was found to be positive and conducive for meaningful learning and understanding of mathematics. Teachers and parents were urged to foster this attitude as an important aspect in learning mathematics.

There is a correlation between the three factors that were perceived as influential ion the learning of mathematics in the rural high schools. It was revealed that parental involvement in mathematics activities correlates with the awareness of mathemaics in the rural environment and the positive attitude towards mathematics amongst the rural people. These three factors were regarded by the rural communities as significant for the role of mathematics in developing rural and tribal communities in South Africa.

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SUMMARY

THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

by

JACOB MAISHA MOLEPO

SUPERVISOR : Prof J.G. Maree

JOINT SUPERVISOR : Prof P.M. Kachelhoffer

DEGREE : Philosophiae Doctor (Didactical Pedagogics)

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The research has found significant interest of the involved members of the community in mathematics activities and policy formation in rural mathematics curriculum development. A need was expressed for urging rural parents and nurturing their interest in what and how their children learn in mathematics.

It was further revealed that a notable amount of awareness of mathematics in the rural environment exists which the rural people perceive and practise on a daily basis. There was a common feeling amongst rural people that this should be used as the basis for the development of abstract concepts which would be better understood by students. The attitude of the rural people toward mathematics was found to be positive and conducive for meaningful

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learning and understanding of mathematics. Teachers and parents were urged to foster this attitude as an important aspect in learning mathematics.

There is correlation between the three factors that were perceived as influential in the learning of mathematics in the rural high schools. It was revealed that parental involvement in mathematics activities correlates with the awareness of mathematics in the rural environment and the positive attitude towards mathematics amongst the rural people. These three factors were regarded by the rural communities as significant for the role of mathematics in developing rural and tribal communities in South Africa.

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SAMEVATTING

DIE ROL VAN WISKUNDE IN DIE ONTWIKKELENDE LANDELIKE EN STAMGEMEENSKAPPE IN SUID-AFRIKA

deur

JACOB MAISHA MOLEPO

STUDIELEIER	:	Prof J.G. Maree
ASSISTENT STUDIELEIER	:	Prof P.M. Kachelhoffer
GRAAD	:	Philosophiae Doktor (Didaktiese Pedagogiek)

Deur hierdie navorsingsprojek is vasgestel dat landelike gemeenskappe wiskunde beskou as 'n belangrike vak wat 'n rol kan speel in hulle sosio-ekonomiese ontwikkeling. Die projek het getoon dat ouers en onderwysers sowel as vorige jare se wiskunde-studente dit eens is dat wiskundige kennis besonder waardevol vir die arbeidsmark is. Dit is algemeen aanvaar dat leerlinge wat wiskunde op die sekondêre skoolvlak geslaag het, met gemak 'n werk bekom en dat hulle 'n positiewe bydrae tot die ontwikkeling van hul gemeenskappe lewer.

Die navorsing het gevind dat daar 'n betekenisvolle belangstelling by die betrokke lede van die gemeenskap is in wiskundige aktiwiteite, soos beleidsvorming vir landelike wiskunde kurrikulumontwikkeling. Daar was ook bepaal dat daar 'n behoefte bestaan om die plattelandse ouers aan te moedig en hul belangstelling te verkry om kennis te dra van die vakinhoude van wiskunde en die wyse waarop hulle kinders wiskunde leer.

Daar is verder aangetoon dat landelike mense merkbaar bewus is van die feit dat wiskunde 'n rol vervul in hul daaglikse gemeenskapslewe. Daar is 'n algemene gevoel onder hulle waargeneem dat hierdie wiskundige konsepte van die daaglikse lewe as basis gebruik moet word vir die leer van abstrakte

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wiskunde konsepte wat die leerders dan beter sal verstaan. Daar is verder gevind dat die houding van die landelike gemeenskappe teenoor wiskunde positief is en dat dit bydra tot die betekenisvolle leer en begryping van wiskunde. Onderwysers en ouers is aangemoedig om die positiewe gesindheid te ondersteun as 'n belangrike aspek vir die leer van wiskunde.

Daar is 'n duidelike korrelasie tussen die drie faktore wat as invloedryk beskou word vir die leer van wiskunde in die plattelandse sekondêre skole. Daar is aangetoon dat ouers se betrokkenheid by wiskunde-aktiwiteite korreleer met die bewustheid van wiskunde in die landelike omgewing en die positiewe gesindheid van die gemeenskap teenoor wiskunde. Hierdie drie faktore was deur die plattelandse gemeenskappe as betekenisvol vir die rol van wiskunde in die sosio-ekonomiese ontwikkeling van die landelike gemeenskappe en stamme in Suid-Afrika beskou.

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THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

LIST OF TEN KEY WORDS

1. MATHEMATICS
2. DEVELOPMENT
3. RURAL
4. COMMINITIES
5. ATTITUDE
6. SOUTH
7. AFRICA
8. PARENTS
9. TEACHERS
10. STUDENTS

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CHAPTER 1
INTRODUCTION AND ORIENTATION

1.1 INTRODUCTION

Mathematics, through the medium of science education, has emerged over a few decades as one of the most important subjects influencing the life patterns of black people in the world. Adams (Lewin, 1991:61) refers to science education in general, which includes mathematics, as follows:

> *The early 1960's and early 1970's witnessed massive science education reform activities aimed at a more utilitarian interpretation of Science Education for pupils in both developed and developing countries.*

Reys and Stanning (1988:26) also support this view and according to them:

> *Knowledge of mathematics is essential for all members of our society. To participate in our democratic processes and to be unrestricted in career choice and advancement, people must be able to apply mathematical ideas.*

The introduction of technology into the lives of many people has called upon their background of mathematics to cope with, and manipulate, technological instruments such as television and computers. The relationship between mathematics and technology is emphasised by Dowling and Noss (1990:24) who says that:

> *New technology is a powerful tool which opens up new areas of mathematics and changes the way in which society makes use of mathematics in the factory, office and home.*

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Many urban residents have, to a large extent, been able to come to terms with such a transformed life-style, because of the impact of mathematics teaching and learning in the urban schools since 1976. This emphasis on mathematical knowledge for social and economical advancement might, inter alia, have been prompted by the 1976 uprisings. These uprisings were concentrated in large townships such as Soweto and the East Rand.

Maree (1994:29) also refers to the relationship between mathematics and technological survival skills when he says:

> *Om die waarheid te sê, lê die wiskundige konsepte en vaardighede wat in die primêre skool onderrig word nie alleen die basis vir die aanleer van meer gevorderde wiskunde nie, maar voorsien dit ook die kind van oorlewingsvaardigheid ("survival skills") in ons tegnologiese eeu. Skriftelike werk verhoog die doeltreffendheid waarmee rekene gedoen word, veral met groter getalle, en voorsien 'n permanente rekord daarvan.*

Christiansen, Howson and Otte (1986:49) support the importance of mathematics as a foundation for advancement in technology by claiming that living a **normal life** at the close of the twentieth century, in many parts of the world requires everyday use of mathematics of some kind. It is also believed that the greater advancement of technology (for example advances in aircraft design and manufacture, space travel, use of computers, et cetera) is based on a high and difficult level of mathematics.

The 1976 uprisings were basically brought about by two factors. The first was the imposition of Afrikaans as a medium of instruction in schools for black people under the then Department of Bantu Education.

Mashabela refers to the language issue as follows:

> *When Soweto exploded on Wednesday, June 16, 1976, I was covering for The Star the local high school pupils' protest march,*

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called specifically to demonstrate against the medium of instruction in schools within the complex (1987: preface) and:

When W.C. Ackerman, director of Bantu Education in the Southern Transvaal region which included Soweto issued a directive late in 1974 compelling principals of schools and school boards who administered schools, to use Afrikaans as medium of instruction from the beginning of the 1975 school term, he could not have realised he was stirring an hornet's nest (1987:5) .

The second factor was the unfortunate killing of a Soweto student called Hector Peterson, by the police during the demonstration and described by Mashabela (1987:21) as follows:

Hector. It was Hector (Peterson); he was bleeding; and later at the clinic, Hector was certified dead, but Tiny (his sister) was not told. Instead nurses told women teachers who were also at the clinic, and the teachers asked her to take them to her home, where they broke the bad news to the family.

From this turning point, there was mounting pressure on the education authorities to focus their education provision on better facilities in the townships. The private sector and non-governmental organisations (for example, Urban Foundation), also joined the campaign for better education provision.

The whole exercise of providing better facilities to the urban townships was predominantly done to divert the attention and condemnation of the international community from squalid and embarrassing conditions most of the township residents and students were having to cope with. This was not enough to satisfy the increasing demand for better facilities. Many projects such as Star schools, Pace College and Shareworld were established in, for example, Soweto. Mathematics also received immense attention.

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The advantages of technological transformation and profuse provision of adequate resources enjoyed by urban black pupils were unfortunately not extended to their rural counterparts. The rural and tribal communities were left to their own devices to cope with the conditions and curricula that had been designed by urban dwellers, who disregarded or had no knowledge of the basic needs of the rural people. In this regard Smith (1984:13) says:

> *Whatever the lack of clarity about aims, approaches and methods of tackling the educational needs of rural populations, there has been a good deal of criticism of formal education systems in predominantly rural areas. Such charges as irrelevance, alienation and urban bias are common.*

Griffiths and Howson (1974:1) warned curriculum specialists that:

> *If they unite to produce a curriculum but neglect any of the four factors — the nature of the society, the nature of its children, the nature of its teachers and the nature of mathematics — then they are likely to produce something ill-balanced, irrelevant, or impossible to implement.*

The underresourcing of rural schools has also been a problem in countries such as the United States of America (USA). According to Reynolds, Greemers, Nesselrodt, Schaffer, Stringfield and Teddlie (1994:101):

> *The handful of studies and reviews that have looked at rural school effectiveness (for example Buttram & Carlson, 1993; Conklin & Olson, 1988; Lomotey & Swanson, 1990; Springfield & Teddlie, 1991) have identified two areas of differentiation between effective rural and urban schools, resources allocation and cohesiveness. Rural schools are, in general, characterized by scarcer resources than urban schools*.

Reynolds *et al.* (1994) also found that rural schools usually have smaller faculties or student bodies. These bodies are more culturally homogeneous and, therefore, more likely to be cohesive. However, the opposite of this is

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true of South African rural schools where different tribal communities have been forced together with little resources. Instead of smaller, more homogeneous and cohesive classes, the classes are huge and comprise different cultures which hamper cohesion.

This tendency has also been observed in other countries. According to Sher (1979:3):

> *Just as country roads have been routinely left off national maps, so too country schools have been routinely left off national agendas. Too many rural schools were allowed to fall into disrepair and their material resources became more and more meagre in comparison to metropolitan schools.*

Rural people have not been made aware of, and prepared for, the changing patterns of life, which need a sound basis of mathematical (or scientific) knowledge. Resources have not been adequately supplied to enable rural children to cope with mathematics on an equal footing with urban children. Rural children, as a result, perform poorly in mathematics.

Sher (1979:4) refers to rural community expectations as follows:

> *Thus over many years, a powerful cycle of negative and self-fulfilling prophesies about rural education became deeply entrenched in most OECD member countries* (like in South Africa — own insertion). *Low expectations led to inadequate attention and resources, which led to unsatisfactory conditions, which led to negative results, which led to lower expectations — and on and on the cycle went.*

1.2 MOTIVATION FOR THE STUDY

The research was urged by these factors:

- The poor performance in mathematics of students from rural and tribal communities.

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- The lack of proper facilities in the teaching and learning of mathematics in rural secondary schools.

- The use of teacher-centred approaches in the teaching of mathematics.

- The lack of parental or guardian involvement in the teaching/learning of mathematics in rural schools.

- The poor attitudes to mathematics in the rural schools, and its implications.

- The lack of career opportunities in post-matric life.

- The lack of adequately qualified mathematics teachers in rural schools.

1.3 STATEMENT OF THE PROBLEM

From the above, it appears that rural communities are not aware of the role mathematics can play in developing their lives to cope with the fast changing patterns of life, which are already being experienced by their urban counterparts.

There is, therefore, a need to explore the source of this complacency in rural and tribal communities.

There is a need to know what Standard 10 mathematics students, former Standard 10 mathematics students, teachers and parents of Standard 10 mathematics students think of mathematics as it is presently being taught and learned in rural schools. The research is an attempt to determine whether rural children and their communities share the same perception in respect of mathematics.

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Once such a common perception is established, it will be possible to determine how each of the components of the community (namely students, former students, teachers and parents/guardians) can utilize mathematics for technological and socio-economic advancement.

In this research the following aspects will be attended to:

- The relevance of some learning theories and learning or teaching models for mathematics as an agent for developing the rural and tribal communities in South Africa.

- The role of didactics in developing rural and tribal communities in South Africa.

- The relationship between mathematics didactics and the subject didactics of mathematics with special reference to the teaching/learning of mathematics in the rural and tribal communities in South Africa.

- Didactic principles and their application in the teaching and learning of mathematics with special reference to the role of mathematics in developing rural and tribal communities in South Africa.

In addressing the above aspects, there is a need to establish the perception of the components of the communities regarding the role of mathematics in developing their lives. There is therefore a need to clearly state a null hypothesis and other hypotheses. Such a null hypothesis and related hypotheses will focus the research on specific answers.

1.4 THE NULL HYPOTHESIS AND OTHER HYPOTHESES

Since the perceptions of the four selected components of the rural and tribal communities are sought, the following statement will serve as the null hypothesis:

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The present mathematics that is being taught in the rural high schools does not play an important role in developing rural and tribal communities in South Africa.

The null hypothesis is determined by the other three hypotheses stated below:

- The rural communities in South Africa do not have a positive attitude towards mathematics.
- There is no mathematical awareness in rural communities.
- The non-school rural communities should not get involved in decisions or activities pertaining to mathematics.

1.5 AIMS OF THE RESEARCH

In view of the fact that rural pupils in South Africa perform generally poorly in mathematics, as compared to their urban counterparts, it is imperative that new ways and means be found to direct the attention of education planners, administrators and curriculum developers to the need for the development of educational facilities in rural schools.

Strategies need to be found to improve attitudes, teaching methods and teaching facilities for the meaningful learning of mathematics and its utilization in students' post matric and community life.

In order to achieve this aim, the following objectives will be pursued in this study:

- To establish the **role** that mathematics can play in rural community life.
- To establish the general **attitude** to mathematics in rural communities.
- To identify the factors causing poor mathematics results.

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- To identify whether there are facilities for meaningful teaching and learning of mathematics in rural schools.
- To identify the influence of parents or guardians on the content and learning of mathematics in rural schools.
- To identify the role of the education department in the learning of mathematics in rural schools and the development of rural communities.

1.6 THE RESEARCH PROGRAMME

The objective of this investigation is an attempt to activate the role of mathematics towards a better life in the rural communities. This will be achieved by:

- The analysis of research already done by educationists, so that the role of mathematics in rural communities can be clearly defined. This analysis will assist the researcher in developing questionnaires that will serve to determine the extent of existing perceptions in rural communities concerning the role of mathematics in their lives.

- The development and adaptation of four questionnaires aimed at establishing the views on the role mathematics may play, or plays, in the lives of the rural Standard 10 mathematics students, ex-standard 10 students and their parents and teachers.

- Administering the questionnaires to the above mentioned groups.

- The analysis of the questionnaires received from Standard 10 students, former Standard 10 students and the parents and teachers of Standard 10 students statistically.

- Based on the analysis, determine the role of mathematics in rural communities in South Africa for socio-economic development.

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- Make recommendations based on the analysis of the questionnaires to various stakeholders in curriculum or educational planning.

1.7 DEMARCATION OF FIELD OF STUDY, ASSUMPTIONS AND LIMITATIONS

The respondents in this project involve the Standard 10 pupils, who were doing mathematics at rural high schools in 1994 under the Department of Education, as well as former students of the same schools who were doing mathematics; parents and teachers of the current Standard 10 students. The study will concentrate on schools which are found in typical rural villages within a twenty kilometers and fifty kilometers radii from the centre of Pietersburg City.

Schools in townships, which also fall under the former Lebowa government will not be considered, because they are closer to the town's technological influence, which may have a different or misleading bearing of a semi-urban nature on the research.

The reason for choosing Standard 10 pupils is because they are completing a formal school career. Some will soon be expected to be assimilated into the socio-economic environment of the labour market. Others are expected to move into institutions of higher learning. They are matured enough to understand why and how they learn or learned mathematics in schools.

This investigation is based on the following assumptions:

- That students in Standard 10 will respond without bias or prejudice to the questionnaires they have to complete. That they will fill in the questionnaires independently of their colleagues or anybody else, except for the personal explanations offered by the researcher when required to do so.

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- That ex-standard 10 school leavers should respond without bias or prejudice to the questionnaires they have to complete and that they will do so independently of their friends or whoever it may be, except the researcher for explanation of some concepts when required to do so.

- That teachers will complete the questionnaires without bias or prejudice. That they will do so independently without the involvement of their colleagues nor seniors and juniors.

- That parents or guardians will complete the questionnaires without the involvement of anybody else except the researcher when offering assistance to explain certain concepts, where necessary.

- That all the respondents mentioned above will honour the plea made in the questionnaires to answer the questions without discussing it with anybody else.

1.8 DEFINITION OF TERMS

Each of the terms constituting the topic in this research is defined as follows:

1.8.1 ROLE

This is defined as *a person or thing's characteristics of expected function* according to the Readers Digest Oxford Wordfinder (1993). By **role** the researcher refers to the function that mathematics will serve as a mechanism through which a change may be influenced or effected.

1.8.2 MATHEMATICS

The word mathematics has been defined in many different semantic and syntactic patterns. The definitions given below tend to embrace, in a general sense, all the complex definitions which have been given since its introduction

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as a subject that covered and replaced arithmetic and other related fields, which used to be emphasized prominently in the school syllabus. The complexity of defining mathematics is best described by Temple (1981:2) when referring to the need to engage in creative thinking when solving different problems. He states that:

> *Each question requires for its solution a fresh exercise of that kind of creative imagination which we call mathematical abstraction. There is no general paradigm or algorithm to direct and guide our thought. At each stage in the advance of mathematical thought the outstanding characteristics are novelty and originality. This is why mathematics is such a delight to study, such a challenge to practice and such a puzzle to define.*

The author goes further to refer to attempts made to define mathematics by some notable scholars as far back as in the nineteenth century and at the beginning of the twentieth century. First there is the definition, boldly proposed by Peirce (1881) that mathematics is the science which draws necessary conclusions and more explicitly formulated by Russel (1903:3) that:

> *... pure mathematics is the class of all propositions of the form "p implies q", p and q being carefully specified.*

It was indeed the purpose of Russel's treatise to provide a complete, exact and convincing justification of this definition, and the author employed all his encyclopedic knowledge of the philosophy of mathematics, all his powers of acute and rigorous reasoning, and all the charm of his lucid and persuasive style to achieve this object.

> *The word mathematics comes from the Greek word "mathemike" which means the systematic treatment of magnitudes, relationships between figures and forms and relationships expressed symbolically.*

The Readers Digest's Oxford Wordfinder defines it as the abstract science of number, quantity and space studied in its own right. According to the definition stated by the School's Council (Orton, 1987:83), mathematics is:

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... a discovery of relationships and the expression of the relationships in symbolic (or abstract) form. This is no static definition, but implies action on the part of the learner, of whatever age and whatever ability. It is the fact that mathematical relationships can be discovered and communicated in such a variety of ways that puts mathematics within reach of children and adults of all abilities.

1.8.3 DEVELOPING

This is a continuous form of development. Development is a verb meaning to bring about an instance of being different. Therefore developing here means bringing about a different form. To bring about an alteration in order to become better.

1.8.4 RURAL

It is defined as in the country, of the country or suggesting the country. It basically refers, in South Africa, to an area out of urban, sub-urban or peri-urban locality. It further suggests underdeveloped and without facilities enjoyed by towndwellers.

1.8.5 TRIBAL

The word is derived from tribe, which refers to a group of families (especially primitive) or communities, linked by social, economic, religious or blood ties, and usually having a common culture and dialect, and a recognised leader. One may further say that usually the leader is called a chief or induna. For the purpose of this research the word **tribal** will from time to time, be left out and only **rural** used, as all tribal groups are always found in rural areas.

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1.8.6 COMMUNITIES

According to the Oxford Wordfinder (1993), community refers to all the people living in a specific locality. A clearer definition of community is offered by Mitson (in Fletcher & Thompson, 1980:102):

> *Community implies a group of people sharing together, despite many individual differences in a common major purpose.*

The most important and common denominator in the community is the concept of sharing, as may be seen in the description of community given by Toogood also in Fletcher and Thompson (1980:155):

> *The problems of society today can only be solved when the society has become a community. Community occurs where a common predicament is shared. Sharing requires sympathetic understanding which in turn is the beginning of wisdom or the desired end of education.*

1.8.7 SOUTH AFRICA

It is a country found at the southern end of the African continent. It is a country that used to be ruled by a white minority government. The population is formed by heterogeneous groups scattered across nine provinces namely: Northern Cape, Northern Province, North West, Gauteng, Mpumalanga, Eastern Cape, Kwazulu-Natal, Western Cape and Orange Free State. The country is undergoing a radical political, social and economic transformation, whereby all racial groups have equal status, in all mechanisms of day to day administration. The turning point for this latest democracy was the all-inclusive elections held on 27 April 1994 which were conducted in this country. This study focuses on South Africa.

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1.9 RESEARCH METHODS USED

This study will be conducted by obtaining information from the following sources:

- Published material
- Unpublished material such as dissertations and theses
- Syllabi, bulletins, magazines
- Questionnaires

- **Published material**
  Books, articles, periodicals and journals in mathematics and curriculum studies will be used to clarify the role that mathematics play in developing the life patterns of the rural communities in South Africa.

- **Unpublished dissertations and theses**
  These will be consulted in order to ascertain which research has already been done in a similar field and has relevance for this specific study.

- The findings of the research will be discussed and formulated into a coherent conclusion. Recommendations based on the findings will be made for the improvement of the teaching and learning of mathematics so that it will play a positive role in developing rural and tribal communities in South Africa **(chapter seven)**.

Finally, a summary of the thesis with an overview of the research, will be given **(chapter eight)**.

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CHAPTER 2
RELEVANT LEARNING THEORIES AND LEARNING/TEACHING MODELS

2.1 INTRODUCTION

Every subject found within the school curriculum has its unique features and perspectives. Its content determines a particular volume of knowledge explaining a particular field of perceptions. It is this unique feature which distinguishes one subject from another within any curriculum package.

According to Pratt (1980:4) a curriculum is:

> *... an organized set of intentions, which articulates the relationships among its different elements (objectives, content, evaluation, et cetera), integrating them into an unified and coherent whole.*

Skilbeck (1984:31) broadens this view by acknowledging Hirst's argument on the definition of curriculum when he says that:

> *... a liberal or general education should be grounded in systematic study of clearly defined areas of knowledge; not subject necessarily, but domains individualized and differentiated by (i) concepts; (ii) logical structure or propositions; (iii) criteria for truth.*

In mathematics, content differs from the content of other subjects such as history. But it is also important to note that some concepts within a subject may be used to explain concepts in other subjects for example, numbers are borrowed from mathematics to describe a certain historical period, for example, 1652 is a number associated with the year that Jan van Riebeeck came to South Africa.

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A common denominator of all school subjects in a curriculum is the system through which they are learned or taught. Holt (1980:53) observes the following in this regard:

> *... the curriculum must be seen neither as a seamless robe fashioned by the child from his own undirected experiences, nor as a patchwork quilt of separate subjects, each viewed as a distinct specialist without regard for a concept of general education. It must offer both unity and variety; it has shape and purpose yet it must provide a range of learning experiences which meet the varying responses of pupils and at the same time, reflect an underlying rationale which can articulate them into a coherent whole.*

Most learning theories may be successfully used when certain subjects are taught or learned. Teaching and learning models may also be used to teach different subjects. In this chapter some teaching and/or learning theories and models will be investigated to discover the relevance they have for the role of mathematics in developing rural and tribal communities in South Africa. It has been hypothesized by many psychologists that for meaningful learning to take place, selected learning theories need to be applied in the classroom. In this regard Mokhaba (1993) stresses that:

> *Understanding the theories about how pupils learn and the abilities to apply these, especially to the learning of mathematics, are important prerequisites for effective mathematics learning.*

It is important to realize that the various theories available for the meaningful understanding of mathematics, have equal value. None is necessarily better than the other and may therefore be used in combination or conjunctively. Swenson (1980:9) illustrates the commonality of learning theories by saying:

> *As theories are modified to prevent direct contradiction by data that does not fit the theorist's original concept, they tend to lose the special clear insight of their developers and become diffuse and*

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complex. The result of this process is that theories tend to become more and more like one another while retaining their specialized systems languages, or jargon.

Mokhaba (1993) also points out, in this regard, that:

The different theories of learning should not, however, be viewed as a set of competing theories, one of which is true and the others false. Each theory can be regarded as a method of discovering, organizing and studying some of the many variables in learning, and, therefore, in intellectual development. Teachers can select and apply elements of each theory in their particular classes.

Learning theories are the tools available to the teachers to guide them to select relevant teaching methods in their lessons. Theory and practice should go hand in hand, as Curzon (1985:7) points out:

Teorie en praktyk beweeg hand aan hand en teorie kan inderdaad as 'n "gedistilleerde praktyk" beskryf word.

Fortenelle (in Mokhaba, 1993) reminds us that:

... to despite theory is to have the extensively vain pretension to do without knowing what one does, and to speak without knowing what one says. Indeed, the practical teacher, like all other professional workers, cannot escape the pervasive nature of theory.

These mentioned statements are all applicable to the whole of South Africa which includes the rural and tribal communities. Though some learning theories may be easy to apply in rural and tribal schools, others may be difficult. This may depend largely on environmental factors. Rambaran (1989:378) supports this view and states the following:

This research has indicated that there is a close relationship between performance in mathematics and the pupils environment.

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The following teaching and learning theories may serve as a source for guidance when selecting proper methods in order to prepare learning packages in mathematics in rural and tribal schools.

2.2 LEARNING THEORIES IN MATHEMATICS

2.2.1 PIAGET

The theory that was advocated by Piaget (1966) is based on a child's mental development. According to Piaget, learning is categorized according to the stages of development from birth to adulthood. Mokhaba (1993:152) explains this as follows:

> *Concerning children, Piaget has identified four distinct stages of cognitive development. He found that these stages correspond to ages.*

2.2.1.1 **Sensori-motor stage (0-2 years)**

In this stage the child depends more on motor and instinctive tendencies for assimilation of experiences. The child develops mentally, physically, emotionally and spiritually owing mainly to all the sensori-motor activities which he/she undertakes. No form of organized teaching or learning may take place at this stage.

2.2.1.2 **Pre-operational stage (2-7 years)**

In this stage some form of teaching takes place, though the cognitive stage of the chid is dependent on symbolization. The child is able to associate certain symbols with some concepts, though at this stage there is an incapability of reversing actions. According to Schminke, Maertens and Arnold (1978:4):

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> *The thinking of the pre-operational child is also characterized by an inability to reverse actions mentally.*

The child has not yet reached a stage where he/she may engage in operational thought.

2.2.1.3 **Concrete operational stage (7-11 years)**

This is the stage where the child is capable of reversing concrete situations and some abstract concepts. The child's thinking is still limited to physical objects that exist around him/her. Hudson (1986:74) describes how the child behaves in this stage:

> *Thus while they (children) are experiencing physical forms of communication, their conception about the world becomes increasingly accurate and sophisticated. This is because they think about objects in terms of the properties and possibilities of these objects with which they busy themselves. They classify, consider possible relationships, discern quality and quantity, and apply these mentally and physically.*

In this stage learning takes place but it's mostly limited to the less abstract ideas.

The implication for the teacher is that there is a need for a well organized teaching model in which teaching/learning media are used. These will enhance the understanding of the various concepts that will be involved. Local objects and various forms of concretization will be necessary to make pupils understand concepts easier.

For the rural and tribal school mathematics teacher, the use of objects from the rural environment will develop a sense of acceptance of mathematics as a subject that also belongs to the rural community. This is the stage where

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ethnomathematics plays an important role in the development of mathematical concepts, because the vehicle through which mathematics is taught bears relevance and familiarity, which may in turn maximize comprehension of the subject.

2.2.1.4 **Formal operational stage (11+ years)**

At this stage the child has reached the final cognitive developmental stage. It is the stage where the child is able to engage in the testing of abstract hypotheses.

While the association of ideas and concrete environment may still be important in this stage, the child can now think abstractly without the need for concrete objects. The child is able to solve problems and engage in independent manipulations. London (1988:88-89) summarizes this stage by saying that the children are:

> *... able to read with abstraction, form hypotheses, solve problems systematically, and engage in mental manipulation.*

The implication for the rural and tribal teacher is that an association of the previous stage and this stage should be maintained. This will help to develop a sense of the importance of mathematics to the environment of the child. Subsequently the abstraction of mathematics and its complex hypotheses have some value for the environment of the child and his/her community. The rural openness and its natural complex beauty will be seen as having a stronger and concomitant relationship with the natural rules and complexities that characterize mathematics. Such associational development of mathematics with the beauty of nature has influenced great mathematicians such as Pythagoras. This relationship is illustrated by Smith (1951:73) when he says that:

> *Aristotle (384-322 B.C.) tells us that Pythagoras related the virtues to number, and Plutarch says that he believed that earth was*

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produced from the regular hexahedron, fire from the pyramid, air from the octahedron, water from the icosahedron, and the heavenly sphere from the dodecahedron, in all of which the physical elements are related to number and to form.

2.2.2 BRUNER

Bruner is one of the great contributors in the field of learning theories. His work has established itself in learning through participation and by discovery. This idea is summarized by Mokhaba (1993:142) when acknowledging Dean's work:

> *Participation through learning by discovery is one of the important aspects of Bruner's belief.*

This theory addresses itself to the need for learners to think logically, systematically and creatively. According to Gagné *et al.,* (1992:63):

> *When minimal amounts of learning guidance are provided, instruction is said to emphasize discovery on the part of the learner.*

Reigeluth (1983:27) also supports this assertion by acknowledging Bruner's theory:

> *Bruner developed a model of instruction based on discovery methods and stages of intellectual development (Bruner, 1960), and he was among the first to talk about forming a theory of instruction.*

Bruner has summarized his theory of participation and not rote memorization in the following words, quoted by Hollis and Houston (1973:42) in Mokhaba (1993:143):

> *... to instruct someone in these disciplines is not a matter of getting him to commit the results to mind; rather, it is to teach him to participate in the process that makes possible the establishment of*

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knowledge. We teach a subject, not to produce little living libraries from the subject, but rather to get a student to think mathematically for himself ...

Bruner's theory may be viewed in the following four ways with regard to the learning of mathematics:

2.2.2.1 **The Construction theorem**

This theorem revolves around the fact that for meaningful learning to take place, replicas of a concept may be studied first. In other words this theorem suggests that the concrete world should be used in order to study the abstract world. There is therefore a strong relationship between the concrete operational stage, according to Piaget's developmental stages theory, and Bruner's construction theorem.

According to this theorem, learning takes place through the construction of a representation of a principle or concept in order to understand it. This theorem is best summarized by Reigeluth (1983:316) when he says:

Whenever the actual object, event, or symbol is not involved one must be concerned with the question of fidelity. Fidelity means the degree of correspondence between the actual object, event or symbol and its representation.

2.2.2.2 **The Notation theorem**

Bruner suggests that the simplest form of notation for representation should be used. Complicated forms of notation, particularly in mathematics, should be systematically and efficiently developed in order to allow a systematic development of principles and general rules and abstract concepts. This aspect of learning is clearly summarized by Mokhaba (1993:145):

Bruner's notation theorem states that early constructions or

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representations need not be complicated, but can readily be made cognitively of a simpler structure. As a result they can be better understood by pupils if they contain a notation which is appropriate for the pupils' level of mental development.

The implication of this theorem for the child in the rural area is that the teacher must make sure that notations representing constructions should represent the environmental background. This will help ensure that learning develops a flavour that is compatible with the background and experiences of the child. The child should be encouraged to participate in selecting notational representation that will best represent mathematical concepts which the child wishes to acquire, such as for instance in the language of sets. A particular sheep may be shown as an element (ϵ) of the flock of sheep belonging to Matome. This may be given as Saϵ Mf, meaning sheep A is an element of Matome's flock. This may be developed from concrete form through a construct and notation theorem to a more abstract conceptualization of a mathematical concept.

This requirement is best summarized by Parot as quoted in Mokhaba (1993:145) when he says that pupils should have a say in:

(i) *creating and selecting notational representations for mathematical ideas;*

(ii) *formulating simpler and more "transparent" notations which should be used when concepts are being learned by young pupils.*

2.2.2.3 **The Contrast and Variation theorem**

This theorem states that for a child to understand concepts or representations, they should be compared with one another to discover the similarities and commonalities. They should also be contrasted with one

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another to discover differences and dissimilarities. Such similarities and variations will help the learner to develop a systematic relationship that will in turn vivify the concept or set of concepts that are to be learned or arouse more curiosity. Concerning this Flemming and Levic (1993:7) state the following:

> *In contrast, epistemic curiosity is aroused by a perceived gap or incongruity based on the characteristics of a stimulus and a person's existing knowledge or expectations. When epistemic curiosity is aroused a person is motivated to seek more information to resolve the incongruity.*

The implication of this theorem for the rural teaching and learning situation in mathematics is the wealth of natural ideas and beauty available in the open rural world to be used to represent ideas in mathematics. Such ideas may be contrasted and varied to understand the existing relationships. They could form the basis for a stronger and more meaningful mathematical concept development.

2.2.2.4 **The Connectivity theorem**

In this theorem Bruner argues that relational connections exist amongst all the systems of the mathematical field. One area of mathematics is in one way or another related to the other areas. These connections or relationships should be strengthened to develop a more holistic approach towards the teaching and learning of mathematics. The usefulness of every branch of mathematics is better understood if it is taught or learned in relation to the other areas of mathematics. Each branch should be seen in a "network" or "city-highway interchange" relationship perspective. The importance of this theorem is best summarized by Mokhaba (1993:146) when he says that:

> *... there is a dire need for the mathematicians to engage in research in order to establish relevant connections and relationships among*

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> *mathematical structures. Not only are connections important for progress of mathematics; awareness of connections is equally important in learning mathematics.*

The implication of this theorem for rural children in learning mathematics is that concepts should be associated with the usability for practical situations in the community and how other areas of mathematics contribute in sustaining such usability or improving it. In, for instance, building a bridge across the river, an aspect of "land survey mathematics" needs to be applied using Pythagorean concepts and a plumb-line.

2.2.3 DIENES

Dienes has emerged as one of the notable constructivistic mathematical psychologists in modern mathematics teaching and learning. He experimented both extensively and intensively in developing systems of learning through which the child manipulates objects in order to develop concepts and understand them. According to Mokhaba (1993:132), Dienes:

> *... regards the learning of a concept as a creative art which cannot be explained by any stimulus-response theory such as proposed by Gagné's stages of learning theory.*

His theory emphasizes the use of objects and games in the teaching of mathematics. He believes in the active engagement of the learner in the process of the learning programme by playing with objects and playing games which have been systematically provided and arranged by the teacher to ensure an intuitive learning outcome.

His theory is divided into six different stages of participation in the teaching/learning procedure in mathematics, (Mokhaba, 1993:133) as Bell postulates them:

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1.	*Free play*	*2.*	*Games*
3.	*Searching for commonalities*	*4.*	*Representation*
5.	*Symbolization*	*6.*	*Formalization*

The stages are briefly described as follows:

2.2.3.1 **Free play**

During this stage the learning activities do not have any systematic pattern. Pupils are just engaged in the manipulation of such activities. Experiments are conducted by the learner and he/she discovers various elements of concepts that have to be learned.

Rey and Post (1983:40) in Mokhaba (1993:134) state that during this stage the learner: *... interacts directly with physical materials within the environment. Different embodiments provide exposure to the same basic concepts, but at this stage commonalities are observed.* According to Mokhaba (1993:134) at this stage:

> *... pupils form mental structures and attitudes which prepare them to understand the mathematical structure of the concept.*

2.2.3.2 **Games**

After going through the free play stage, pupils start to realize that there are patterns and rules which govern certain events. Such rules and patterns are followed in activities focused on games. Bell (1987:125) shows how important games are in the teaching and learning of mathematics:

> *Games permit students to experiment with the parameters and variations within the concept and to begin analyzing the mathematical structure of the concept. Various games with different representations of the concept will help students discover the logical and mathematical elements of the concept.*

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2.2.3.3 **Searching for commonalities**

The importance of this stage is that pupils look for common properties in concepts. The games help them to trace these properties and their applications. These properties become a valuable mechanism for sorting (for example, sets); classification (for example, geometric figures) and contrasting (as in Bruner's theory of contrast and variation).

2.2.3.4 **Representation**

The need for the representation of the concept arises once the pupils have managed to trace commonalities. Such a representation may be provided by the teacher. Such a representation may include, inter alia, *... a diagram, a verbal representation or an example*, according to Mokhaba (1993:135).

2.2.3.5 **Symbolization**

Verbal and mathematical symbols become necessary once the pupils are able to make representations of concepts derived from the games. Pupils should be encouraged to make their own symbols to represent their ideas before correct symbols are made available or accessible to the pupils. According to Mokhaba (1993:136):

> *It follows naturally that the teacher will thereafter have the pupils compare their symbolisation with those in the textbook.*

2.2.3.6 **Formalization**

This is the final and advanced stage in the learning of mathematical concepts. It is the stage where proofs, refutations and axioms in mathematics can be formulated. Application of properties and commonalities acquired can now be effected through construction and analysis, to name but a few.

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The implications of Dienes' work to the rural and tribal children in mathematics are multivaried:

(a) Natural environment

It is a theory that may be used to explore the vast number of natural properties existing in the natural environment of the child, for example tree leaf arrangements. Smith (1951:4) reminds us of the vast presence of mathematics in plant life by saying:

> *It needs only the most casual observation to show the presence of mathematical forms in plant life. They appear for example in phyllotaxy, or leaf arrangement, of plants; in the regular polygons in the structure of the pineapple; the breadfruit, and the watermelon; and in the Golden Section of the fern, the ivy, and other leaves.*

He (Smith) goes on to suggest how mathematical properties may be extracted from nature by saying that:

> *... such considerations naturally lead us to speculate on the causes that led certain leaves, millions of years ago, to arrange themselves about a stalk in obedience to the law of series first expressed by Leonardo Fibonacci in the 13th century. Objects of free play may not be bought but are abundantly available in the rural environment of the child.*

(b) Traditional games

Various traditional games played by rural children may be used to develop a typology of suitable games for the establishment and acquisition of mathematical properties and principles, for example, the geometric weaving of a skipping rope with a pattern, but made from shrub branches.

(c) Mathematical acquisition

A stronger association of mathematics and the rural natural splendour can

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develop and may form the basis for a more meaningful and purposeful, as well as insightful, mathematical acquisition.

(d) Abstract concepts

Abstract concepts develop out of a simple and less expensive and less stressful learning environment.

A combination of the various stages and aspects of learning described above will be a sensible basis necessary in the teaching of mathematics. Such a combination approach constitutes the constructivist approach. This approach is characterized by predominant involvement of the learner in the manipulation of learning opportunities made available by the teacher in or outside the classroom. The teacher offers the necessary support and challenges. According to Mokhaba (1993:167) this approach has the following perspective:

> *From the constructivism perspective, knowledge originates in the pupils' activity performed on objects. In other words, the pupil learns as he/she is actively engaged with the mathematics subject matter, he/she is simultaneously constructing or giving meaning to his/her mathematical experiences.*

This approach is also referred to by the Open University Course as Developing Mathematical Thinking. This programme is described by Gordon (1989:5) as follows:

> *An important principle of the Open University programme is that pupils are introduced to mathematical language via their everyday activities and spoken language. In other words, pupils are introduced to abstract mathematical symbolism by talking about the concrete representations of those relationships, first with the instances they are familiar with and then with aids, structured to illustrate mathematical relationships.*

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The importance of the role played by the environment during the process of knowledge acquisition or learning is shown by Maree (1992:62) when referring to Piaget (1973:703), who says:

> *Kennis en intelligensie ontstaan nóg by die leerder nóg by die omgewing, maar wel by die interaksie tussen die twee.*

2.5 THE IMPLICATIONS OF LEARNING THEORIES FOR THE RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

It is important to note that learning theories have been developed with an eye on the average child from a mathematically sound environmental background. The rural and tribal environment may pose a different mathematical learning problem as factors and perceptions inherent in such rural and tribal communities towards curriculum design may be of a different nature. Therefore the following implications may be of relevance to rural and tribal communities in South Africa in mathematical learning:

- The mathematical knowledge offered to children should go hand in hand with their developmental process and epistemological development.

- The background of the children in rural areas should be the starting point of abstract concept development.

- The beauty and mathematical abundance of nature should always have a balanced relationship with what the children are expected to learn in mathematics.

- The tradition and culture of such children may be fully explored to discover the unrecognized and subtle mathematical wealth as a basis for the discovery and formalization exercises in learning.

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- All learning theories may be conjunctively and collectively harnessed to develop into situations of mathematical learning that will encourage insightful understanding of concepts.

2.6 TEACHING AND LEARNING MODELS

Teaching and learning models in mathematics provide the important tools that have to be acquired for use by every teacher. Teachers in rural and tribal schools also need to have knowledge and understanding of some of the models. This may help to design lessons with a more relevant approach to the teaching and learning of mathematics in the rural areas. Various learning models have been experimented with and proved to be of use in the teaching and learning of mathematics. A few models, which the researcher believes will have considerable relevance for rural situations, are subsequently discussed.

2.6.1 INQUIRY MODEL

This model focuses on inquiring. It is a model in which a question is formulated or facts arranged in such a way as to formulate a general principle which in the end is to be scrutinized until it answers the question "why". Post (1992:38) summarises this model as follows:

> *Inquiry is a process of framing questions, gathering and processing data relevant to those questions, and drawing inference or conclusions about the data. In mathematics, the inquirer emulates the behaviour of the mathematician. The enquirer learns to value evidence, to think rationally and to produce new (at least to the enquirer) knowledge.*

Mokhaba (1993:181) states that Bell (1987) has identified the following four steps in this model:

1. *In the first step a question is formulated or mathematical*

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facts, concepts, principles arranged into an all-embracing and general principle.

2. *The second step is concerned with the collection of relevant information for solving the problem under consideration.*
3. *The third step is where the information gathered helps to broaden and organize the existing knowledge of the pupils.*
4. *The fourth step is where analyses and evaluation of the process of inquiry takes place.*

The implications of this model for the rural and tribal children in mathematics teaching and learning are:

- The child is actively involved in the process of solution-seeking.

- The information required may involve material from the child's environment (rural) which in itself has more meaning to him/her.

- The generally untapped rural and tribal wealth of ideas may be used as the basis for complex mathematical situations (for example the Ndebele traditional wall painting may have an intriguing enquiry basis in tessellation, for instance). This notion is further supported by Post (1992:38) when he says that:

  ... inquiry takes students and teachers beyond the textbook into problem-solving investigations which may also involve the classroom, the school and the community.

2.6.2 PROBLEM-SOLVING MODEL

In this model the class may be given a problem in which they have to solve using the skills which they will have acquired from the teacher. Klein

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(1991:310) views a problem-solving strategy[1] as taking the following procedure: *After the problem has been defined, the next step is to develop a plan of attack. There are two major strategies — algorithms and heuristics — that can be used to solve problems.*

- **Algorithm**: This is where the teacher teaches pupils a precise set of rules which may be used to solve the problem, while in heuristics pupil's guessing is used though the problem may not always be solved.

- **Heuristics**: Heuristics may be used in various rural situations where games of guessing may be used. Such games may have some mathematical value if properly planned. Algorithms may also be used with examples related to the background of the children.

2.6.3 THE GROUP PROCESSES MODEL

This model, sometimes referred to as discussion model, concerns itself with the situation in which ideas are exchanged amongst the pupils and their teachers. Pupils interact with fellow pupils and with their teacher while they are working on a specific task. According to Mokhaba (1993:185) this model:

> *... is an attempt to turn the classroom into a place where there is free cross-pollination of ideas amongst pupils and between mathematics teacher and pupils.*

Gagné (1992:291) explains this further by saying: *Instruction that takes the form of discussion is said to be characterised by an interactive communication* (Gall & Gall, 1976), while Post (1992:36) adds by saying:

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1 This is defined in more detail in Chapter 6, par. 6.5.3.36 and 6.5.3.37.

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> *Class discussion can be a very meaningful mathematics teaching/ learning strategy. It is a direct teaching strategy because the teacher is responsible for structuring the flow of the interaction and for directing the students involvement and participation.*

Gagné (1992:282) indicates how this model may be used through problem-solving:

> *Problem-solving is also a commonly adopted goal for discussion groups.*

To the rural teaching and learning of mathematics this model could have the following values:

- Students do not rely on the teacher's experiences only, but also on the experiences of their fellow students.

- The students' rural and tribal background may be developed into a mathematical problem in which each student has a chance to combine his experience with those of others in order to seek a joint solution.

2.7 SUMMARY

The learning theories and teaching and learning models that have been discussed in this chapter are not the only ones available and suitable for the rural and tribal mathematics teaching and learning situation. However, they have been selected as the ones with a more direct rural and tribal learning relevance. If effectively utilized in planning mathematics lessons, these may have a much more effective learning outcome. They represent some of the most commonly known and positively tested theories which the rural mathematics teacher is expected to know. This assumption will be tested

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in chapters five and six when questionnaires will be distributed to rural and tribal high school teachers.

Taking the learning theories and teaching/learning models one step further, it makes sense to focus on didactic principles of teaching and of teaching mathematics and are discussed in chapter three.

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CHAPTER 3
RELATIONSHIP BETWEEN DIDACTICS, SUBJECT DIDACTICS AND THE SUBJECT DIDACTICS OF MATHEMATICS

3.1 INTRODUCTION

In the preceding chapter the researcher has concentrated on the role that is played by some teaching and learning theories and some teaching models in the teaching of rural children, with special reference to mathematics. For one to understand how children learn mathematics, through the application of whichever theory, as discussed already, one needs to understand teaching and the theory of teaching. This brings forward the need to discuss the concepts of didactics, subject didactics and the subject didactics of mathematics.

Each of the three concepts will be discussed separately to understand what it is, to understand its structure (content) and its role (purpose or aim). The relationship each has with the rural and tribal child's learning, will also be shown. After the discussion of each, the author will attempt to show the relationship of each with the other, and later the interrelationship with one another.

3.2 DIDACTICS, SUBJECT DIDACTICS AND SUBJECT DIDACTICS OF MATHEMATICS

3.2.1 DEFINITIONS

3.2.1.1 Didactics

The word didactics is said to be from the Greek word "didaskein", which according to Van der Stoep and Louw (1984:29) means:

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... to teach, to offer content or impart knowledge; to teach in order for another to learn.

Van der Stoep and Louw (1984:29) define didactics in broader terms as follows:

Didactics is therefore the scientific study of the teaching activity, that is the theory concerned with teaching.

According to these authors, didactics can, in the broadest sense, be described as:

*... the theory of the concept **teaching**: it examines the conditions basic to effective teaching, the general principles that should be taken into account; the various forms that teaching activity can take; the methods relevant to teaching; the relationships existing between teaching and learning the meaning of teaching content; the ways in which teaching content can be organized; what the concept **school** actually comprises and how it is seen in general educational terms; and, should the teaching activity fail in its orthodidactic (correcting) programme.*

Louw (1992:70) takes this definition a step further:

*Didactics therefore indicates the teaching activity (of the adult teacher) and the learning activity (of the child-pupil). Not only does the concept **didactic** include these two activities, it also suggests the interrelatedness of the activities and in this sense, it reflects more accurately what actually takes place in the situation.*

Duminy (1980:10) argues that there is **lack of precision** in the definition of didactics. Didactics has commonly been confused with **teaching** by many researchers. Duminy argues that:

... it is commonly understood to refer to teaching or instructing. But its meaning is sometimes restricted to methods of teaching.

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This confusion may be corrected by looking at teaching as being an integral part of didactics. Teaching on the one hand, is regarded as an activity through which the learner (child) learns. Teaching in this sense is an operation in itself. The results are measured after the operation has been performed. Teaching may further be regarded as the vehicle through which the learning theories, some of which were discussed in the previous chapter, are applied or put into motion.

On the other hand, according to Louw (1992:3), didactics is: *everything to do with teaching and learning.* It is not only concerned with the teaching activity but also with the planning of such activities (called methods of teaching, selection of learning content, understanding learning and its application). It is broader than teaching itself because it takes into account both the stimulus and the desire to learn (response) which are the causes of the need to be taught. It looks more deeply into the mechanics of teaching and the dynamics of learning. It answers the three basic questions: what to teach? whom to teach and how to teach? In other words, it determines whether the subject matter selected is suitable for the child in question. If so, whether the method or group of methods selected will help the child to learn the content successfully. This view is supported by Degenaar and McFarlane (1982:4) when they say:

> *The terrain which is denoted by the term Didactical Pedagogics is therefore the teaching (instructional) activity of an adult and learning activity of the child in an educational (pedagogical) situation. The terrain can also be described as the teaching-learning activity between an adult and a child, with the explicit precondition that the adult-child relationship is a pedagogic relationship, and that the aim of the activity is the child's eventual attainment of adulthood.*

Didactics is seen as a field through which many dimensions of looking at successful teaching should be perceived. It is a field through which the

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teacher should look for suitable building materials for the type of wall he would like to build. Methods of learning or teaching; content, made up of various clusters of cultural, religious, ethnic, economic and socio-psychological bodies, all form the overall body of this field. It is in pursuance of the concept of forming that Louw (1992:3) summarizes the theory of didactics by referring to didactical pedagogics:

> *The terrain which is denoted by the term Didactical Pedagogics is therefore the teaching (instructional) activity of an adult and the learning activity of the child in an educational (pedagogical) situation. The terrain can also be described as the teaching-learning activity between an adult and a child, with the explicit precondition that the adult-child relationship is a pedagogic relationship and that the aim of the activity is the child's eventual attainment of adulthood.*

By this concept (forming) it means that didactics has the fundamental aim of pursuing a goal (forming) and arriving at or achieving the goal (formedness). In simplest terms it means didactics, as a process (teaching) is aiming at reaching the level at which a satisfaction is reached that the learner has undergone a change (forming) and has in fact changed (formedness). Changedness (formedness) is the goal or the end product while the process (forming) is a pursuance of delivering theory of forming, referred to (according to Van der Stoep & Louw, 1984) as "Bildungslere", in which "bildung" means teaching and "lehre" means result. This theory may be summarized into two different theories according to Van der Stoep and Louw (1984:35-39), which are described as follows:

(a) Formal forming

This theory of forming is child-centred. It emphasises the study of the child to see which learning materials are suitable for him/her to understand the selected learning content in order to satisfy his/her mentors (teachers or adults). The following two assumptions in this regard are important:

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- **Functional forming:** that is, the child will be influenced to acquire the norms and skills that will make him to react to the environment by manipulating resources for purposes of survival and socio-economic participation in adult life.

- **Methodical forming:** that is, methods so selected will make the child to be more susceptible to the content and be in the position to be more amenable to the functional and formative forming.

(b) Material forming

In short this type of forming, according to Van der Stoep and Louw (1984:37):

> *... seeks a spiritually enriching forming practice through clearly and effectively planned learning situations.*

The aim of this forming is primarily the development of moral judgement and the capacity to select wrongs from rights within the hurly-burlies of life and its complexities. The child finds him-/herself within the complete reality of life and has to make himself settled and acceptable in relation to this reality. He has to find a relationship that is suitable for him to adjust within the complexities of the reality of life.

According to Vrey (1979:60):

> *His (child) life-world contains things to which he is not perfectly oriented; new ideas, persons and objects are always appearing and meaning has to be assigned to them. Growing experience and a more effective cognitive structure make it possible, within the expanding ambience of meaning, to deal with these challenges more speedily.*

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(c) Categorical forming

This theory of forming views knowledge as a totality made up of various categories. It grounds itself on the wholeness of reality with different faculties or categories, where man sees himself in relation with each category or some categories or essences. The child needs someone to unlock or unfold the complexity of these essences while he/she (the child) should also show some willingness (that is, school readiness) in accepting this offer. Van der Stoep and Louw (1984:38) explain the position of the child in these relationships or categories as follows:

> *The child can gain access to the different categories of reality in the teaching situation only if the teacher concentrates on sifting through the categories in order to determine the elements. Elements in this sense represent these basic primary insights concerning a certain aspect of reality which give the child access to reality and which therefore enable him to understand related aspects of reality.*

Vrey (1979:60) says that the child has the potential and the will to overcome obstacles and meet challenges and summarises this as volitional intentions which he describes by saying that:

> *The supreme goal of education is undoubtedly adulthood, but this is readily divisible into three categories, viz. the individual's world of meaning in which he is oriented, belonging as an attribute of his complex relations with significant others, and an adequate self that assures him of an accepted identity and the awareness that he possesses certain powers and knowledge.*

The willingness of the child (educand) to learn or be receptive to learning is also explained by Kgorane (1983:9) when he describes the acquisition of character by the educand as a member of the community that has its own culture. He (Kgorane) does this by reiterating what Grace de Laguna said:

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In acquiring character, an educand remains the same individual with the same individual capacities. But since the conditions of his life call for organization of some of these potentialities at the expense of others through choice, his becoming which requires accountability and the bearing of responsibility, is never complete. He remains the same individual but acquires character.

The concept of subjects is seen as epitomizing such categories and that of the situatedness of the learner viz-a-viz these complexities, together with his readiness and receptiveness become the cornerstones of this type of forming. Piek (1984:16) summarises this type of forming by referring to the learning material by saying:

The learning material must be organised in such a way that the physical, spiritual, intellectual, emotional, moral, social, cultural and religious shaping of the child may all be achieved.

(d) The aim of didactics

Didactics, as it has already been explained, is a theory of teaching. It is a theory that has a mission in the didactic situation, in that it engages the didactician in examining or reflecting on the best possible way in which the child (learner) should find a suitable relationship with reality. Piek (1984:15) summarises this by saying that it:

... involves three areas of knowledge on the part of the teacher. It implies first of all that the teacher himself is in possession of sound and adequate knowledge of the content. It requires secondly that he know different ways or methods of unlocking and revealing the learning material and possesses the skill to employ these methods. Thirdly, it requires the teacher to know and be able to recognise the limits of a pupil's learning ability.

As has been discussed above, the position of the child in such a reality or cultural milieu is predetermined by the views harboured by the teacher.

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The child's formedness depends on the belief or conviction held by the teacher. If the teacher, who represents the sociological ideology of the community within which the child lives, has a conviction of, say, functional forming, the conveyance or manipulation of the subject matter by the concerned child will be dominated by the child's intentions ultimately, a functionalist formedness.

In this sense didactics or the theory of teaching is manipulated and sifted through by the teacher to select only the principles and teaching or learning theories that are concomitant with the prevalent ideological perception that is dominant in the community from which the child comes.

(e) Implications for rural communities

Since the child seems to have limited power to directly influence his/her own learning, it should remain the role of the teacher to clearly understand the field of didactics in order that he/she may not be out of step with the basic and direct educational needs of his/her pupils. This will help with the balancing of the equation of knowledge so that all the domains (namely, affective, cognitive and psychomotor) will be satisfied. These domains are summarised by Mehrens and Lehmann (1984:39) referring to Bloom (1956:7):

> *The cognitive domain includes those objectives which deal with the recall or recognition of knowledge and the development of intellectual abilities and skills.*
>
> *The cognitive taxonomy contains six major classes of objectives arranged in hierarchical order on the basis of complexity of task (knowledge, comprehension, application, analysis, synthesis, and evaluation). Each of these six classes is subdivided further. The affective domain is concerned with changes in interest, attitudes and values and the development of appreciation and adjustment. It is divided into five major classes arranged in hierarchical order*

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on the basis of level of involvement (receiving, responding, valuing, organization, and characterization by a value). The psychomotor domain includes, objectives related to muscular or motor skill, manipulation of material and objects, and neuromuscular coordination.

This does not mean that the teacher should lose sight of the needs of the society from which the child comes, lest a situation of socio-pedagogic conflict may develop. The ideological and social background of the community should be reflected in the process of forming and formedness, or to put it in another way, the ideological and sociological perceptions of the community should be reflected during the process of teaching (forming) and at the point of understanding (formedness).

It is on this basis that rural teachers should also take into consideration the fact that the communities have a rich cultural heritage that is primarily of rural or country nature. While the sophisticated urban lifestyle has a role to play in shaping rural communities, the didactician in the rural background needs to appreciate the fact that some elements of rural social ideology may also have a role to play in influencing some aspects of urban essences and practices.

The rural teacher should, against this backdrop, associate his/her teaching with the rural essences. His selection of methods, aims and activities of the teaching learning situation should be based, without prejudice, on the rural and tribal practices that dominate the day to day lifestyles of such a community. Mathematics like any other subject is cannot be left out of this deduction.

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3.2.1.2 **Subject didactics**

From the previous discussion it becomes clear that didactics is a general theory of teaching and learning. On the other side, subject didactics refers to the same concept, but it applies to a more specific area of knowledge or body of knowledge of a subject. It may be worth understanding first what the word "subject" means before the concept subject didactics is discussed.

The word "subject" is defined in the **Longman's Dictionary** (New Edition: 1987) as *branch of knowledge studied, especially in a system of education.*

A more precise definition of "subject" is given by Zais (1976:330-331)who quotes Wheeler (1967:178) who says:

> *A research discipline or subject is taken to be a coherent and consistent body of knowledge which relates to some particular area of man's concern and which gains its unity from its own inherent logic, in most cases the logic of explanation or exposition.*

Subject didactics therefore refers to the theory of teaching that lays special emphasis on a particular branch of knowledge, such as History. It finds its residence in the special branch of knowledge where the principles governing that branch are studied. According to Duminy (1980:11): *... subject didactics means exactly what it says, namely didactics dealing with a school subject.* They go on to explain that:

> *... one refers to the subject didactics of Afrikaans, of English, of History and so on. The application means that all the facets of the field of study of didactics are continued into the study of the teaching.*

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Degenaar and McFarlane (1982:2) describe subject didactics as follows:

> *It can thus be concluded that subject didactics deals with the teaching and learning of a specific school subject.*

Van der Stoep and Louw (1984:41) describe subject didactics by regarding it as part of didactic theory when they say: *As the didactic theory represents an attempt to arrive at generally valid pronouncements and findings regarding teaching as such, so subject didactics attempts to interpret the general findings of the didactic theory in the teaching of specific school subject.* But the strong relationship of didactics and subject didactics is further illustrated by Van der Stoep and Louw (1984:41) when they say that:

> *Didactics theory accompanies subject didactics in that it provides the general structure of teaching in terms of which teaching as such is done.*

Subject didactics looks at how a particular school subject is taught. All that governs didactics also governs subject didactics though in the latter only a certain area or compartment of knowledge is dealt with. In whatever type of forming or formedness the society is anchoring its ideological perceptions, it would seem that they will be considered with special reference to a particular subject concerned.

Consequently teachers of particular subjects will have to know the content of their subjects as reflected in the relevant syllabi, so that they will be able to convey the knowledge to their pupils in accordance with the expectations, aspirations and ideological perceptions of the communities in question. Thacker, Pring and Evans (1987:40) sight a warning against this background when they say:

> *Arguments may have been deployed to the effect that teachers require professional freedom in order to cope with the varying needs of their pupils or students, but there is, I would maintain,*

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> *little evidence of a systematic effort on the part of teachers to give the learners the necessary power, skills and responsibility which are required if they are effectively to express their needs and determine their learning programme.*

The knowledge conveyed may differ in terms of formedness, for example material formedness vis-a-vis formal forming on one hand, or it may differ in terms of the situatedness of that particular community. Rural communities may have different perceptions of biology than towns folk for instance. Biology may be learned in the rural set-up with the final assumption or perception in mind that it may help in the improvement of such communities in fish rearing and agricultural survival or development; while the urban population may have a vastly abstract perception of, for instance, using Biology as the subject through which the Ozone layer health syndrome could be circumvented. Diametrically different systems of thought are existing and anchored in subject didactics of this subject. The same principle applies to the subject didactics of mathematics.

3.2.1.3 **Subject didactics of mathematics**

The subject didactics of mathematics refers to didactics pertaining to the teaching of mathematics. This theory looks at the principles governing the teaching of mathematics as well as all the activities and methods that form the field of the theory of teaching mathematics.

The subject didactics of mathematics answers the question of which values should be considered. According to Oosthuizen, Swart and Gildenhuys (1988:2), in the past, mathematics didacticians laid emphasis on formative value and material value variable, as they say:

> *The emphasis changed on various occasions from the material value to the formative value and back again.*

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In the subject didactics of mathematics, like in other subjects as already discussed, societal expectations also influence the approach of the subject teacher to the organization of the teaching of his pupils. This influence determines what and how the teachers of mathematics should teach the subject. For instance, according to Oosthuizen *et al.,* (l988:3): *The so-called newmath placed the emphasis on the axiomatic-didactic nature and structure of the subject. The aspects such as set theory, groups and rings were consequently included in school syllabi.* The authors go on to describe the present position in the subject (Oosthuizen, *et al.* 1988:3):

> *There is currently a strong feeling against the tendency to formalise the teaching of mathematics. Many mathematicians and didacticians are convinced that the subject can only be presented meaningfully in schools when it is done practically and oriented towards the solving of problems. The material value of mathematics is now much more emphasized than the formative value.*

The aims of teaching mathematics are set by the societal expectations and should therefore form the cornerstone of the subject didactics of mathematics. Two types of societal aims are distinguished by Howson and Mellin-Olsen (in Ernest, 1991:125):

> *Howson and Mellin-Olsen (1986) distinguish the aims and expectations of different social groups, including mathematics teachers, parents, employers and those in the higher levels of the education system (universities). They pose two conflicting types of socially situated aims, the S-rationale (social, or intrinsic goals) and the I-rationale (instrumental, or extrinsic goals).*

Such societal expectations indicate the level at which society values the degree of importance of this subject. This view was expressed in the Cockroft Report, as quoted by Christiansen *et al.* (1986:49) in the following way:

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There can be no doubt that there is a general agreement that every child should study mathematics at school; indeed the study of mathematics ... is regarded by most people as being essential.

This view expressed by Cockroft permeates the entire fabric of social interwoveness but the values and types of formedness differ from society to society. In some cases employers influence the learning of mathematics to be that of material benefit against other values as may be seen according to Christiansen *et al.* (1986:52) when they refer to employers:

Generally they say they require 'good basic mathematics', although it is not clear that they know what this is. Mathematics is seen first, second and last in vocational, utilitarian terms; it is almost never referred to as part of human culture and employers remain unconvinced by arguments as to 'the beauty' of the subject.

The fundamental notion is that subject didactics of mathematics should be anchored in a proper and more acceptable approach as juxtaposed against the wishes and expectations of the society. The content of mathematics should not be the only determinant of the outcomes of the didactical process in this subject, lest it loses its respect and integrity within the society as Christiansen *et al.* (1986:52) put it:

Whether one adopts a utilitarian view or not, it is difficult to support an academically inspired change of curriculum for all pupils if the net result is to decrease competence and confidence in practical tasks required in a job or at home. On the other hand the evidence that such a decrease occurs is hardly conclusive.

While this referred to the curriculum of mathematics, it also refers to the didactics of this subject as it forms a complement of the curriculum.

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(a) Implications for rural communities

Subsequently the mathematics teacher should take into account the values of the society he is representing when transmitting such values to the children. The teacher should know and have insight into the ideological and sociological values of such a society or community in order that he may be in the position to avoid a conflict of interest between himself and the community. This will in turn avoid the development of a warped and imbalanced formedness in the child, with regard to community expectations.

The rural mathematics teacher should, in his pursuance of the fulfilment of the requirements of the didactic principles and foundations of mathematics as a subject, take into account the expectations and aspirations of the rural community. Whether rural people espouse material values, or cultural values should form the epicentre of the teachers exploitation and manipulation of the theory of teaching such a subject. Cultural practices of such communities may be explored to find which aspects have a bearing and role towards forming and formedness in mathematics. In other words, the teacher of mathematics in a rural school should be aware of and abide by the *theory of social diversity in mathematics education* (Ernest, 1991:l33). This is likely to make such a teacher achieve his aims in the mathematical didactic situation and the outcome will reflect a better performance in the subject.

Ernest (1991:133) summarizes as follows:

> *... sociologists of education have long indicated the importance of society, social relations and social diversity ... as well as the construct or ability for education.*

The importance of cultural differences has been condensed by D'Ambrosio (1986:5) as quoted by Nickson and Lehrman (1992:128):

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> *We have built a concept out of cultural attitudes and cultural diversity, that is, different groups of individuals behave in a similar way, because of their modes of thought, jargon, codes, interests, motivation, myths.*

Nickson and Lehrman go on to support this perception by saying:

> *Rather, if we were to pay more heed to D'Ambrosio's (1986) notion of cultural grouping and at the same time, to the social nature of mathematical knowledge, we would be better able to develop mathematics curricula which cater for cultural differences than is the case at the moment.*

This type of mathematics curricula will address itself to the mathematics as described by D'Ambrosio (1985:45) as ethnomathematics which he contrasts with the normal school mathematics as follows:

> *Mathematics is adapted and given a place as "scholarly practical" mathematics which we will call, from now on, "academic mathematics", i.e. the mathematics which is taught and learned in the schools. In contrast to this we will call ethnomathematics the mathematics which is practised among identifiable cultural groups, such as national-tribal societies, labor groups, children of a certain age bracket, professional classes, and so on. Its identity depends largely on focuses of interest, on motivation, and on certain codes and jargons which do not belong to the realm of academic mathematics.*

3.3 SUMMARY

It is important to note that there is a strong relationship between didactics, subject didactics and the subject didactics of mathematics. Didactics refers to the general study of the theory of teaching, subject didactics refers to when the knowledge acquired from such a general study is applied to a

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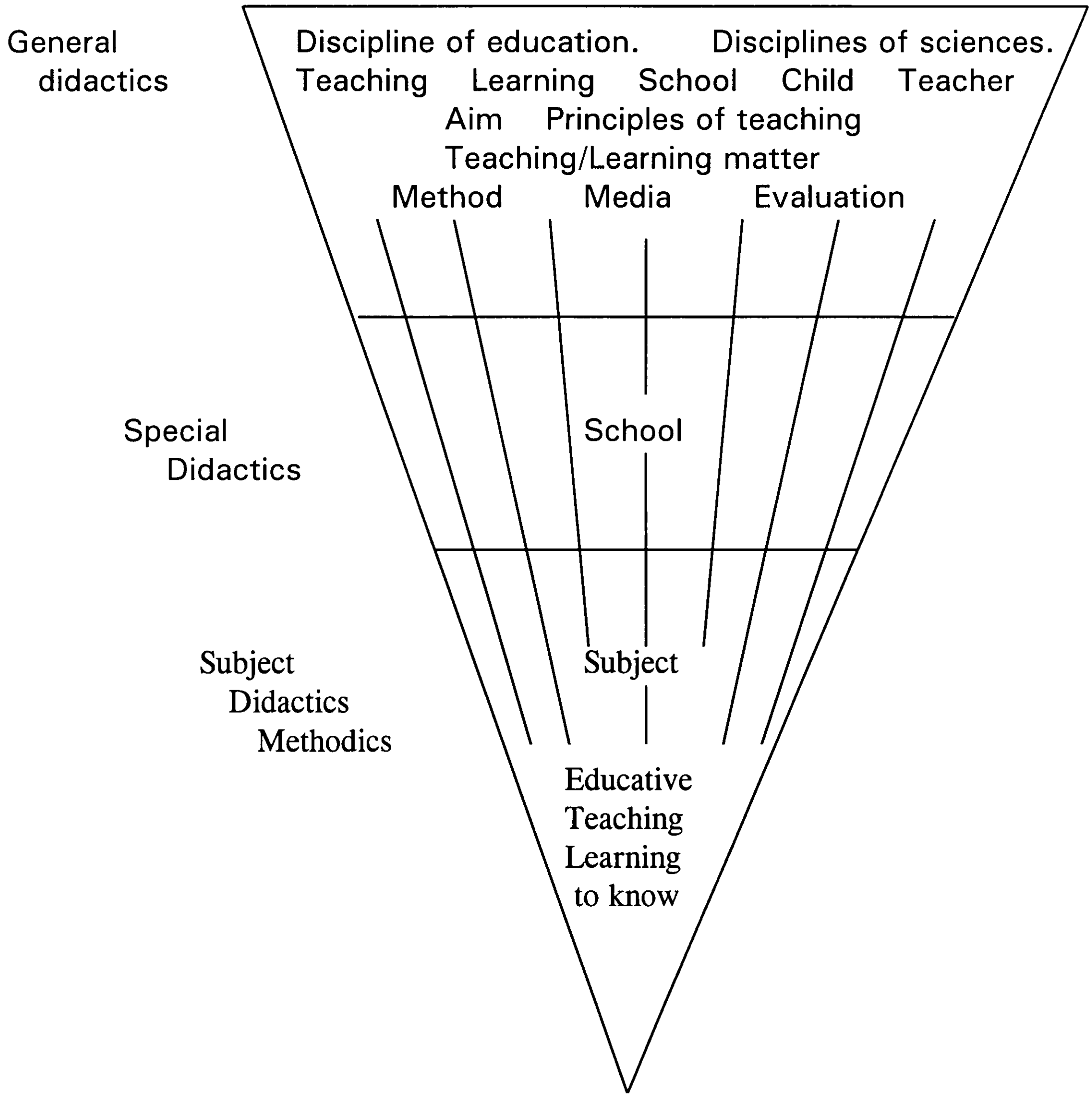
smaller or particular area of the learning unit called the subject; while the subject didactics of mathematics refers to the application of the theory of teaching of a particular subject that is, mathematics. A pyramid (in reverse) similar to the one used by Duminy and Songhe (1980:213) shows the relationship between general didactics, subject didactics and special methodics, or subject didactics of mathematics.



(Adopted from Duminy, 1980:315)

In this pyramid, didactics deals with many general aspects of the theory of teaching, such as teaching, learning, aims, principles of teaching, method and evaluation. Subject didactics has all the above but specifically pertaining to individual subjects as each subject is a separate entity. This

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relationship is crucial in maintaining an observance and coherence of the social and ideological needs of the community in which the rural mathematics teacher finds himself. The teacher's general didactical knowledge should relate systematically to the knowledge he needs to teach an individual subject; while also being able to apply this knowledge to, specifically, mathematics.

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CHAPTER 4
DIDACTIC PRINCIPLES AND THEIR APPLICATION IN THE TEACHING AND LEARNING OF MATHEMATICS

4.1 INTRODUCTION

In chapters two and three, two aspects of teaching and learning were discussed, namely learning theories and the science or the field of teaching (Didactics).

These two aspects have implications for successful teaching and learning of mathematics in the rural and tribal schools. It is important to note that in addition to all the implications for teaching and learning, there is another aspect which is equally important before any successful teaching and learning can take place. This aspect is composed of didactic principles. For any meaningful execution of a project or programme in the field of education, the foundations or established norms or conventions in that regard should be first mastered in order to have a clear understanding as to whether one is on the right track or not. This explains the necessity for teachers to know which didactic principles exist in order to be able to select and use those which are relevant for the teaching or learning situation that has to take place, as Rambaran (1989:56) advises:

> *These principles must at all times be considered and applied when selecting specific methods of instruction. As many of these principles as possible should be applied to each and every lesson* (Mursell, 1954:26; Steyn, Yule & Badenhorst, 1983:14).

Before identifying and discussing the principles, it is important to know what is meant by the concept "principle". The word "principle" can be better understood when given in Afrikaans. It is called "beginsel" and, according to the "Verklarende Woordeboek", it means: *die eerste, grondslag,*

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grondreël, oortuiging, oorsprong. The words quoted above have to do with the beginning, foundation, conviction or what is believed to be fundamental. Many authors and scholars differ significantly in the definition of the term "principle" as illustrated by the following authors: Avenant (1980:54) shows the various ways in which authors attempt to clarify what principle means by putting it in Afrikaans as follows:

> *Sommige skrywers verskil ook skerp oor die term 'beginsel ' en verkies die benaming 'kriteria, 'grondslae' of selfs 'boustene'.*

He (Avenant) is of the opinion that some authors differ sharply about the term "principle" and choose "criteria", "foundation" or even building bricks.

It must also be noted that principles are not rules, laws or regulations but guidelines. Duminy (1980:22) emphasizes the need to avoid confusing principles with rules or laws by saying:

> *... **principle** is used because it is principles rather than laws or which are dealt with. They must be grasped and understood rather than merely memorized. They are guiding stars rather than **blue prints, recipes** or **tricks of the trade.***

Mokgalabone (1992:37) sheds more light on this assertion and says:

> *It (didactic principle) is a conviction according to More and de Lange, (1974:43). It indicates an inevitability, an essential context. It is essentially a generalization that provides a guide to conduct or procedure, for example, the principle that effective teaching demands control of the classroom situation.*

Didactic principles may therefore be regarded as the fundamental factors or issues established to have a major influence on teaching and learning.

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This stands to reason that principles should serve as a means through which a goal for successful teaching and learning could be achieved and should therefore not be memorised but be understood before being applied.

4.2 DIDACTIC PRINCIPLES

A number of such principles have been identified and established by different educationists and educational psychologists. A summary developed from various sources of such principles is given by Fraser, Loubser and Van Rooy (1993:59-60)

TABLE 4.1: ANALYSIS OF VARIOUS SOURCES WHICH ADDRESS THE ISSUE, REVEALS A NUMBER OF VARIOUS PRINCIPLES TO BE TAKEN INTO CONSIDERATION DURING TEACHING

CAWOOD (1982)	DUMINY (1981)
Objectivity Planning Motivation Individualisation Socialisation Self-activity Experience Global perception Mastering Evaluation	Totality Individualization Motivation Perception Primary environment Mother-tongue instruction Example
VAN DER STOEP AND LOUW (1984)	**SHIPLEY *et al. (1972)***
Sympathy Clarity Tempo Dynamism Balance	Active learning Variety of methods Motivation Balanced curriculum Individual difference Lesson planning Suggestion Encouragement Remedial teaching Democratic environment Simulation Integration Perceptualization of reality Independence

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Upon closer scrutiny of the principles collated above, many similarities are detected, for example, **global perception** in Cawood's typology matches with **perception** in Duminy and **perceptualization of reality** in Shipley. Encouragement (Shipley), sympathy (Van der Stoep & Louw), motivation (Duminy; Cawood *et al.*) have almost the same meaning, namely motivation. Planning, systematization, and lesson planning, as taken from various columns previously mentioned, also refer to a common idea, namely, planning.

It is thus important to note that many authors do not differ from one another concerning the definition of various principles of teaching. The only difference is mainly based on semantic expression of such principles and many principles claim commonality and interrelationship with one another. This commonality and relationship syndrome is expressed by Duminy and Songhe (1980:22):

> *In studying these classifications it becomes clear that, apart from the variety of classification possible, certain basic principles appear time and again and claim recognition in any classification. One also comes to the conclusion that there is such a coherence among these principles that a discussion of one invariably involves one or more of the others.*

The researcher has also identified the most common general didactic principles which have a direct bearing on the teaching of mathematics, with special reference to the rural and tribal communities in South Africa. These principles form the basis of guidance on the procedures that can be followed by teachers of mathematics in rural schools for purposes of relevance and suitability of the subject for the development and day-to-day running of life in rural communities.

The following principles are identified for this purpose:

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- motivation
- individualisation
- totality
- perception
- environmental teaching
- mother-tongue instruction

4.2.1 PRINCIPLE OF MOTIVATION

4.2.1.1 **Importance of motivation to rural pupils**

The principle of motivation is important in the teaching and learning situation in that it serves to encourage and develop the learners' interest. According to Fleming and Levi (1993:3) such interest or willingness is crucial in a subject like mathematics, as they point out:

> *The extent to which an instructional stimulus will be received, acquired, and applied depends on the student's willingness to learn and perform in addition to his or her ability to do so.*

Unmotivated learners may be forced by circumstances to learn mathematics, but this does not mean that proper understanding of the subject is guaranteed, as Fraser *et al.* (1993:60) asssrt:

> *A lecturer may succeed in catching and retaining an unmotivated student's attention during teaching. However, this does not mean that she is dealing with a motivated learner who is eager to participate in the teaching activities. Personal commitment to master new subject content effectively is a condition for meaningful learning.*

Hunter (1996:1) takes a more radical position on the role of motivational factors concerning the child when she says:

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> *No one can make a child or anyone else learn. At best, circumstances in the environment can be arranged so a child will be encouraged to do something that will result in his learning.*

Hunter's viewpoint is supported by Piek and Mahlangu (1990:32) when they say:

> *No matter how excellent the teacher's preparation, presentation and control are, if the pupils in his class do not approach their tasks with interest and enthusiasm, the teacher will not get the results he should Therefore, teachers motivate their pupils to inspire, encourage and impel them to take the required action. Interest are the things that attract and hold the pupil's attention.*

Motivation takes place when certain techniques are followed — such techniques may come sequentially or blended in accordance with the circumstances prevailing within or around the teacher — learning situation. A summary of these motivational techniques is offered by Rambaran (1989:63) from Kramer (1978:11) when he says:

> *Many motivational techniques have been suggested for the teaching of mathematics. Some of these techniques are:*
>
> - *arousing the interest in the content presented and stirring his curiosity*
> - *making the pupil see the importance of what he is doing*
> - *teaching the patterns of thought that the pupil can apply successfully*
> - *recognising good work*
> - *presenting enrichment exercises, including games, puzzles and mathematics tricks.*

Motivation may also have a significant influence on the mathematical achievement of learners in the rural areas. The wealth of knowledge gained by the rural child from his surroundings will not have any meaning for the

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child unless it is properly organised and the child is encouraged or motivated to associate it with the knowledge gained at school. Such motivation should be done by bringing the school closer to the child's rural life. This closeness of school and life is put forth by Duminy (1980:35) when the author refers to the role of the teacher in particular:

> *The role of the teacher, apart from establishing links with the child's environment, consists in the creation of the learning situations which will stimulate the child's desire to learn.*

For rural students to learn meaningfully, the subject matter should be associated with, or have strong relevance to, rural ways of life, practices, culture or the environment.

The importance and relevance of what the child learns and what value he attaches to it is emphasized by Fleming and Levie (1993:4) when they say:

> *The motivation to learn depends largely on the learner's personality, the nature of the thing or skill to be learned, and the learner's perceptions of the value and difficulty of learning it.*

4.2.1.2 **Types of motivation**

(a) **Extrinsic motivation**

Motivation is approached from two different forms, namely Extrinsic and Intrinsic motivation. Extrinsic motivation refers to motivation that emanates from outside the inner interest of the learner. It stems from outside the subject matter area. According to Piek (1984:22):

> *Extrinsic motivation stems from outside the subject matter area, but is in some way analogous to it. One thinks here of favourable circumstances, an exemplary teacher, the subject matter and the method of instruction, competition, prizes, allocation of marks, promotion and various other rewards.*

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Duminy (1980:33) describes extrinsic motivation by pointing at the negativist nature enshrined in its format by saying:

> *It is derived from factors outside the learning situation, such as the granting of marks, credits, free lesson hours, diplomas, certificates and prizes. Rivalry and competition are widely used, while negative extrinsic motives include sarcasm, ridicule and various forms of punishment.*

The implication of extrinsic motivation to the teaching of mathematics in rural schools is two-fold.

- On one hand such motivation may be useful in letting students know that they could be better than their classmates in scoring higher marks or winning classroom competitions. This may motivate some to continue studying mathematics further, sometimes for the mere fact that they will be regarded with high esteem in the village. They may enjoy respect because many people will regard them as a genius in the village. Unfortunately this may lead to memorization of rules and facts with little application to solutions of rural developmental problems and hurdles.

- On the other hand those who are unable to achieve high marks and be left out of the competition winning arena may withdraw into their learning cocoons and become forever demotivated.

(b) Intrinsic motivation

Intrinsic motivation is based on the fact that the learner assimilates the learning content in such a way that he makes it his own. According to Duminy (1980:32) in this type of motivation:

> *... the pupil is appealed to so directly by the subject matter and everything that belongs to the teaching-learning situation that he*

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> *shows spontaneous interest without the need for any encouragement from outside the situation. When a child studies a certain subject, and he is intrinsically motivated towards that subject, then genuine interest in the subject is the result.*

Hunter (1996:37) describes the meaning of intrinsic motivation as follows:

> *... when the activity itself is rewarding (enjoying reading or swimming) we have a situation where motivation is intrinsic, that is the activity will achieve the goal.*

In this type of motivation the learner is motivated by his own achievement, in the subject and the extent to which it makes sense to himself and his own world. Piek (1984:22) supports this notion when he says:

> *It is closely related to the learning situation and is determined by such factors as the meaningfulness of education, its purpose, the pupil's attitude towards self-activity, self-realisation, values, norms and standards, and the will to accomplish intellectual maturity by means of education.*

The implication of this type of motivation for rural mathematics learners is that the teachers in this subject should make mathematics learning as simple, relevant and down to earth as possible. Examples and analogies should as far as possible be derived from the familiar environment in order to induce interest and insight in the subject matter. Knowledge gained through meaningful learning and self-engagement in the learning process will not be easily forgotten by the learner. The application of such knowledge to the development of rural communities will have relevance and a fruitful outcome.

It is, however, of paramount importance to the teachers in general and, more specific, to mathematics teachers, to take note of the fact that the blending of the two types of motivation in the teaching and learning situation will in

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most cases yield better results. This advice is galvanized by Rambaran (1989:63) when he says:

> *Whilst the extrinsic motivation provided by the teacher at the beginning is important, the pupil is being able to see the importance of the work he is doing so that motivation becomes intrinsic is even more important.*

In conclusion, the principle of motivation is of particular interest in the education of rural children in the sense that most rural children feel left out when educational resources and curricula are designed. Motivation in the teaching-learning situation will help to reassure them of the attempts by educational authorities to reverse these imbalances. It is the task of the teacher in the rural school to ensure that the confidence, will and interest of rural children are rekindled by developing rural children's awareness of their potentialities concerning education, and particularly, the understanding and application of mathematics.

4.2.2 THE PRINCIPLE OF INDIVIDUALIZATION

The principle of individualization has its origin in the belief that every child or individual has his own unique qualities or characteristics which differentiate him from others when it comes to mastery of facts, subject matter or knowledge. This includes the tempo at which such knowledge, facts or subject matter may be assimilated. According to Piek (1984:22):

> *The advantages of the principle of Individualization in the teaching-learning situation lie in the fact that this principle takes account as far as possible, of the reality that each child is a unique individual. It is a natural phenomenon that, as the children progress on the road of development, the difference between them become more and more pronounced.*

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Such differences existing amongst the different children under the charge of every teacher have a serious bearing on teaching in the classroom, pointed out by Fraser *et al.* (1993:64) when they say:

> *The didactic principle of individualisation acknowledges the fact that individuals differ from each other and that a teacher has to take these differences into account when planning and executing his teaching strategies.*

De Corte (1995:10) points out the need to apply this principle to facilitate the catering for individual children when he says:

> *In the classroom it might be that different learning environments and different teaching styles are needed for different pupils, which would present very great teaching problems in the sense that any individual teacher also presumably has preferences which are in accord with only a proportion of the pupils. Any acceptable theory which enables us to understand individual differences would be acceptable.*

It would sound that it would be ideal if each child is offered education according to his capabilities, by having each child taught by his own teacher in his own classroom. Unfortunately because of financial implications, this system is almost impossible as the costs involved would be unbearable. Orton (1987:4-5) explains how difficult it would be to provide each child with an environment that would specifically suit each child's individual differences when he says: *The learning processes and outcomes of learning vary among students due to individual differences in a diversity of aptitudes that affect learning, such as approaches to and misconceptions of learning, learning potential, prior knowledge, interest, self-efficacy, self-worth, etcetera.* It is, however, possible to apply this principle within a conventional classroom situation through the use of differentiation, as illustrated by, amongst others, the following authors.

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Rambaran (1989:633) argues for the need to encourage cooperation in learning amongst pupils with individual differences by saying:

> *... pupils do not learn in a vacuum, nor do they live in a vacuum after they leave school. It seems more effective, both for the learning of mathematics and the development of sound human relationships, to encourage students to work together to solve their problems than to isolate students from one another.*

Piek (1993:22) goes further by suggesting a method that may reconcile individual differences in pupils with the need to maintain the work of an individual to progress with others in class.

> *Differentiation, as an educational principle, is a direct result of the didactic requirement of individualising. Differentiation seeks to fulfil this requirement by an effort at reconciling class and individual teaching.*

Fleming and Levie (1993:201) also agree that many differences within individuals exist and suggest appropriate strategies for lesson designs to address such differences.

> *The search for truly individualized instruction has typically ventured into dynamic assessments of learner preferences, cognitive states, and cognitive styles. To many, especially those interested in artificial intelligence-based (AI) applications of computer-based instruction, the capability to alter lesson strategies dynamically seems the most essential manifestation of truly individualized instruction.*

Van der Stoep and Louw (1984:56) see differentiation or differential teaching as an approach that leads the child primarily to self-discovery by stating:

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> *Learning implies that a child must learn to know himself in the learning situation and even, as it were, discover his own possibilities.*

Van der Stoep & Louw (1984:57) go on to express the implications of the lack of teachers, of applying opportunities for the individual and personal development of each child within the classroom situation and the role of the teacher towards fulfilment of each child's didactic destiny:

> *If there is no evidence that the child has discovered himself in the teaching situation, it means that aspects such as anticipation and expectation were not adequately realised in the teaching situation. The didactic situation is aimed at helping the child towards self-discovery in reality so that he can establish his own position regarding reality. The teacher's task is pre-eminently to aid, support and help the child in his self-discovery to enable him to reach what he can and to become what he ought to be.*

It is thus important for teachers to look into the possibility of the application of the differentiated teaching, which is the cornerstone of the principle of individualization.

4.2.2.1 **Implications for rural mathematics teaching and learning**

Rural children, like other children, have individual differences. Some of the children may be good at quick mastery of mathematical concepts/principles while others may have a moderate tempo of understanding. The rural children may also display slow learning tendencies.

It is, therefore, imperative for teachers in rural mathematics classes to apply differential teaching strategies within their classes by studying performance profiles of their pupils from previous classes. For example, the Standard 10 mathematics teacher may ask for formative and summative progress reports, together with general socio-pedagogic profiles of such students or records,

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from the previous Standard 9 teacher[2]. Such reports may be studied in order to understand performance rate and level of each individual child in the Standard 10 class. The background that includes socio-economic background of each child should also be studied in order to know in what other activities the child is gifted socio-culturally, which may be integrated into the personal or ability — wholesomeness of each child.

This approach in which the entire child's abilities are recognised and fostered, is called the holistic approach. Maree (1992:147) referred to this approach when he emphasized the need not to look at problems of underachievement in mathematics as isolated entities when he said:

> *Vir die doel van hierdie studie sal die term holisties gebruik word om die feit te beklemtoon dat ontoereikende prestasies in wiskunde nie geïsoleer beskou kan word nie, maar te alle tye binne die konteks van 'n mens wat die probleme ervaar: so word kennis van insig in ontoereikende prestasie in wiskunde altyd gekombineer met 'n humanitêre begrip vir die kind as 'n unieke, eenmalige, onherhaalbare individu, sy persoonlikheid, sy omstandighede, sy verhoudinge op alle vlakke, sy psigobiologiese samestelling, sy psigofisiologiese konstitusie en sy intrapsigiese funksionering.*

Once the teacher knows his pupils, he will be able to know how to go about in designing work or tasks for pupils according to their rates of learning. He will also be in the position to select examples or analogies that will suit individual understanding capabilities of each child. Examples familiar to children should be selected to suit sub-themes or tasks designed for individual pupils or differentiated groups; these should be accompanied by examples from the relevant environmental factors or realm to form the basis for meaningful and proper application of the principle of individualisation.

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2 **Formative report** refers to the report that is meant for the improvement of practice while **summative report** refers to a report geared to career decision-making (Turner & Clift, 1988:10).

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4.2.3 THE PRINCIPLE OF TOTALITY

The principle of totality has its origin associated with the "Gestalt" psychologists. The pioneers of this field of learning are Westheier and Kohffka. According to Mokhaba (1993:64)

> *It is one of the most important schools of psychological thought and emphasises the idea of totality in teaching This school of psychological thought proposes that man observes everything as a whole and that learning is promoted when the subject matter is presented in the form of "wholes" rather than as separate parts.*

Piek and Mahlangu (1990:17) also add their voice on how Gestalt Psychology operates:

> *According to the Gestalt school of psychology, a person acquires knowledge of a concept as a whole, not in parts. The pupil in the teaching-learning situation is a totality or complete individual.*

According to Duminy (1980:23):

> *... an attempt to treat and develop the different faculties separately, unquestionably leads to a warped and unbalanced personality.*
>
> *Man is now seen as a unity, totality, or a whole. And although various dimensions or sides to this "multi-dimensional unity" - which is man - can be distinguished, these dimensions can never be divorced or separated.*

Avenant (1980:91)explains this principle by referring to the interrelationship of the various parts as seen in an integrated form:

> *Hieruit word afgelei dat onderwys alleenlik doeltreffend kan wees as dit die leerling in staat stel om verwantskappe in te sien. Daarom word verbandsiening dan ook as basiese beginsel in die onderwys verhef. Hierdie uiters belangrike rigsgsnoer heet onder*

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meer die totaliteitsbeginsel, in Engels "the principle of integration" of "the principle of focus and context" en in Duits die "Ganzheitsprincip." As breë, algemeen geldende leidraad stel dit ook verbandlegging, samehangsbepaling en deel-geheel-verbandsiening as vereistes vir doeltreffende onderrig.

If one goes along with this field of psychological thought, it means the principle of totality regards learning as having to take the form of globalization or approaching the subject matter as an entity or unit made up of a variety of undivorced or integral subunits.

According to Piek (1984:18):

In the teaching-learning situation an effort must be made to generalise and unify knowledge so that it forms a homogeneous, significant whole.

He goes on to say:

According to the principle of totality, the imparting of separate bits and pieces of knowledge, the memorising of rules and facts and the learning of certain attitudes as such can never be enough. All the learning material in a particular subject must be correlated and integrated into a meaningful whole.

This principle occupies a significant place in the teaching and learning of mathematics in the rural schools. Mathematics is a subject that cannot be mastered in isolated fields. Its nature is so interrelated that to master one section alone and not correlate it with the others amount to some form of memorization which leaves little room for insight and application. Algebra, for instance, is vastly used in interpreting trigonometric concepts and vice versa: Logarithmic functions are better understood if related to algebraic concepts. This view is supported by Christiansen *et al.* (1984:143) when they drew a conclusion about the nature of mathematics when they say:

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Thus, despite all the demands of the unadulterated method, a teacher is encouraged to use the visual power of geometrical illustrations to make algebraic truths plausible.

According to Piek and Mahlangu (1990:18):

The conventional curriculum, which emphasized specific groups of logically arranged subject content, had to make way for a curriculum without boundaries, with the purpose of arranging the content in such a way that it is in line with the social functions, needs and existing life problems of the child.

Piek and Mahlangu (1990:18) further advise that:

To realise the above mentioned claims, new methods like the project method have been developed. Such methods may be used to integrate existing natural phenomena and features with Mathematical ideas in the rural schools.

In the rural areas, there is a great deal of features such as undulating hills, tapering mountain chains, widening rivers, systematic tree leaf formations that may form the basis of more meaningful and discernible discussions in mathematics lessons in which calculus, geometric series and logarithmic functions are to be mastered. If his/her environment is made more understandable for the child and brought into the classroom situation, many more ideas are learned instead of mathematics alone as a subject. This view is shared by Vithal (1993:276) when he says:

The unifying concern of mathematics educators in these varied contexts is with giving meaning to the mathematical knowledge and practices which students bring with them to the mathematics classroom by virtue of having lived in a particular community and culture, relevant and culturally meaningful mathematics curricula.

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The environment, background and social practices of the child are reinforced and even further appreciated instead of the possible development of a negative attitude and inferiority complex associated with their rural origin or rurality that make them feel marginalised and unimportant in comparison with their urban counterparts.

This could lead to these children withdrawing into an everclosed cocoon of self-disrespect and self-underscoring as Piek (1984:18) advises:

> *The child must come to realise that everything surrounding him at home and elsewhere in his environment is also considered by the school to be important.*

4.2.4 THE PRINCIPLE OF PERCEPTION

Tied firmly to the environment of the child, is the need to have a clear perception of the environment. Therefore the principle of perception is considered one of the most important didactic principles for the purpose of this study.

The word perception (sometimes referred to as observation) in its comprehensive sense is defined by Duminy (1980:39) as:

> *The extremal observation of objects (by means of all or some of the senses) and together with it the inner experience and assimilation thereof is called perception.*

It is closely linked up with thought or thinking, but for thought **to be activated,** perception will first have to take place. According to Piek (1984:20): *Sensory observation of things become meaningful only when it is followed by internal experience*, and goes on to say that:

> *... the process constantly makes use of concrete images, therefore observation is a prerequisite for thought.*

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The relationship between perception and experience is illustrated by Avenant (1980:119) when he says that:

> *Die mate waarin 'n leerling byvoorbeeld bepaalde prikkels waarneem en deur kognitiewe prosesse verwerk, sal dus grootliks bepaal word deur die mate waarin dit sy hart raak. Anders gestel — hoe meer emosioneel mens betrokke raak by leerstof, hoe makliker sal jy dit verwerk (leer).*

This principle is based on three important factors, namely perception, thought and language. Rambaran (1989:61) supports this notion by referring to Steyn *et al.* (1983:19) and Piek (1984:20):

> *Only when sensory awareness results in an inner experience in which language and thought play a vital role, perception in the didactic sense takes place.*

Perception or observation takes place through the sensory organs, which is then interpreted by thinking, which forms images. The images are then expressed through language to give meaning. It is therefore important to use appropriate words for images of concepts developing in the child's mind. Avoidance of the use of unnecessary excessive words, called verbalism (Piek, 1984:40, and Duminy 1980:42) should be one of the teacher's tasks along the way through which the child develops abstraction or higher order thinking.

This principle occupies a special place in the teaching and learning of mathematics in the rural schools. Used properly, it will make the child gather a lot of experiences at home and on his way to school through visual observation and the actual sensory touching and feeling of objects, structures and patterns. The child, for instance, may observe the cow-dung painting on the floor of the **lapa**, as practised in the Northern Sotho speaking culture for decoration and protective carpeting of the hardened soil floor, and the floor of the mud-built hut. Out of such paintings, a lot of

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mathematical structures such as triangles, squares, polygons and polyhedra may be observed. Such experiences, can be followed meticulously by, for instance, requesting a number of children in class to relate or show on the board what they may have discovered at home, which in their belief, has some mathematical value. This may be done at the beginning of a mathematics lesson as a starting point or introduction for a particular theme, for example, Polygons.

In the light of the above discussion, it sounds imperative for the mathematics teacher in the rural schools to fully understand perceptual abilities and/or problems of the pupils in his class. This will help him to maximise these potentials in order to develop more meaningful learning experiences for children, as based on home-based or school-based observation.

This may not only motivate the children but also increase chances of internalization of such experiences and freedom to participate in the mathematical teaching and learning situation, as Avenant (1980:123) summarizes:

> *Nie alleen geniet die leerlinge die werk en word dit beter onthou nie, maar hulle vrymoedigheid tot openbare optrede word ook versterk.*

4.2.5 THE PRINCIPLE OF ENVIRONMENTAL TEACHING

The principle of environmental teaching is closely connected with the principle of perception discussed above. Environment forms one of the most important factors in developing a more unified and coherent teaching and learning outcome. It is therefore important to consider the environment of the child in the development of the whole personality in accordance with the principles of Gestalt psychological thought. By environment it is here meant, according to Duminy and Songhe (1980:46):

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> *... that locality, that town, city or village, where the child spends his youth. That is where, for the first time, he experiences life in fullness and these experiences will be part and parcel of his inner life for the rest of his days.*

For the environment to play a meaningful role in mathematics, according to Piek (1984:19):

> *The teacher must therefore take note of the particular nature and demands of the community when determining the purpose, content and methods of his teaching.*

The wealth of experiences gathered at home by the child should be mobilised, coordinated and integrated with lessons or learning programmes in mathematics. The child should see the home and the school coming up with a learning package that makes him develop an attitude of appreciation and insight of the usefulness of the milieu within which he grew up.

For the rural mathematics teacher Duminy (1980:46) refers to the usefulness of the abundance of learning materials available in the rural environment:

> *Rural schools have on their doorsteps an almost endless variety of teaching and learning materials. Starting-points for presentation lessons, discussion, observation, enquiry, can be found in flowers and weeds, trees, farm animals, insects, birds, roads and footpaths, streams and dams, water life (plant and animal), the weather, the seasons, the stars, and natural phenomena like frost, floods, droughts, etcetera.*

An example of the use of this wealthy rural background in mathematical lessons is given by Mokhaba (1993:68) when he says:

> *... the environment of the pupil, especially the Black pupil, is filled with traditional drawings and decorations on the walls and floors of buildings, which are of a geometrical nature. These geometrical*

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patterns and structures on the walls and floors of huts can be used to explain certain concepts and structures. This study of African drawings and decorations is known as ethnomathematics.

This type of mathematics is defined by Vithal (1993:276) by referring to the meaning of "ethno". It has been emphasised that "ethno" should not be taken as relating to race but rather as denoting or deriving from cultural traditions of a group of people. Of particular interest is what are seen as building blocks of ethnomathematics when Vithal refers to D'Ambrosio's (1986) definition:

A broad conception of "ethno" according to D'Ambrosio (1987:4) "encompasses all the ingredients that make up the cultural identity of a group": their language, codes, values, jargon, beliefs, symbols, myths and their ways of reasoning. Associated with these, he argues, are numerous mathematical practices such as ciphering and countering, measuring, classifying, ordering, modelling and so on which constitute ethnomathematics.

The rural mathematics teacher has a task to understand the foundations and virtues of a discipline of mathematics that will help him to articulate and integrate the child's home background, values and perceptions into the basic disciplines of pure and applied mathematics. Vithal (1993:285) in pursuance of the adoption of a ethnomathematical approach as a viable approach in which children's background is of vital importance, argues for its use in the teaching and learning situation of mathematics by referring to Pompeu (1992) when saying that:

... if an ethnomathematical approach is employed, then since it is based on activities taken from the pupil's background it calls for greater participation of the pupils' relatives in particular, and of the whole society in general.

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4.2.6 THE PRINCIPLE OF MOTHER-TONGUE INSTRUCTION

The principle of mother-tongue instruction forms one of the cornerstones of intuitive development of the child at school. According to Stuart (1989:199) as cited by Mokhaba (1993:76) mother-tongue has a special role in the child's life. He says that:

> *... it supplies with a cultural heritage which to a large extent will determine his future thoughts, feelings, acts of volition and behaviour.*

Duminy (1980:52) agrees with the importance of mother-tongue by saying that the child:

> *... through his mother-tongue he gains a whole cultural heritage, which will to a great extent, determine his further thinking, feeling, desires, attitudes, etcetera.*

Mother-tongue finds a special place in didactics as it allows the child to bring to school with him a wealth of educational experiences which may best be expressed in his/her own language which can be integrated smoothly into the school-based or pedagogic-didactic learning situation. Mokhaba (1993:77) when referring to the formulation of mathematical concepts in the child's mind when at school says that:

> *Mother-tongue is very important to the clear formulation of mathematical concepts. Through it, the pupil will be able to understand facts, concepts, principles and skills that are communicated to him/her by the subject teacher in the didactic situation during the presentation of the lesson.*

It is important to note that mother-tongue has a stronger influence than second language, and subsequent languages, during the first few years of the child's school career in the learning of mathematics. The importance of

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teaching through mother-tongue, especially in the first few years of the primary school phase, is emphasised by Uhl (1994:80) when he says:

> *Instruction in special mother-tongue or bilingual classes has above all the advantage that it minimises half-literacy. There is a linguistic explanation for this. Apart from bilingualism in the home, the rule is: the greater and more extensive a pupil's ability in the mother-tongue, the better a second language can be learned. The difficulties of the sscond language are only mastered if the basics of the mother-tongue are mastered.*

It is of paramount importance to note that the mother-tongue instruction at school does in no way bring about a lower quality in performance (this includes mathematics) as illustrated by a German multicultural education example of Turkish immigrants by Uhl (1994:80). Such an example was called "sideways beginner" (or "Seiteneisteiger" in German). Uhl (1994:8) says the children have *... attended school in their home country and only come to Germany in their youth.* The author goes on to show that the children performed even better than their Turkish peers who spent years in German schools. The result of the switching over from mother-tongue to German are, according to Uhl (1994:8):

> *They read and write better German, use more advanced diction and sentence structures, perform better in mathematics, display more sophisticated work techniques, and are more successful in vocational training.*

According to the German example there was much harm in the previous South African school's instruction language policy, where the use of either English or Afrikaans as the only media of instruction overshadowed or rendered indigenous languages to be of less importance. Mother-tongue should form the foundation of mathematics teaching, before a switching over to a second or foreign language as a medium of instruction is made.

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The child was expected by socio-pedagogic authorities to switch over from mother-tongue to an official language in a country such as South Africa where there are many ethnically based languages, as it used to be the case prior to the policies of the new government structure which took over after the all-inclusive elections in 1994. The syllabus was then made compulsory to be taught in one of the two official languages, namely Afrikaans or English. This was done so because of the following reasons normally advanced by the education authorities, as summarized by Duminy:

(i) *The mother-tongue does not include the necessary scientific and technical terminology to enable it to be used in the teaching medium at secondary and higher levels of education.*

(ii) *In the mother-tongue instruction there is a paucity of literature in general, and academic textbooks in particular.*

(iii) *The mother-tongue is still associated with the former period of isolation from the main cultural currents of the world.*

(iv) *In wide areas of the country the mother-tongue is not acknowledged as one of the official languages.*

(v) *The commercial value of the mother-tongue is negligible because most employers use only the official languages.*

This meant that in South Africa, mother-tongue might not be used any further than generally in standard 2, according to the then Department of Education and Training. This does not mean that mother-tongue, other than English or Afrikaans might, as a rule, not be developed and used in higher order learning in mathematics, for instance as is the case in other countries. According to Duminy (1980:54) it may happen in other languages (such as German), though the school will have to carry the burden of intensive and scientific development of such a language.

Through purposeful and linguistic teaching, the linguistic efficiency and skill brought from home are now heightened and extended. The school is given the task because the mother-tongue is the most

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effective vehicle or carrier of all the other things that the child is expected to learn at school.

The above arguments, though warranting further premise and research, stand to support the probable hypothesis that any of the ethnically-based languages in South Africa may be developed to serve as a medium of instruction throughout the child's school career and university career. This has fortunately been entrenched into the new South African Language Policy (New Language Policy:9) where it states:

The education language policy in the country must conform to the spirit of the language provisions in the Constitution. In other words, matters such as the medium in which a pupil's instruction takes place and the number of languages that are to be compulsory school subjects may not conflict with the language nor with section 32, which provides that every person shall be entitled to instruction in the language of his or her choice where this is reasonably practical.

4.3 SUMMARY

The six principles discussed above are not necessarily the only ones which have an influence on the pedagogic and didactic situations found in the rural schools in South Africa. As already explained in the introduction, they have been selected on the basis of the fact that they are most commonly discussed in various texts readily available to the rural teachers, and bear much stronger influence or association with the rural learning environment than many other principles.

It is important to note that in order that meaningful teaching or learning may take place in mathematics in the rural situation, a serious consideration of the rural environment is necessary. This rural wealth of experiences brought about by the child forms a strong foundation for integrative learning (totality)

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to take place. Such integrative learning also depends on the capacity developed and encouraged in the child's perceptual senses to assimilate the experiences gathered from home and developed into higher order and more abstract actualization of mathematical ideas.

The language capability developed by the home, as the first learning institution, is then essentially considered as a vehicle of self-expression. The ideas are better initially expressed at school through mother-tongue before a more scientific language is used for further development of such ideas.

From the above explanation, it may be realised that there is a strong interrelationship amongst all the principles discussed in this chapter. It will therefore be in the interest of rural mathematics teachers to always make sure that every teaching or learning adventure undertaken is based on the proper consideration of the "boustene" (Avenant, 1980:54) or principles.

The teaching of mathematics to rural children should always be grounded on the relevant principles in order to boost and establish a closer relationship between the acquisition of mathematical ideas found at home and the higher order development of such ideas at school. The learning of mathematical concepts may become more simplified and easier to acquire. This may also lead to a better awareness and need for self-actualization by the rural children, as their home becomes part of their school and their school also part of their home.

Munn (1993:35-36) explains the importance of the home-school partnership in the educational development of the child when she says:

> *Much out-of-school learning happens in the home, especially in the early years, and some of it is deliberate teaching by parents. Parents also have influence on the sort of media, community and peer group which the child encounters. The process and its relationship to schooling are complex and as yet, incompletely*

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researched or understood (Marjoribanks, 1979; Mortimore & Blackstone, 1989; Tizard & Hughes, 1984) but it seems clear that home-learning, reinforced by consistency of contact and natural bonding, has a powerful influence, especially on attitudes which are learnt.

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CHAPTER 5
EMPIRICAL RESEARCH DESIGN

5.1 INTRODUCTION

In chapters two, three and four, a theoretical framework of reference was developed regarding the perceptions and aspirations of the rural and tribal communities in as far as the relevance and role of mathematics for their socio-economic life is concerned. It became evident that the network of relationships between the mathematics that is taught in the rural classroom and the ethnomathematical experiences children bring along from home into the school, form a major basis for meaningful education to take place in the rural schools.

It had been established that in order for meaningful understanding of mathematics to take place, with special reference to the rural schools, various learning theories and didactic principles need to be properly understood and be fully operationalized by teachers for purposes of being in the position to apply them effectively in the teaching-learning situation in the classroom.

In this chapter the theoretical assumptions stated in chapter one concerning the above mentioned will be placed in empirical context. An attempt will be made to acquire empirical data on **the role of mathematics in developing rural and tribal communities in South Africa.** The method of investigation, the research group, the measuring instrument and the statistical techniques will be clarified. While this will be done, the researcher commits himself to the notion that the people (subjects) who are used in this research are more important than any detached analysis of their actions to maintain a more

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collaborative, personalized (some might even say fraternized) vision of the research.

5.2 METHOD OF RESEARCH

The research method for this study is based on a two dimensional approach. On the one hand, a theoretical field was explored in which the role of mathematics in the rural and tribal communities was studied through the investigation of suitable learning theories, didactic processes and didactic principles, together with how they may be applied in rural classes to foster and boost rural communities' morale and initiative for socio-economic development. On the other hand, an empirical investigation is to be conducted, in which certain assumptions are operationalized as questions or statements that will attempt to gain more information on the role of mathematics in developing rural and tribal communities in South Africa. The two dimensions will then form a coherent organism that will form the basis for understanding the needs and aspirations of the community under discussion.

Answers and responses to questions will culminate in scientifically based suggestions and recommendations regarding the role of mathematics in developing rural and tribal communities in South Africa.

5.3 SAMPLE

5.3.1 POPULATION AND SUBJECTS

The knowledge derived from a research is generally derived from a sample of a universe (Travers, 1978:26) and in the testing of almost any hypothesis by statistical means, an assumption is made that the observations recorded, represent a sample drawn from a defined universe by methods that do not introduce bias (Travers, 1978:285). The universe in this research refers to the population from which the sample was extracted.

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Another definition of **sample** is given by Fraenkel and Wallen (1993:79):

> *Most people, we think, base their conclusion about a group of people (students, Republicans, football players, actors and so on) on the experiences they have with a fairly small number or **sample** of individual members. Sometimes such conclusions are an accurate representation of how the larger group of people acts, or what they believe, but often they are not. It all depends on how representative (that is how similar) the sample is of the larger group.*

For practical reasons, the researcher restricted investigation to selected secondary schools situated within the former Lebowa Homeland (region) in the Northern Province. The sample is regarded as representative of the broader South African society with regard to the rural secondary school population.

The sample in this research is divided into four different categories, namely:

- Standard 10 students of the 1994 mathematics students from ten high schools scattered around the Pietersburg rural villages. Each school is situated at least 20 kilometres from the Pietersburg central business district, but less than 50 kilometres from the same centre. This will be referred to as sample A throughout this work.

- Former Standard 10 mathematics students from any high school (including the above mentioned schools) within the same geographical location. This will be referred to as sample B in this work.

- 1994 Standard 10 mathematics teachers from three rural areas around Pietersburg. It is assumed that most of the teachers selected for this sample will have a rural background and experience based on their own home origin or attachment to the

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rural schools. This is in those areas[3] as the areas are also predominantly rural in terms of location. Such background or experience will enable the respondents (teachers) to respond to the questionnaires with a high amount of accuracy and discriminality. This will be referred to as sample C.

- Parents of guardians of the 1994 Standard 10 mathematics students referred to above. It is assumed that most of the parents or guardians of this group of students reside in the same vicinity of the schools referred to, where their children of children under their guardianship attend school in the already described rural environment. This will be referred to as sample D.

5.3.2 DISCRIMINATION IN THE SAMPLE

In all the samples selected for this research study, gender, race, religion and socio-economic status were not taken into consideration as criteria for selection.

5.3.3 SAMPLE SIZES AND SAMPLING PROCEDURE

Since analysis through descriptive and inferential statistics is anticipated in this research, the samples were made rather large (based on random sampling) for purposes of obtaining more accurate conclusions, as required by practical research than in smaller samples. This notion is supported by Fraenkel and Wallen (1993:187) when they referred to random sampling by indicating that by keeping a large sample is desirable because it helps ensure that one's sample is representative of a larger population since all the characteristics of such a population are assumed to be present in the sample

[3] An area is made up of a group of about four areas. Each area is composed of a number of schools which is for purposes of educational administration.

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in the same degree. This research is based on the same principles discussed previously.

5.3.3.1 **Schools**

From all the schools in the area around Pietersburg, that is, schools within 20 kilometres outside Pietersburg, ten high schools with Standard 10 mathematics were randomly selected from within four different areas. For the school to qualify, it has to be 10 kilometres or more from a formal semi-urban settlement (or township — this is a town in which only black people stay, or stayed, in South Africa in accordance with the abolished Group Areas Act).

Samples A and D are based on the ten selected high schools, while sample B is derived from both schools in sample A and any other schools with Standard 10 mathematics within the same geographic location described above.

5.3.3.2 **Areas**

Sample C, was selected from different rural education circuits around Pietersburg. Teachers (respondents) in this sample are not necessarily from the schools selected for sample A discussed above, although in a number of cases they do come from those schools.

5.4 THE RESEARCH INSTRUMENT

5.4.1 THE CHOICE OF INSTRUMENT

The research instrument chosen for this study is a structured questionnaire, which is referred to as an instrument in which the respondent selects his responses from available categories where answers may come in the form of yes, no, agreed, undecided, disagree and so on (Johnson, 1977:151).

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Mahlangu (1987:25) defines a questionnaire in the following way:

> *The questionnaire or the enquête method usually assumes two forms: (i) the introspective form in which the questions are put directly to the child, touching on matters relating to the child, and (ii) the extrospective form in which the questions about the child are answered by somebody else, usually the teacher.*

Vockel (1983:78) defines it as a device which enables the respondent to answer questions, and that the answers the respondent will give are determined by the nature of the questions. It is of particular importance to note that the researcher has noted the warning cited by Vockel (1983:78) that if one wants the respondent to reveal an attitude, personality trait or other internalized characteristic, the job becomes more difficult.

Four different questionnaires were designed for four different samples, as already discussed in par. 5.3.1 above. The subjects in each sample will respond to the questions by writing or marking an answer (Fraenkel & Wallen, 1993:113).

The main advantage that led up to the selection of this instrument was the fact that it could be mailed to larger number of subjects scattered around the Pietersburg rural environments. However, the questionnaires were not mailed but delivered personally by the researcher or his research agents (namely, principals and mathematics teachers of participating schools, circuit office clerks and some inspectors). The questionnaire was found to be less expensive as a research instrument for this research than interviews (Mouly, 1978:188).

5.4.2 DESIGN OF THE QUESTIONNAIRES

The seeming lack of relevance of science and mathematics within the prevailing culture is perpetrated by abstract textbook presentation of these subjects. This in turn promotes a rote learning approach. As such,

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mathematics and the physical sciences have been instrumental in establishing an intellectual mystique that has been used as a barrier to social access (Nkomo, 1990:391).

The above claim made by Nkomo forms the pivot of this research undertaking with special reference to mathematics in the rural area. This seeming lack of relevance of science and mathematics together with the need for understanding the perceived role of mathematics within the rural communities will be investigated in this work, through the questionnaires. The concept of relevance is defined by Pimm (1988:202) in the following way:

> *Relevance is a property of an appropriate correspondence between qualities of some mathematical topic and qualities of the perceiver. Relevance is a relative notion: it describes a* ***ratio*** *between aspects of the content and the pupil.*

The teaching of mathematics in rural areas has always been done without identifying the perceptions of the rural people on its role and the development impact it has on their day to day lives. In order to understand the degree of credibility the rural and tribal communities give to the role of mathematics in their lives, the questionnaires were developed and designed by the researcher for distribution among such rural subjects. The questionnaires consist of a paper and pencil test comprising items which must be answered on the questionnaires themselves (Sedibe, 1994:102). A more elaborate definition of a questionnaire is given by Walker (1985:91):

> *The questionnaire may be considered as a formalized and stylized interview, or interviews by proxy. The form is the same as it would be in a face to face interview, but in order to remove the interviewer the subject is presented with what essentially is a structured transcript with the responses missing.*

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Four sets of questionnaires[4] were designed as a means of answering the research questions. The questionnaire statements, which were based on the content of the literature study conducted in chapters one, two, three and four above claim validity. The statements of the four questionnaires are basically similar, as they share the same thematic content. Their only major difference is that they are meant to address different respondents, namely, students, former students, teachers and parents or guardians.

The questionnaires consist of information about the following categories of the teaching of mathematics, and its role, in the rural and tribal communities in South Africa, ranging from the role of mathematics in community development, rural mathematics awareness, attitude to mathematics and community involvement in mathematics[5].

In compiling the questionnaires, an attempt was made to design statements or questions to which answers will be representative of:

- The views of present (1994) Standard 10 mathematics students on the role of mathematics (Sample A).

- The views of former Standard 10 mathematics students on what they see as the role of mathematics in their present and post-school spheres of life (Sample B).

- The views and role of parents or guardians of students doing mathematics in Standard 10 in 1994. The role of parents or guardians in their children's work is believed to have a remarkable impact on the performance of their children's work, not only in mathematics but also in other school subject areas. A similar

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4 See questionnaire in Appendix B.

5 These categories are covered by the four hypotheses discussed in chapter one.

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observation was made when parental and community involvement was invigorated in Los Angeles in the United States of America and research thereof was conducted. This involvement resulted in improved reading attainment for sixth grade students (Walberg, 1982:318). An opportunity is hereby created in this research to establish a similar pedagogic impact parental involvement may have in the rural community (Sample D).

- The views of teachers of the 1994 Standard 10 mathematics on what they see as the role of mathematics in the development of the communities they serve (Sample C).

5.4.3 BIOGRAPHICAL INFORMATION

In this research, no names were required from the respondents to ensure anonymity, because it is believed that if such anonymity is not guaranteed, then those who return questionnaires may well be very different individuals from those who do not (Travers, 1978:329). The importance of anonymity is stressed by Biott in Burgess (1993:64) during a research that was conducted in a group of schools to evaluate the progress of a project called ESG Urban Primary School Project:

> *Teachers felt able to say what they wanted to say only if they were protected by anonymity, and some of the anonymous statements they made at that time were subsequently included, with their agreement, within the **history** section of the final report.*

Information on the sizes of the family units were required, together with employment information of breadwinners to gauge what type of community background was prevalent in the population under scrutiny. Circumstances which would allow or disallow the smooth studying in the home environment for the students were also included, as it is believed that they might have an influential bearing on the attitudes of students and other members of the community towards the learning of mathematics.

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5.5 A SURVEY OF THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

5.5.1 BACKGROUND PERSPECTIVE

In order to make reliable conclusions regarding the perceptions of rural communities on the role of mathematics on their (communities) day to day lives, this chapter will attempt to determine, by means of structured questionnaires, whether all the groups (samples) harbour the same or different views. There will be intra- and intergroup correlations to determine if there is consensus or lack thereof, in the responses on the role of mathematics in these communities.

5.5.2 DATA COLLECTION BY MEANS OF QUESTIONNAIRES

5.5.2.1 The research group

The research group is composed of four different sub-groups referred to in paragraph 5.3.1. as samples A, B, C and D[6].

The groups were randomly selected, though the researcher considered the fact that areas should be predominantly rural in nature.

5.5.2.2 Distribution method

The researcher distributed the questionnaires to the schools and through agents such as principals, inspectors, mathematics teachers and other teachers with whom the researcher made special arrangements.

The agents were requested to administer the questionnaires to Standard 10 students and Standard 10 mathematics teachers equally in each case. For

[6] See par. 5.3.1 above.

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students this would be done in class, while in the case of teachers questionnaires would be distributed during area-based or regional mathematics meetings or conferences. This methods simultaneous administering was chosen in order to uphold the criteria of uniform implementation (Sedibe, 1994:105) and because the instrument saves time, since it is administered to all members of the group at the same time and usually in the same place (Fraenkel & Wallen, 1993:347). However, this criterion was not slavishly adhered to, as in some cases with parents or guardians and individual respondents responded at different times. In cases, for instance where teachers did not have a formal mathematics meeting, they would respond to the questionnaires at their respective homes or schools.

In the case of the former Standard 10 mathematics students (sample B), the questionnaires were given to students and teachers at the 10 selected schools to help trace the respondents. Some were traced by the researcher and other by his agents. Due to a variety of factors such as distance from the workplace or higher and tertiary education in institutions far off, the number of responses was predicted to be limited.

In the case of parents or guardians of the 1994 Standard 10 mathematics students, the questionnaires were given to the students themselves to give to their parents or guardians to complete and return to the principals by the same route.

Some questionnaires were written in the local language (that is Northern Sotho) for illiterate or semi-illiterate respondents in the latter group. This was done because it was assumed that some parents or guardians would not be able to read English, given the low level of English literacy in the Northern Province. In the latter's case the respondents were required to use the services of an interpreter of their choice, other than their own children, to assist them in completing the questionnaires. The researcher and his agents

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were also available for assistance in interpreting the questionnaires and filling in the appropriate answers as dictated by the respondents.

In all four cases a uniform procedure of completing the questionnaires was explained to the respondents on the cover page of each group's questionnaires. The criteria according to which the questionnaires were compiled, will be discussed.

5.5.2.3 **Compilation of the questionnaires**

In order that it may be claimed that the questionnaire is scientifically valid and acceptable for research, it is necessary to use the essences table (Sedibe, 1994:105) and the Advantages and Disadvantages of Close-Ended versus Open-Ended Questions table below (Fraenkel & Wallen, 1993:351)[7].

TABLE 5.1: ESSENCES TABLE (Adopted from Sedibe, 1995:106)

FEATURES OF THE QUESTIONNAIRE	DESCRIPTION	MEANING OF THE QUESTIONNAIRE REGARDING THE YOUTH'S PERCEPTION ON CAREER LIFE
1. Choice of question		
• Question selection	Questions of which the answers will be meaningful in solving the research problem, are selected.	Meaningful questions have been selected, for example questions that are related to the adolescent's perception on career life.
• Questions interest	Questions are selected that should stimulate the curiosity of respondents.	

7 See Appendix.

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FEATURES OF THE QUESTIONNAIRE	DESCRIPTION	MEANING OF THE QUESTIONNAIRE REGARDING THE YOUTH'S PERCEPTION ON CAREER LIFE
• Question enthusiasm	Priority is given to questions which will create enthusiasm among respondents, in order to motivate them.	
• Question scrutiny	A thorough study of the research field is undertaken to highlight essences which may be formulated as questions.	
2. Question formulation		
• Question phrasing	Essences are written as questions in a comprehensive manner.	An effort was made to formulate questions in such a manner that they may not be incorrectly interpreted by Standard 8 and 10 pupils.
• Question meaning	The respondents must understand the meaning of each word in the question.	
• Question exactness	The meaning of each word in the question must be simple and unambiguous.	
3. Question reduction		
• Question enlightenment	Each question (if possible) is subdivided into further, shorter questions.	Each question in the questionnaire is reduced in such a manner that it asks the Standard 8 and 10 pupils exactly and clearly what it is supposed to ask regarding their perceptions on career life.
• Question concretisation	Each question must be related to something that actually constitutes a problem.	
• Question specialisation	Each question should be focused on a single aspect of the research field.	
• Question clarification	All possible signs of prejudice are removed from the questions.	
• Question rationalisation	Questions are rewritten in terms of perceptions.	

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FEATURES OF THE QUESTIONNAIRE	DESCRIPTION	MEANING OF THE QUESTIONNAIRE REGARDING THE YOUTH'S PERCEPTION ON CAREER LIFE
4. Question classification		
• Question ordering	Related questions are grouped together.	Related questions are grouped together in the questionnaire.
• Question purpose	Do the questions assist the researcher to clearly pursue the research objectives?	
5. Question evaluation		
• Question phenomenology	Will each question pass the test of phenomenological processing?	Each question in the questionnaire has been evaluated phenomenologically.
• Question testing	How does each question rate as meaningful after the pretest?	
6. Question structuring	Questions are structured to facilitate local, systematic, unambiguous and motivated answers.	The questions are logical and well structured.
7. Application		
• Selection of respondents	Sampling techniques are used to randomly select respondents who may have the required information, and who will be willing to share this information.	

5.5.2.4 **Layout and structure**

The questionnaires in this study were structured according to the procedures summarised in Table 5.1 above, to determine the views of the rural people, in respect of the mathematics to rural and tribal communities in South Africa.

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5.5.2.5 **Interpretation of the questionnaires**

(a) Introduction

According to Sedibe (1994:07), when citing Smith (1981:1) each scientific field endeavours to unravel a specific, more or less defined segment of the "Umwelt". Such knowledge may not be obtained in a disorderly manner. It must be unravelled in an orderly and systematic way. It is therefore important to note that information obtained through completed questionnaires should be given in such a way that meaningful conclusions are obtained.

According to Wiersma (1980:47), such meaningful conclusions or necessary data may be obtained if a research problem has been adequately formulated and appropriate hypotheses or questions have been developed and all items related to the research problem, and as a composite, they should produce the necessary data.

Such necessary data may be obtained through statistics method that lends itself to such exposition. This method is described as a mathematical discipline concerned with the collection, analysis and interpretation of data (Johnson, 1977:34).

The statistical method that will be used in this research depends on the measuring scale which will be used. In each questionnaire an opinion of the respondent will be sought. If the respondent is unable to respond to all the items as required by the questionnaire, a conclusion will be reached that the respondent had either not understood the question(s) or statement(s) or it will be assumed to have no answer to the item at all.

These respondents' questionnaires will be used together with those who responded to the entire questionnaire. If there are, for example, 31 items in a questionnaire, and one respondent completes only 15 items, the 15 items will be evaluated and regarded as a complete questionnaire response, and

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will be evaluated similarly with those who completed all the 31 items. The intervals are thus equal according to the measuring instrument. The following are possible calculations in this research:

- Calculation of the Norm
- Calculation of the Standard Deviation
- Calculation of the correlation coefficient
- Statistical analysis procedures including, among others, the Chi-square test, Kruskal-Wallis Variance Test and percentages.

An attempt will, therefore, be made to structure the information in such a way that the perceptions of, and attitudes of rural and tribal communities to the role of mathematics in theerlives are clearly identified.

(b) Interpretation of questionnaire data

Each questionnaire is designed to give each respondent a chance to express his views on, or attitude to, the need for mathematics to address the rural patterns of life with the primary aim of developing such communities.

Different perceptions will be studied, within each group, while comparisons will be conducted between groups. A cross-sectional approach will be used to collect this data. This design involves the collection of data at one point in time from a random sample representing some given population at that time (Wiersma, 1980:168).

Each question or statement will be analysed separately according to its basic features. The data will be analysed according to each sample or subgroup. For example, teachers' questionnaires will be analysed for teachers only, as a subgroup. After all the subgroups' responses have been analysed, groups will then be compared to get a global assessment of the responses.

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5.5.2.6 **Rationale of the questionnaires**

The questionnaires were designed with the following aspects taken into consideration:

(c) The dimensions and their related questions or statements

The dimensions discussed in the preceding chapters are applicable here. These dimensions, together with their related questions and statements will be presented here. The questions to be asked in a questionnaire or in an interview reflect the hypotheses or research questions involved. To find out what to measure, one needs only to mention all the variables that are being dealt with in the study involved (Tuckman, 1988:223-224). This procedure has been followed in this research under discussion.

Questionnaires A, B, C and D will be mentioned here (the same procedure will be followed in the next chapter). Some of the questions and statements have been adapted from Rambaran (1989:173-328) and Fraenkel and Wallen (1993:112-113).

It must be noted that most of the divisions in the questionnaires are interrelated. The statements or questions could be repeated in more than one division or dimension for the purpose of the operational research.

All the questions and statements are based on assumptions which were stated in the literature review discussed in the preceding chapters. The focus of the dimensions is on the role of mathematics in developing rural and tribal communities in South Africa. The purpose in mind is to establish the views of the entire community fabric by cross-sectionally administering the questionnaires to students, their teachers, their parents and the former students, with the ultimate aim of determining the need for curriculum review, reorganisation or remodelling to suit the lifeworld of the rural and tribal communities.

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Reference will be made to the subject's response by citing card number (C) in the case of Questionnaire 1, 2 and 3 and (B) in the case of Questionnaire 4, while in the case of Questionnaires 1, 2, 3 and 4 the letter (V) will be used to denote variable[8]. An example of the above is as follows: C15V14 will refer to card number 15, variable number 14 in question 11 of Questionnaire 1[9].

Because of the nature of mathematics it has always been regarded as a subject with a simplistic linear structure, which is an assumption long thwarted by people such as Travers (1978:101) and the attitude of teachers, students and parents or guardians who rejected it, the following have been included to address this attitude specifically:

(i) Cognitive domain

The greater part of Questionnaires 1 and 2 is based on the relationship between the child (student) and the subject (Mathematics). The attitude of the student towards the subject or against it may determine the degree to which the subject will be assimilated by him. According to Orton (1992:125) a limited amount of research has been done in this field but he points out that *... interesting results were obtained by Kempa and McGough (1977) in a study of attitudes to mathematics amongst sixth form students.* Orton (1992:125) goes on to say that:

> *Kempa and McGough also claimed that students' views about the difficulty of mathematics did not appear to have been a major determinant of whether students chose mathematics in the sixth form. Much more important were the perceived usefulness of mathematics and a liking for the subject.*

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8 Questionnaires are named as follows: Questionnaire 1 (for sample A); Questionnaire 2 (for sample B); Questionnaire 3 (for sample C) and Questionnaire 4 (for sample D).

9 See Appendix B for copies of questionnaires.

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Attitude is referred to as an affective framework that predisposes an individual toward or against, away from actions, information and attitudinal objects (Wilson, 1969:324). Another definition of attitude is given by Letshufi (1988:3) when he says:

> *... attitudes are learned, emotionally toned predispositions to react in a consistent way, favourably or unfavourably. Attitude therefore influence the individual's acceptance or rejection of persons as they have meaning for the individual. Once incorporated into the self, they force the individual to act and react in a way consistent with his beliefs and feelings.*

The assumption made in the questionnaires is based on the fact that certain attitudes exist within the subjects' (students') minds on the mathematics content or its teaching, with special reference to the rural teaching learning situation.

The love or hatred for the subject matter and the amount of confidence or lack of it established by the student concerning the teacher, together with the level at which adults in the home have developed interest in what the child does at school, will influence the type of attitude that will develop between the student and the subject matter. This will in turn have a bearing on the degree of assimilation of the subject matter. Bastiani in Munn (1993:103) points out the significance of partnership in the educational development of the child, when he says:

> *... successful schools go well beyond the basic legal requirements to develop effective, two-way communication that are accessible in a variety of ways and at all reasonable times, work hard to find ways in which parents can encourage and support their children and provide them with practical help and above all, build a sense of shared identity and common purpose — the beginnings of at least a genuine partnership.*

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The theory of life space developed by Lewin (1942:210) on positive and negative valences bears this out. His description of learning, both as cognitive change and as change in valences reflects this emphasis. In any cognitive change (that is intellectual learning) change in knowledge and so on plays an important role (Zais, 1976:289).

The items on attitude change, for example C15V9 and C25V10[10], dwell on the theory stated above by Zais (1976:289) where attitude is said to influence the degrees to which the student's cognitive structures react to the impact of learning mathematics in this case.

(ii) Normative domain

The degree to which mathematics may change perceptions and values in the society in their day to day life, form the focus of this study. The dimensions in which this will take place is the affective one. The child in the rural community goes to school to learn mathematics with certain expectations in mind. Such expectations may come from him as an individual or his teacher or the society at large. The pattern of parental involvement that focuses directly upon the educational process, with the parent participating as an educator, shows a relationship with school achievement in mathematics (and reading), as well as self acceptance (Walberg, 1982:319). Such expectations will come with a lot of pressure in the case where parental involvement cited above by Walberg in his studies, in American school exist.

Among such expectations are changes in personality, attitude and socio-economic status. The questions and statements have been structured to establish envisaged changes in the self-actualising educand. Vrey (1979:15-16) and other psychologists in this field argue that unless an individual has an inner feeling of the need to change from within himself, external attractions may fail to bring about this process. This idea is supported by De Corte (1995:9) when he says:

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[10] See Appendix B for Questionnaires 1 and 2.

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> *... it is generally agreed upon that effective and meaningful learning is facilitated by an explicit awareness of, and orientation towards a, goal (Bereiter & Scanndamalia, 1989; Shuel, 1992). Because of its constructive and self-regulated nature, it is plausible to assume that learning will be most productive when students choose and determine their own objectives; therefore, it is desirable to stimulate and support goal-setting activities in students.*

C15V12 and C25V13[11] are, for example, intended to find out from the respondents, and particularly the students, whether they see mathematics as being likely to bring about change in their lives and future careers. The researcher intends to establish whether there is any utilitarian or technocratic values the respondents envisage, which may have a bearing on their career development. As it was pointed out in chapter one, mathematics, as a perspective of education, may change the socio-economic patterns of the lives of rural people as a driving force behind self-awareness and creative participation in the creation of wealth. Education, including mathematics as one of its components, has never had the influence of its "bottom line" to industry questioned by the public. It may often be stated that the objective of education is the cumulation of cross forces, but its efficiency is generally perceived as the total of the "vertical force". The governmental curriculum policy will continue to influence human resources needs (Warwick, 1989:26).

(iii) Motivational aspect

Motivation has already been discussed as a basis for sound learning environment and opportunities[12]. The items in this section[13] are predominantly aimed at establishing the extent to which parents and

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[11] See Appendix B in Questionnaires 1 and 3.

[12] Discussed in chapter four.

[13] See Appendix B in Questionnaire D (items B53V10 and B53V11).

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guardians get involved in the work of their own children or children under their guardianship at school.

These items described above have been included to determine the extent to which parents and guardians are/are not, expected to play a role in the motivation of their children or children under their guardianship, to learn mathematics at school as the basis for community development.

(iv) Development factor

If formal education (of which mathematics is a component) is to be beneficial to the villagers, it needs to be perceived as something which meets their desires and expectations, either in terms of socio-economic mobility, social status or both (Rao, 1985:273). Rao's argument anchors in the overall general formal education, but since mathematics is one of the major components of the curriculum package in schools today, given its technological usability, its role in the development of rural and tribal communities is to be put under the spotlight, with desires and aspirations cited above.

The role of mathematics in developing rural and tribal communities is the major focal point of this research[14]. The questionnaires have been designed in such a way as to unearth the views of various subjects (respondents) in the four samples on what they regard as being the role of mathematics in developing the communities under discussion.

For example, ClSV14, C15V15 and C15V34 to 38 deal specifically with this assumption. In the other questionnaires, the same assumption is also dealt with, like in C53V30 to 37.

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14 This constitutes the null hypothesis.

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(v) Parental or community involvement

Parents' involvement in their children's school work is one of the subjects that are under vigorous debate within the various communities as having a serious influence on the performance of children at school. Maree (1995:49) summarizes this debate by saying:

> *Leerlinge is afkomstig uit verskillende huislike omgewings en het verskillende agtergronde. Daar is leerlinge uit vermoënde huise en leerlinge uit behoeftige huise; leerlinge verskil ten opsigte van etniese en kulturele agtergronde; motivering om op akademiese gebied te presteer verskil van kultuur tot kultuur soos ook leerlinge se belangstellings en die premie wat hul ouers op geleerdheid plaas.*

For the experiences and cultural background, brought to school by various children, to have any meaningful influence, a warm and caring relationship between the student and parents, relatives or the community in which he lives need to be developed in the home, as Maree (1995:49) puts it:

> *Leerlinge uit meer stimulerende omgewings het 'n rykdom van ervarings en leer dikwels makliker. Eweneens gebeur dit dat leerlinge uit behoeftige huise (nie-stimulerende omgewings) soms agterstande het, sukkel en stadiger leerders is as gevolg van beperkter ervarings.*

This argument is taken a step further more specifically by Cronbach (1977:207) when he says that the warmth of the home is evidently the most important factor in promoting the child's adjustment while firmness with opportunities for independence produce boys who in Grade III and VI are superior in school work, successful as leaders and easy to work with other people.

According to the arguments posed by the two educationists above, it seems vital to find out how parents at home treat their children or their children's work. Presumably, and as already argued above, without the warmth of parents or home environment, certain attitudes uncalled for may develop and

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affect the children's learning. Christiansen, *et al.* (1986:43) indicate the value attached to communication between the school and parents for purposes of promoting a healthy learning environment and opportunities for children when they say:

> *Schools vary greatly in the degree to which they encourage visits from and communication with parents. Yet it has long been realised that parental help and prompting can be a major determinant of a pupil's success. It is important then to create opportunities for contact between parents and teachers. This is done in many countries through, for example, "parents evenings" or the "Fachkonferenz" at which school programmes can be discussed with parents present.*

The view expressed by Christiansen *et al.* cited above is supported by Decker, Decker, Demmon-Berger, Martin and Hill (1988:63) when they say that:

> *... the more people who are involved in community education's planning and programs, the more successful those programs will be. The positive side of increased involvement by many is a sense of community cohesion.*

The questionnaires have been designed to establish the level of involvement of parents or guardians in the school mathematics world of their children, or children under their guardianship.

Items such as C15V19; C15V34-38; C15V50-51 and B53V38-51 deal more specifically with this issue[15].

(vi) Rural culture in mathematics

The concept of rural culture and ethnicity in mathematics has been included as items in the questionnaire. This has been done because the total cultural

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15 See Appendix B for Questionnaires 1-3.

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environment socialises the student into dispositions which are the raw material of any educational enterprise. When children go to school they bring interest, prejudices, enthusiasms, strengths and limitations, formed in part through indiscriminate contact with the total culture (Mncwabe, 1990:25).

In particular, the rural experiences brought to school by the rural pupils appeal to the teachers to show interest in plant and animal life and have some training in drawing and simple handwork. The more interesting features of the neighbourhood should not be overlooked (Bell & Sigsworth, 1987:38).

It is crucial thus, for rural mathematics teachers to note that their students may also bring these experiences to school and the role of the teacher is to interpret them into theoretical principles in mathematics and demonstrate their applicability in the school work.

There is also a strong need to take into consideration the influence of different cultural backgrounds of students concerning mathematical achievement, as emphasized by Maree (1995:49)[16].

The items on rural culture have been included to establish the level of awareness of the rural communities in the assumed abundance of mathematical content issues or availability of natural resources in the vicinity of, and within the rural communities and their schools. Kindred, Bagin and Gallagher (1984:17) warn against the school running its programs against the expectations of the community when they say:

> *Nothing evokes a quicker reaction from parents and citizens than the adoption of policies and practices that run counter to their established attitudes, beliefs and habits. This has been evident on many occasions when new blocks of subject matter have been*

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16 Maree referred to this in par. 5.5.2.6.

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introduced into the curriculum that cause pupils to think or act contrary to the convictions held by parents or relatives.

The questionnaire items have been included to establish such sensitivities, amongst others.

This consideration of parents or guardians discussed above will facilitate the expression of community views on the inclusion, exclusion or extended development of the branch of mathematics called ethnomathematics. The latter deals predominantly with cultural issues in mathematics[17].

The items relevant in the aspect discussed (namely culture in mathematics) are, inter alia, C15V31-32; C15V45; C25V31-34 and B53V38; B53V43; B53V53-54[18].

It is of particular significance for the teacher to know the level of involvement of the members of the community, especially parents or guardians, in the student's work. It is the duty of the teacher to learn something about the interests of communities which take up some of the time of families with pupils in the school. Antonouris and Wilson (1989:135) support this view as follows:

Knowing the interest of mum, dad and children will help teachers understand the influences surrounding the pupil, and may lead to insights which can then be used to develop pupil learning in the classroom situation.

The home background and community involvement are assumed to have a closer correlation with what children may need to learn in the classroom in order to become balanced personalities.

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17 Ethnomathematics was discussed in chapter four.

18 See Appendix B for all questionnaires.

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Where parents have a knowledge and understanding of what the school is trying to achieve and are sympathetic towards it, they will be likely to encourage their children to adopt the goals, values and outlook implicit in the programme of secondary education that is being offered. Concerning this, effective communication between the school and parents will lead the parents to motivate and manage the child in ways that the school finds help (Smith & Tomlinson, 1989:54).

5.5.2.7 **Administration of questionnaires**

The questionnaires were administered to the various subjects in the samples according to the following procedure:

(a) Access letter into research area

The researcher submitted an application for permission to conduct research in the areas and schools of the Department of Education in the former Lebowa homeland, a months before conducting research in the mentioned areas. The Department of Education approved the application, sent approval letters to the ten selected schools and all the areas that were likely to be affected. The researcher was also sent an approval letter which allowed him access into any of the schools[19].

(b) Pilot research

Pilot work, that is, conducting preliminary try-outs of the measuring instruments, is essential and takes time (Postlethwaite, 1986:127). This is conducted to determine whether questionnaire items that are to be used in the intended population posses the desired qualities of measurement and discriminability. Pilot tests enable the researchers to debug the questionnaires by diagnosing their failings (Tuckman, 1988:237-238).

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19 See Appendix A for the copy of the letter of approval.

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One school was selected for purposes of pilot research. The school does not form part of the research group. There were seven students doing Standard 10 mathematics in1994. They were given Questionnaire 1 (that is Standard 10 mathematics questionnaire) to complete and return through their principal. They were also given Questionnaire 4 to give to their parents or guardians to complete and return through their principal.

The mathematics teacher of the seven students referred to above was given Questionnaire 3 to complete and return to the principal of his school. All completed questionnaires were collected by the agent of the researcher and returned to the researcher for analysis and evaluation.

Five other Standard 10 mathematics teachers[20] from the neighbouring pilot research school were given teachers' questionnaires by the researcher to complete and return to the researcher.

After receiving all the completed pilot research questionnaires, the researcher reviewed the responses by eye for clarity and distribution without necessarily running an item analysis (Tuckman, 1988:237). Minor linguistic mistakes were discovered such as sentence construction and spelling errors. Such errors were corrected and returned for another round of response. After receiving the second pilot responses, the questionnaires were regarded as refined.

After this exercise, the questionnaires were viewed to have a high degree of reliability which encompasses important qualities of data such as (1) Stability of data; (2) Internal consistency, and (3) Equivalence of alternate test forms (Eichelberger, 1989:119).

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20 These teachers were not teaching standard 10 mathematics, but had taught such classes before.

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(c) Distribution of research questionnaires

The questionnaires were designed for four different groups of the research sample. The administration of the questionnaires was thus going to be conducted according to the groups[21].

(i) Questionnaire 1 (1994 Standard 10 mathematics students)

The questionnaires were taken to the ten selected high schools[22] by the researcher or his agents. The questionnaires were given to the principal to give to the mathematics teachers to distribute to the respondents to complete within a given period[23]. After completion of the questionnaires, they were packed and sent back to the researcher, or collected by the researcher or his agents, on a set date.

(ii) Questionnaire 2 (former Standard 10 mathematics students)

The researcher contacted the principals of the ten selected schools to give him (the researcher) the lists of names and contact addresses (both physical and postal addresses) for their 1992 and 1993 Standard 10 mathematics students who had completed their studies. Students in any class assisted, where necessary, in furnishing the principals or researcher with information pertaining to the whereabouts of those ex-students. The ex-students' parents or guardians were approached by the researcher to gather appropriate information.

The former students were visited on an individual basis by the researcher or his agents and given the questionnaires to complete. Those who were not easily reached (because of economic or transport reasons) were sent the questionnaires by mail and requested to send them back to the researcher. The school also assisted by sending questionnaires through students from

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[21] The samples and corresponding questionnaires have already been discussed in par. 5.5.2.6 above.

[22] Selected schools were discussed in par. 5.3.1.

[23] One day was agreed upon for completion of these questionnaires.

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any class who happened to have easier access to the respondents, as their relatives, friends or acquaintances.

A period of two months was allowed for respondents in this sample because of the technical problems related to accessibility and traceability. As a result of a possibly limited number of respondents who were traceable and as a result of job placing or higher education studies, the researcher considered even respondents who did not come from the sample schools referred to in paragraph 5.5.2.7 above[24].

In the latter case the researcher or his agents collected the questionnaires from the respondents, or in cases where this was not easy, the researcher or his agents requested them to send the completed questionnaires to the researcher by mail.

(iii) Questionnaire 3 (1994 Standard 10 mathematics teachers)

The questionnaire in this sample was sent to the 1994 teachers of mathematics in Standard 10 in the following areas (circuits) through the area managers, area inspectors or mathematics advisors:

- Polikwane circuit
- Mankweng circuit
- Ramokgopa circuit
- Kone-Kwena circuit
- Nebo circuit.

In each case an equal number of questionnaires to the corresponding number of schools offering mathematics in Standard 10 in the area, was sent to the area offices. At least an extra 10 questionnaires were included to cater for

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[24] See par. 5.3.1.2. Students who came from other schools than those in the sample schools, were also considered.

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the schools which might have more than one Standard 10 mathematics teacher.

On the front page of each questionnaire an explanation for the completion procedure was explained.

The researcher made arrangements with the area (circuit) offices to collect the responses and keep them safely for collection on a set date. In some cases the agents based at the area offices took them to the researcher's home.

(iv) Questionnaire 4 (parents or guardians of the 1994 Standard 10 mathematics students)

The students[25] were given their parents' or guardians' questionnaires by their principals or mathematics teachers to give to their parents or guardians to complete. The questionnaires meant for this sample respondents had the following special points considered:

- **Language**

  Two different linguistic groups were provided for. There were questionnaires written in English as well as questionnaires which were written in Northern Sotho, which is the home language of the vast majority of students in the ten selected schools, according to the records of all the schools[26]. The major reason for the need to translate into Northern Sotho (the home language) was based on the prevalent incidence of illiteracy in the area, as one of the studies conducted by Carstens, Du Plessis and Vorster (1986) discovered, as quoted by Maree (1994:48):

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25 1994 Standard 10 students referred to in par. 5.3.1.

26 See Appendix B for the two types of questionnaires.

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... in 1986 was 45% van alle swartes bo die ouderdom van 20 geletterd, 68% van alle kleurlinge in dié ouderdomsgroep, 80% Indiërs en 97% blankes.

As a result of this handicap the researcher produced English based questionnaires for those who may be able to read and write English. Another batch was translated into the predominant home language (Northern Sotho) used in the Pietersburg rural environment.

- **Interpretation of questionnaires**

  The researcher recognised the fact that some adults were not able to read nor write. The students taking questionnaires to their parents or guardians were requested and guided by the researcher and his agents, together with the principals and mathematics teachers in the ten selected schools, to help their parents or guardians interpret and to explain the questions or statements to the respondents, where necessary.

  Permission was given to let the intermediaries complete responses dictated to them by the respondents, if the respondents could not read or write. It was the responsibility of the researcher to pay some visits to the respondents, on a sample basis, to ascertain that no rigging of the research took place.

5.6 SUMMARY

After all completed questionnaires were received from the respondents, the necessary follow-ups were made by the researcher and his agents. The responses were entered into the computer. Analyses, deductions and conclusions about the data will follow. The analysis of the results are

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discussed in chapter six, while deductions, conclusions and recommendations are done in chapter seven[27].

It was pleasing to note that in all the samples, a **high percentage** of responses on the questionnaires were received. These percentages will be discussed in the following chapter under the heading: **Analysis of data and results.**

27 See chapter one for the hypotheses preceding the deductions and conclusions.

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CHAPTER 6
DATA PROCESSING AND STATISTICAL ANALYSIS OF THE RESULTS

6.1 INTRODUCTION

The discussion in this chapter is on the methods used to process the results, together with the methods used to analyze and interpret results statistically by means of the computer. These will help to find out the attitudes, perceptions and aspirations of the various categories of subjects on the role of mathematics in developing rural and tribal communities in South Africa. According to Worthen and Sanders (1987:328), the aim of data analysis is to reduce and synthesize information to make sense out of it and to allow inferences about populations, while the aim of interpretation is to combine the results of data analysis with value statements, criteria, and standards in order to produce conclusions, judgements, and recommendations. Since the individual respondents were merely required to complete one questionnaire, the results will be discussed according to each questionnaire. In each questionnaire individual (or groups of) items will be analyzed. The research will be analyzed in order to test the validity of the null hypothesis and other related hypotheses expressed in chapter one, paragraph 1.4. It will be of importance to repeat these hypotheses in this section in order to refocus the work on the goal of this research.

6.1.1 THE NULL HYPOTHESIS

The present mathematics taught in rural high schools does not play an important role in developing rural and tribal communities in South Africa.

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6.1.2 OTHER HYPOTHESES

There are three other hypotheses which developed or emerged alongside the null hypothesis. Such hypotheses are:

- **Hypothesis 1:**
  The rural communities in South Africa do not have a positive attitude towards mathematics.

- **Hypothesis 2:**
  The rural communities in South Africa are not interested in getting involved in the education of their children in mathematics.

- **Hypothesis 3:**
  There is no mathematics awareness in the rural environment amongst the rural communities in South Africa.

The data will be analyzed in order to find out whether the null hypothesis is accepted or rejected. On the basis of the null hypothesis more evidence will be analyzed to determine the relationship between the null hypothesis and other factors such as attitude to mathematics, involvement of rural communities in mathematics learning activities of their children concerning curriculum matters, and mathematics awareness in the rural environment, all expressed as hypotheses 1, 2 and 3 respectively.

It will also be necessary to find out how related to one another the four hypotheses are. Therefore, there will be a need to use non-parametric statistical methods such as the Kruskal-Wallis non-parametric one-way analysis of variance in which the p-value is used. Chi-Square and Spearman Correlation coefficient will also be referred to[28].

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28 These are discussed in chapter seven, par. 7.3.5.

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It should, however, be noted that while some statistical methods will be used to analyze data, the predominant approach in this research is based more on qualitative verification of the hypotheses. The focus is based more on the individual response to various questions or statements in the questionnaires.

6.2 DATA PROCESSING

Since there were four different questionnaires meant for four sample groups, each questionnaire's responses were entered into the computer in four different categories. Because of the variably large sizes of the samples, the computer was found to be a useful instrument in this work. This would ensure accuracy and fastness in calculating the data, as supported by Slavin (1984:219) when indicating that calculation of statistics using the computer is faster and more accurate than computing statistics by hand or with a hand calculator. Although the storage of data was a tedium in itself, the analysis of data was rapidly and accurately executed.

6.2.1 THE STORING OF RESPONSES

- The alternatives marked by each respondent in each questionnaire were entered into the computer.

  The responses for Questionnaires 1, 2, 3 and 4 were entered separately.

  In Questionnaire 1 (Standard 10 students) and Questionnaire 4 (Standard 10 parents or guardians), the responses were entered according to the school to which the sub-sample belongs. In the case of Questionnaire 2, (for former Standard 10 mathematics students) no specific attachment to a school was considered as

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an issue. In the case of Questionnaire 3 (teachers) the responses were grouped according to the area or circuit in which the teachers are working.

- After the responses were entered, a print-out was made. The entries were checked to ensure that they corresponded with the responses made by the subjects in the returned questionnaires. Errors were rectified and reentered to ensure that all the data was correct.

- The computer supplied the following information on the printouts:

- ○ The number of respondents in each group, school or circuit. This allowed for checking to verify that the number entered corresponds to the number of returns initially recorded.
- ○ Mean score in each variable.
- ○ Standard Deviation in each variable.
- ○ Minima and maxima.
- ○ Analysis of each individual variable with the following information:
    - * Frequency distribution of responses
    - * Percentage
    - * Cumulative frequency
    - * Cumulative percentage.

The accuracy of the statistics supplied by the computer was determined by the use of pocket calculator, together with pen and paper.

It must be noted that all the information was entered by means of the codes next to the responses that the pupils had encircled. The responses were moved into a box that corresponds to the variable number and another code on the far right.

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6.2.2 DISCUSSION OF QUESTIONNAIRES

Each questionnaire will be discussed individually hereunder under the subheadings of "Data processing method" and "Storing of responses in the computer".

6.2.2.1 Standard 10 mathematics students questionnaire (Q1)

(a) Data processing method

The processing of responses from Standard 10 mathematics students questionnaire involved responses to 51 questions or statements. All the 315 students completed the questionnaire, with 100% returns.

(b) Storing responses in the computer

The responses in the Standard 10 mathematics students questionnaire were entered into the computer as follows:

- The name of the student's home village was entered, with a supplied code.

- The occupation of father and of the mother. Codes were also used.

- ○ The number of individuals staying in one house. Codes represented numbers.

- ○ Number of students in the mathematics class to which the respondent belongs. Codes represented given numbers.

- ○ The responses to all other items were entered differently according to variables.

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- ○ In the case of variables that did not have predetermined response choices the respondents were required to give their own views. The views were grouped according to similarities and given a similarity codes, which were then entered into the response code boxes for entry into the computer. An example is found in Variable 39 in which the respondents were required to give their own opinions on how mathematics can develop the rural communities. Responses were given codes from 01 to 31. The codes represented modes of development.

  The information was checked from the print-out to ensure its correctness and accuracy. After this routine checking, the information was re-entered before analysis could take place.

6.2.2.2 Former Standard 10 students (Q2)

(a) Data processing method

The processing of responses from the former Standard 10 mathematics students involved responses to 35 questions or statements. Only 37 out of 100 responses were received, largely due to the following major limitations:

- This group is composed of individuals who left school after completion of their studies.

- Most of them have entered into the world of work and they are therefore not easily traceable.

- Some of them went back to school after being unsuccessful in their matric results, even if they had passed mathematics in their completing years.

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- Some of them have been admitted into higher education and tertiary institutions and could not be easily contacted, given the financial constraints in conducting this research.

  It was however regarded as fortunate to reach a response number such as 37, which was found to be a, somewhat, useful number.

(b) Storing of responses in the computer

The responses in the former Standard 10 mathematics students questionnaire were entered as follows:

- The home villages of the respondents were entered into the computer according to the code provided for each given village.

- Both the father and mother's occupations were also entered according to the given codes provided for such given occupations, where applicable.

- The occupations of the individual respondents were also given codes.

- For the year in which the respondents passed their Standard 10, codes were also used.

  - The symbols obtained by the respondents in mathematics were also recorded with codes.

  - In the case of all other variables the response options were predetermined and the respondents had to encircle the chosen option.

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- All the encircled responses were then transferred to the response boxes on the right hand side, next to the correct variable number.

- The information was checked from the computer print-out to ascertain its correctness and accuracy. All the necessary corrections were made and reentered into the computer.

6.2.2.3 **Standard 10 mathematics teachers (Q3)**

(a) Data processing method

The processing of responses from the Standard 10 mathematics teachers questionnaire involved 73 questions or statements. All the 48 out of 50 respondents completed the questionnaire.

(b) Storing of responses in the computer

The responses in the Standard 10 mathematics teachers questionnaire were entered into the computer as follows:

- The name of the village where the respondent is working was entered, with a given code.

- The highest mathematics qualifications and professional qualifications of the teachers were given specific codes.

- Experience in years of teaching mathematics was also entered with a given code.

- The number of students which the respondent is teaching mathematics was also entered into a code.

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- In item 12[29], variables V15 to V19, the respondents were required to give their opinions on the concepts in which they believe there is a lot of rural environmental mathematics concepts. Such concepts were grouped according to given codes and entered into the computer.

- In all the other variables, the responses had pre-determined options from which the respondents had to choose.

6.2.2.4 **Parents or guardians of present Standard 10 mathematics students (Q4)**

(a) Data processing method

The processing of responses in this questionnaire involved responses to 57 questions or statements. 156 out of 200 parents or guardians responded in the questionnaire. The number of respondents in this sample does not correspond with the number of **respondents** in Q1 (see par. 6.2.2) above because of some of the following presumed reasons:

- Only one of the parents to the Standard 10 mathematics students was allowed to respond. No provision was made for both parents.

- Some students do not stay with their parents due to migratory labour system to which one or both parents might have been subjected. No provision was made in the research to allow such parents to return home and complete the questionnaire.

- Some parents or guardians were not given the questionnaires because of sheer negligence from their dependents.

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29 See Appendix B, Questionnaire 3.

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- Some parents did not fill in the questionnaire due to the rate of illiteracy prevalent in this research group and environment, nor manage to get someone independent to complete the questionnaire on their behalf while the respondents gave verbal responses.

(b) Storing of responses in the computer

The responses in the Parents or Guardians' Questionnaire were entered into the computer as follows:

- The names of the parents or guardians' home villages were entered as supplied by the respondents. Each village was given a code.

- The parents or guardians' occupations were entered with specific codes.

- The number of children doing mathematics in each family was also entered with a code that represented a specific number.

- The respondents were also requested to give their own opinions on how mathematics may develop their communities. Opinions were given specific codes according to similarity groups. Such modes of development were given number V35 to V37.

○ In all other items the respondents had to encircle a response from a set of pre-determined options.

○ After the entry of all responses, a print-out was made to facilitate thorough checking. After the entries were checked and corrected, they were then reentered into the computer.

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- After all the information from the four samples was entered into the computer, a composite printout was made and the information was checked. Mistakes were rectified, where necessary, and the corrected information was re-entered. Maximum care was taken to ensure the correctness and accuracy of the information.

6.3 DATA ANALYSIS

This section will be devoted to the analysis of data that was entered into the computer. This will entail analysis of responses to questions or statements in each of the four samples. All items will be analyzed, compared, correlated and collated, where need arises, to determine the degree of consensus on the role of mathematics in developing rural and tribal communities in South Africa.

6.3.1 DISTRIBUTION OF RESPONSES

6.3.1.1 Standard 10 mathematics students questionnaire (Q1)

A total of 315 students from 9 rural high schools around Pietersburg City responded to the questionnaire. Table Q1.2 in Appendix E gives the summary of the distribution of responses according to individual variables. The table gives in summary form, the following information

- There are 51 variables in the questionnaire which were responded to.

- The highest possible number of respondents in the group is 315, but only a total of 313 responded, as shown by the highest actual number of respondents in V10, V11 and V19 (by highest possible number where reference is made to all the students who were

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given questionnaires and should have responded, all things being equal).

- The lowest number of respondents to a variable is recorded in V39 as 81.

- The highest possible response mean is 23.6761905 as recorded in V1, while the highest actual mean is 22.3653846 in V4.

- ○ The lowest possible response mean is 1.000000 in V3 while the lowest actual mean is 1.0622010.

- ○ The highest possible Standard Deviation is 16.8903330 and the lowest is 0.17. The highest actual Standard Deviation is 12.9806121 and the lowest actual Standard Deviation is 0.1733599.
  - * The minimum response is 1.00000.
  - * The highest possible maximum of all the variables is 68. This maximum indicates in which variable the highest number of response was recorded.

6.3.1.2 **Former Standard 10 mathematics students**

A total of 37 responses were received from this sample. Table Q2.2 in Appendix E gives a summary of the response information. The following information is derived from this table:

- There were 35 variables in the questionnaire.
- The maximum number of respondents in each variable who returned completed questionnaires is 37 (or 100%).
- The minimum number of respondents per variable is 15.
- The highest actual respondents mean is 17.

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- The lowest actual mean variable is 1.2162162.

- The highest Standard Deviation of respondents is 30.9073115 and the lowest is 0,34. This implies that in V8 the respondents differed tremendously in terms of the years in which they passed Standard 10 mathematics as shown by a high Standard Deviation of 30.9073115.
  - The highest minimum respondents in each variable is 2.0000000.

  - The lowest minimum respondents in each variable is 1.0000000.

  - The highest maximum respondents in each variable is 94.0000000.

  - The lowest maximum in each variable is 2.0000000. This indicate that the highest number of respondents in a variable is recorded as 94.000 as shown in V8 Observation 29 in Table Q2.1. This implies the lowest possible number of observations.

6.3.1.3 **Teacher's questionnaire**

A total of 48 response returns were received from three different areas of education inspection or group of circuits. Table Q3.2 in Appendix E gives the summary of the distribution of responses. The following information was derived from the summary:

- There were altogether 80 variables in the questionnaire.

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- The highest possible number of respondents per variable is 48 and the lowest possible number of respondents per variable is 1.

- The lowest actual number of respondents per variable is 3.

- Variables 62 and 63 were included by mistake and were therefore not responded to. They both do not have any substantial information recorded.

6.3.1.4 **Parents/Guardians' questionnaire**

A total of 156 response returns were received and Table E, Appendix Q4.2 gives the summary of the responses. The following information is extracted from this table:

There were 54 variables in the questionnaire.
The highest number of responses per variable is 156.
The highest mean value per variable is 18.7051282.
The lowest mean value per variable is 1.0000000.
The highest Standard Deviation per variable is 11.6126838.
The lowest Standard Deviation per variable is 0.1132277.

6.4 DATA INTERPRETATION

If all the questionnaires are put together, the following information is interpreted:

- There is a total of 555 response returns received in this research.

- The mean in each case indicates the average number of responses in each variable.

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- The minimum indicates the lowest possible number of response options existing in each variable.

- The maximum indicates the highest number of response options available in each variable.

6.5 ANALYSIS AND INTERPRETATION OF RESULTS

The results in this research were processed through the assistance of computer output. Each variable will be analyzed and interpreted individually. In some cases tables will be used to illustrate and emphasize similarities or differences amongst the responses, especially if such responses belong to the same category, such as the various modes of community development on page 142.

6.5.1 STANDARD 10 MATHEMATICS STUDENTS[30]

As already indicated in paragraph 6.2.2.1, there were altogether 315 variables which had to be responded to. Each of the 315 variables' responses will be discussed below. eference will be made to Table 1.3 Appendix B whenever the number of respondents (N) Means (M) and Standard Deviations (S) are discussed. The following aspects are relevant:

- **Respondent number**

V1 indicates that 315 respondents completed the questionnaire.

- **School number**

V2 shows that a total of 10 schools selected for this purpose were involved in the research with frequencies shown in the frequency tables. This information is summarized under V2. The sample sizes range from

[30] See Questionnaire 1 (Appendix B).

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minimum of 7 to maximum of 44, which means that the smallest number of Standard 10 mathematics students so far recorded is 7 and the largest number is 44.

- **Card number**

V3 gives 315 card numbers, which correspond to 315 respondents.

- **Home village**

In V4 a total of 46 villages were registered as the ones from which the 315 students came. The frequency table indicates the number of pupils coming from a particular village. The highest concentration of students doing Standard 10 mathematics is found in village number 15, with 62 students or 19,9% of all the students together. 6,9% of the villages have only one student doing Standard 10 mathematics in this research.

- **Father's occupation**

V5 indicates the mode of father's occupation and the summary. It is noted that 36,1% of the respondents come from a family in which the father is employed as a labourer which is the normal case in rural villages. It may also be realised that 20,4% come from families where the father has died. Another important feature is the fact that 35 or 11% of students did not answer or do not have fathers. It is however somewhat encouraging to note that only 7.1% or 20 come from families with unemployed fathers. Another notable feature of the results is the fact that 6.8% or 19 students are supported by fathers who are on pension.

- **Mother's occupation**

In V6[31] the employment of mothers to Standard 10 students is spread through 40 modes. The highest concentration of employment mode is that of housewife, which virtually refers to unemployment of women in the rural

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[31] See Appendix B.

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areas. This comprises 37,6% or 106 students who come from such a background. The next is 17% or 48 who have been explicitly recorded as unemployed. The combination of the two modes amount to 54,6% or more than half of the mothers who are without economically active employment. The highest percentage of those who are in some form of employment is labourers: (12,4% explicit labourers and 10.3% domestic workers). Only 4,3% of the female parental workforce are employed as teachers. 5,7%'s mothers have died. It may be concluded that the mortality rate of mothers is lower than that of fathers in this area if compared as 5,7%: 20,4% = $\pm$ 1:3. It is also noted that 33 students had no parents or did not respond to this variable.

- **Number of people at home**

V7 (see Table Q1V7) indicates that the number of people living at home with each of the student range from 5 to 10. High concentrations of students live with 3 people, 2 people, 6 people and 1 person. 70, 54, 53 and 44 students, respectively, are living with such a number of people, as shown by respondents choice in the questionnaire.

It is however, noted that 37,3% of the students stay with more than five people in their families. This may have a negative bearing on the students studies and their level of concentration due to home noise disturbance and overcrowding tendencies.

- **Number of pupils in class**

In V8, the numbers of pupils or students in the same class with the respondents vary from 24 to 144. The highest number of students belongs to a class with 144. This comprises 27,6% of the sample. An interesting deduction to be made in this regard is that 82 responded to the questionnaire and 62 did not do so. The next largest concentration is that of students who belong to a class made up of 32 students and 9,4% from

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a class with 31 students. 18 students did not know the number of students in their classes.

- **Attitude**

V9 required students to reveal their attitude to mathematics. Attitudes were measured on a three-point scale. The results are as follows:

Those with a negative attitude (I hate it) amounted to 0,6%. Those with a positive attitude (I like it) amounted to 54,3. There was 45% of students who were unsure of their attitude to mathematics. Only 4 students did not respond to this variable (recorded as missing frequency). It may thus be deduced that mathematics is loved by the majority of the pupils in the rural areas.

- **Post-matric mathematics study**

V10 was meant to find out the level of interest in students to study mathematics further. A three-point scale was also used and the results are as follows:

62,9% have an interest in studying mathematics further. Only 5,8% intend not to study mathematics beyond matric and 31,3% are undecided. Only 2 students did not respond to the question (frequency missing). Linked to "Attitude" above, the important deduction to make here is that since mathematics is liked by most of the pupils, the corresponding keenness to study it further is indicated and expected.

- **Reason for study**

In V11 the respondents were required to indicate the reason why they will or will not study mathematics beyond matric, and the following were the results:

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60,7% of the students believe that mathematics is an important subject. These are probably those who chose to study mathematics further as mentioned previously. 22,4% indicated that they are weak in mathematics and will thus probably not study mathematics further. 15% believe that mathematics is useless, while only 1,9% believe that they cannot apply mathematics in their lives. They have also probably chose not to study it further. Only 2 students failed to choose any reason.

- **Mathematics role**

In V12, which is the centre of the **null hypothesis in this research**[32] the students were required to say whether mathematics has or has no active role in their villages. A three point scale was used and the following results were recorded.

68,9% agree that mathematics plays an important role in their villages; 11,5% do not believe that mathematics plays a role. 19,6% do not know or failed to identify the role played by mathematics in their villages. It is thus significant to note that mathematics is viewed by most rural students as having a meaningful role to play in their villages.

- **All students to study mathematics**

Linked to the role of mathematics in villages, V14 requires respondents to indicate if they feel that all other students need to study mathematics. The results were recorded as follows:

22,9% felt that all students in the village should study mathematics, while 32,3% felt that it was unnecessary. It is however interesting to note that 44,8% felt that the matter should be left to individual students to decide. In other words, the interpretation in this variable is that even students who

[32] The null hypothesis states: The present mathematics taught in the rural high schools does not play an important role in developing rural and tribal communities in South Africa.

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regard mathematics as important and having a role to play in their villages, do not deem it necessary to have all students studying mathematics.

- **Mathematics and community development**

In V14 the respondents were requested to indicate if mathematics can help to develop their communities. A three-point scale was used and the following results were recorded.

88,1% agreed that mathematics may help to develop their communities. Only 2,9% disagreed while 9% indicated that they did not know. Only 3 did not answer the question.

- **Mode of development**

In V15 to V18 only those who chose "Yes" as an answer or who agreed with the notion that mathematics could help to develop their communities (that is the 88,1%) were required to indicate "Yes" or "No" concerning the mode of development they believe mathematics will assist in developing their communities. The results are summarised in the following table:

TABLE 6.1: SUMMARY OF MODES OF COMMUNITY DEVELOPMENT

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
15	136	1,68	0,47	31,6%	68,4%
16	202	1,10	0,30	90,1%	9,9%
17	148	1,55	0,36	84,5%	15,5%
18	149	1,67	0,15	93,3%	6,7%

○ In Q1V15, mode of development is "By forcing all students to study Mathematics". The results recorded are:

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31,6% agreed and 68,4% disagreed. It is thus deduced that the respondents feel it unnecessary or unuseful to force people to study mathematics for purposes of community development. A total of 179 did not respond to this question as it was a conditional one.

- In V16: "By encouraging all students to study Mathematics" and the results were recorded as:

  A total of 90,1% of the students who said "Yes" in V16 felt it necessary to have students encouraged to study mathematics. However, 9,9% did not agree with this notion.

- In V17 respondents were supposed to respond to the statement: "By developing a closer relationship between the home and the school". The results are as follows:

  84,5% of the respondents agreed with the statement and 15,5% did not agree. This implies that the majority of the students feel the need for school and rural communities to forge a closer relationship between themselves.

- In V18 the statement to be responded to is "By appointing qualified mathematics teachers to the school". The results were:

  An overwhelming 93,3% agreed that more qualified mathematics teachers should be appointed while only 6,7% differed. There is, according to the response, a need to increase qualified manpower in schools to increase the productivity level or to increase and develop more positive attitudes towards mathematics.

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- **Discussion of mathematics with parents or guardians**

In V19 all the respondents in Questionnaire 1 were requested to say if they ever discuss their mathematics work with their parents or guardians. A three point scale was used and the results were recorded as follows:

49,5% of the respondents said they discuss their work with their parents, while 47,6% said that they never discuss their work with their parents or guardians. Only 2,9% failed to remember if they do discuss their mathematics work with their parents or guardians.

- **Starting the discussion of the students' work**

In V20 the respondents were required to say if they are the ones who start the discussion in V19 above. Again, this means that the questions should be answered only by those who answered "Yes". The results are as follows:

Surprisingly 309, as opposed to 155, who answered "Yes" above, responded to the question. But the results indicate that 142 (or 46%) said that they do start the discussions. This may be assumed that it is 142 out of 155 who said "Yes" in V19 above. The remaining 9 of those who said "Yes" in V19 joined those who said "No" in V19 above and responded "No" to V19 saying that they do not start the discussions.

- **Parents'/Guardians' remarks**

In V21 to V27 the respondents were requested to indicate the types of remarks which parents or guardians used to make after discussing the respondent's mathematics work with them. This implies that only those respondents who chose "Yes" as an answer to V19 would respond to the subsequent questions or statements. The following results were recorded (also summarized in Table 6.2):

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TABLE 6.2: SUMMARY OF PARENTS'/GUARDIANS' REMARKS

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
21	113	1,89	0,30	10,6%	89,4%
22	190	1,14	0,35	85,8%	14,2%
23	111	1,56	0,50	55,9%	44,1%
24	128	1,29	0,46	71,1%	28,9%
25	108	1,58	0,50	58,3%	41,7%

- **For V21 (boring!)**

  10,6% indicated that their parents or guardians felt that the work done by students in mathematics is boring, while 89,4% did not feel that the work was boring. In this case 10,6% constitutes negative response represented by "No" and 89,4% represents "Yes" in Table 6.2.

- **For V22 (Good!)**

  85,8% said that their parents regarded their work as good or appreciable while 14,2% said that their mathematics work was not appreciated by their parents or guardians.

- **For V23 (Don't disturb me!)**

  Of the 111 respondents, 44,1% said that their parents or guardians did not want to be disturbed by discussing their children's mathematics work with them. 55,9% said that their parents or guardians did not feel disturbed. 44,1% represents "No" while 55,9% represents "Yes" as they constitute negative and positive, respectively.

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- **For V24 (Relevant to our life!)**

  71,1% indicated that their parents regarded their work as relevant to their lives. 28,9% did not regard the work as relevant. In this case, 41,7% represents negative feeling (No) and 58,3% stand for positive feeling (Yes).

- **For V25 (Irrelevant to our life, but continue!)**

  41,7% indicated that theii parents regard the work as irrelevant, meanwhile 58,3% felt that the work was not irrelevant.

- **Mathematics in the home environment**

The respondents were requested to indicate if they felt mathematics concepts existed in their home environment.

A three-point scale option system was used for selection of the answer and the results are as follows: 42,5% agreed that a lot of mathematics exists in their home environment. It is important to note that the majority of respondents are aware of the amount of mathematical ideas that are available in their home environment. 28,6% did not agree, while 28,9% did not know if mathematics existed in their home environment.

- **The use of local examples in mathematics by teachers**

In V29 respondents were requested to show if examples from their home village background were ever used to explain mathemattcal concepts. A four-point scale was used for selection of one option from the four. 21,5% agreed that this was done in every lesson. 17% said that the examples were used rarely by their teachers. Only 5,5% could not remember, while 55,9% said that no such examples were used.

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- **Examples from the environment to make mathematics interesting**

In V30 the respondents were required to indicate if more examples from their environment would make mathematics lessons more interesting. Five options were given and the following results represent the choices.

30,8% strongly agree; 38,5% agree and 6,7% disagree. 3,5% are those who do not at all know, while 20,5% are not sure. In a further summary one may say: Strongly Agree + Agree = Agree which is: 30,8% + 38,5% = 69,3%. It is an important observation to note that many students feel that their home background or environment should be brought into their mathematics curriculum. Those who do not agree showed the following responses: Disagree = 6,7%. Don't know + Not sure = 3,5% + 20,5% = 24%.

- **Adults to demonstrate mathematical concepts**

In V31 the respondents had to show if they agree or disagree with the notion that ordinary adult community members may be requested to show, in class, some of the mathematical skills or concepts from their rural background.

22,5% of the respondents agreed with this move and 33,1% did not agree with the suggestion. Those who felt it an unnecessary practice amounted to 44,4%. Those who disagree and those who feel it is unnecessary to do so may be regarded as both being in disagreement over the issue; and both put together amount to 75,5%. There is, thus, a high level of rejection of this practice by the students.

- **Parents to know their children's performance in mathematics**

In V32 the respondents were required to show if their parents may be encouraged to find out or know the performance of their children. A four-point scale was used. The results are as follows:

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53,2% strongly agreed to the suggestion while 38,7% agree. All those who agree ("strongly agree" plus "agree") make up 91,9%. Those who disagree make 4,8% while those who don't know make up 3,2%. It is therefore deduced that the students are in favour of their parents or guardians having access into the former's school work in mathematics. Hopefully this is done by parents or guardians for purposes of encouragement of their children to learn more mathematics and other related skills.

- **Teachers to discuss with parents**

In V33, respondents were to show if they agree with their teachers discussing their students' work with the latter's parents or guardians. The results are as follows:

21,2% strongly agree with the suggestion, while 25,4% agree. Those who strongly agree and those who agree, together, make up 46,6%. 41% disagree with the suggestion; 12,34% do not know or are not sure of whether this should be allowed or not. Pupils who agree with the suggestion and those who do not agree are on the balance.

- **Mathematics in community development**

In V34 to V38 the respondents were required to express their feelings about how mathematics can develop their communities. Five suggestions were given from which choices would be made by saying "Yes" or "No" in each case. The results are summarized in Table 6.3, each corresponding with the discussion:

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TABLE 6.3: SUMMARY OF MODES ON INFLUENCE TO COMMUNITY DEVELOPMENT

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
34	193	1,07	1,25	180	13
				93,3%	6,7%
35	152	1,38	0,49	95	57
				62,5%	37,5%
36	209	1,06	0,2	196	13
				93,8%	6,2%
37	139	1,24	0,43	105	34
				75,5%	24,5%
38	135	1,25	0,42	101	34
				74,8%	25,2%

- **In V34 (Making us find work quickly)**
  Those who answered "Yes" = 180 or 93,3%; "No" = 13 or 6,7%.

- **In V35 (Changing our way of thinking)**
  Those who answered "Yes" = 95 or 62,5%; "No" = 57 or 37,5%.

- **In V36 (Making us think more scientifically)**
  Those who answered "Yes" = 196 or 93,8%; "No" = 13 or 6,2%

- **In V37 (Making us think more productively)**
  Those who answered "Yes" = 105 or 75,5%; "No" = 34 or 24,5%.

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- **In V38 (Making us earn more money)**

  Those who answered: "Yes" = 101 or 74,8%; "No" = 34 or 25,2%.

- **Respondents' own opinion**

The respondents were given an opportunity to give their own opinion which they felt had not been covered in the opinions provided in V34 to V38 above. Only one opinion was allowed. The results are as follows:

Opinions are coded and range from 1 to 31. The most important opinions selected are:

- "Mathematics provides us with better future or life". 8,6% of the 81 respondents gave the opinion.

- "Mathematics will help us gain admission at university or other post matric studies institutions". 8,6% of the 81 respondents gave this opinion.

- "Mathematics makes us think scientifically". 8,6% of the 81 respondents gave such an opinion.

- The next highest of the opinions given were those with 7,4%. Opinions having such percentages were "Makes us brilliant". "None of the opinions" and "Mathematics is important for development".

The rest of the opinions varied from 4,9% to the lowest percentage point (namely, 1,2%).

From V40 to V44 the respondents were required to express their views regarding the role of mathematics in the training of their minds. They were

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given statements in which they had to say "Yes" or "No" to show agreement. The responses are as follows (also summarized in Table 6.4):

TABLE 6.4: SUMMARY OF VIEWS ON THE ROLE OF MATHEMATICS IN THE TRAINING OF THE MIND

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
40	159	1,43	0,50	57,2%	42,8%
41	208	1,17	0,38	82,7%	17,3%
42	144	1,42	1,50	57,6%	42,4%
43	130	1,97	0,17	96,9%	3,1%

- **In V40 (It could retard our mental development)**

  Those who answered "Yes" = 91 or 57,2%; "No" = 68 or 42,8%.

- **In V41 (It will enable us to be socio-economically productive)**

  Those who answered "Yes" = 172 or 82,7%; "No" = 36 or 17,3%.

- **In V42 (It will retard our socio-economic development)**

  Those who answered "Yes" = 83 or 57,6%; "No" = 61 or 42,4%.

- **In V43 (It (mathematics) will make us *"tsotsis"* or thieves)**

  Some ordinary rural people, it would seem, regard subjects such as mathematics to contribute to the general crime rate in the country such as drug trafficking and bank robbery, as they serve to waken up and wisen up many youths. Such subjects are associated with intelligence, and the general belief is that high intelligence quotients contribute to sophisticated and calculated

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crimes. The concept of *"tsotsis"* was brought in to determine if the rural people also harbour the same perception and the following results were obtained.

Those who answered "Yes" = 4 or 3,1%; "No" = 126 or 96,9%. The "Yes" represents negative response and "No" represents positive response in this case and will thus be swapped in Table 6.4.

This implies that such a notion is almost non-existent, and this is a recipe for high confidence in mathematics in the rural areas.

- ○ **In V44 (I have no option regarding this matter)**

  Those who answered: "Yes" = 42,3%; "No" = 78 or 57,7%.

- **Mathematics and communities' uncivilized practices**

In V45 the respondents were required to respond to the statement: "Mathematics will help us in changing some of our Community's uncivilized practices." The results are as follows:

125 or 40,6% said that they strongly agree with the statement. 114 or 37,0% agree. Collectively this means that 239 respondents or 77,6% agree with the statement. It is important to note that rural children believe that mathematics may assist, with its natural laws, the community to break away from their past and accept realities such as thunderstorms and many other practices as natural and not manmade. 44 or 14,3% disagree while 25 or 8,1% do not know or do not have an opinion regarding this matter.

- **Rural mathematics as a subject**

In V46 the respondents were required to respond (by strongly agree, agree, disagree or don't know) to the statement: "Rural mathematics

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should be developed as a subject for rural pupils". The results are as follows:

57 or 18,4% strongly agreed with the statement and 99 or 31,9% agree. A total of 156 respondents or 50,3% agree with the statement. It is an important observation to note that at least half of the respondents see the need for the development of rural Mathematical ideas into a full-fledged subject. Whether this is possible or not, it is a matter of significant debate. The same argument for such mathematics is embedded in the argument on the development of ethnomathematics as a subject meant to address the needs of rural people and other cultures whose advocates are people such as D'Ambrosio (1985), Gerdes (1988) and Bishop (1988). 122 or 39,4% disagree with the statement, while 32 or 10,3% said that they don't know.

- **Mathematics bias towards urban communities**

In V47 the respondents were required to say if they strongly agree, disagree or don't know to the following statement: "The present school mathematics is biased towards urban communities". Here follow the results.

23 respondents or 7,5% strongly agree with the statement and 60 or 19,5% agree. Those who strongly agree and those who chose agree make up 83 or 26,9% of the total of those who agree with the statement. It is noteworthy and important to realise that many rural students (50% as opposed to 26,9% being those who agree) do not believe that mathematics taught in schools necessarily favour the urban children. Of the 308 respondents, 154 or 50% disagree, while 71 or 23,2% do not know.

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- **Changing of Standard 10 mathematics syllabus**

In V48 the respondents were requested to give their view (by strongly agree, agree, disagree or don't know) with regard to the following statement:

"The Standard 10 mathematics syllabus should be changed to suit rural pupils". The responses, were given as follows:

39 out of 311 or 12,5% strongly agree with the statement and 75 or 24,1% agree. A total of those who fall under the category of agreeing with the notion of the need for syllabus change amount to 114 or 36,7%. Those who disagree are 154 or 49,5%. There is a significant link between responses given in the changing of Standard 10 mathematics syllabus and the responses given in the consultation of rural communities and pupils. The number of respondents in both cases differ by 3 only, and the Standard Deviations have a difference of 0,03, while the means differ by 0,24. Those who disagreed that mathematics is biased towards urban communities still feel that there is no need to change the syllabus. Those who disagree with the two notions remained almost the same. Each amounts to 50% or 49,5%, respectively.

It may thus be deduced that because there seems not to be any bias of mathematics towards the urban mode of life, there is thus no need to change the syllabus for that particular purpose.

- **Consultation of rural communities and pupils**

In V49 the respondents were required to express their feelings (by strongly agree, agree, disagree or don't know) to the following statement: "Rural communities and pupils should be consulted when a relevant mathematics syllabus is compiled. Here are the results:

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62 or 20,0% strongly agreed with the statement while 104 or 33,5% agree. Collectively the group that agrees with the statement is 166 or 53,5%. Those who disagree are 89 or 28,7%. 53 or 17.7% do not know.

- **Rural community structures in mathematics committees**

In V50 the respondents were required to say if they strongly agree, agree, disagree or don't know in the following statement: "Rural Community structures should be represented in any mathematics subject committee." The results are as follows:

30 or 9,8% strongly agreed and 111 or 36,3% agree. Together they make 169 or 55,2% those who agree with, or accept, the statement. 99 or 30,1% disagree with the statement. 45 or 14,7% are those who do not know. It is important to note that these responses and those concerning consultation before implementation of the new syllabus, have a considerable link. Those who agree and those who disagree in both cases show the same features and they balance fairly well. Those who agree amount to 53,5% and 55,2%, and those who disagree amount to 28,7% and 30,1%, respectively. Both sets of respondents indicate that those who believe that rural communities should be consulted are the very ones who say that rural communities should be involved in curriculum or subject committees. Those who believe or agree in the two notions are in the majority. The involvement of parents or members of the community is regarded as quite important, as explained by Kriek (1996:189) when he said:

> *Die gemeenskap het self 'n verantwoordelikheid teenoor die onderwys in die algemeen en spesifiek teenoor skole en die daarstelling van kurrikula wat aan die eise van 'n moderne samelewing voldoen.*

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This argument seems to agree with the feelings expressed by rural communities in this research.

- **Consultation before implementation of the new syllabus**

In V51 the respondents were required to respond, by strongly agree, agree, disagree or don't know, to the following statement: "When a new mathematics syllabus has been compiled, it should not be implemented before the rural communities have been consulted." The results are as follows:

30 or 9,8% strongly agree with the statement and 77 or 25,2% agree. A total of 107 or 35% collectively agree with the statement. 142 or 46,4% disagree with the statement and 57 or 18,6% do not know. It is of noteworthy importance to discover that even though the majority of students regard both consultation of rural communities when syllabi are designed and direct or indirect involvement in subjects or curriculum committees as important, they, however, do not believe that it is necessary for implementors of the syllabi to consult them before actual implementation takes place.

6.5.2 FORMER STANDARD 10 STUDENTS

The responses to questions are as follows:

- **Number of respondents**

V1 indicates that 37 respondents completed and returned the questionnaire.

- **Number of schools**

V2 indicates that all the 37 respondents came from two different groups. 16 respondents came from the first group while the rest (21) came from another group. It should however be noted that the respondents were not

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from only two schools but schools divided by the main road stretching from Pretoria to Tzaneen. This divides the research area into two main geographical areas.

- **Card number**

V3 gives 37 card numbers which correspond to the number of respondents in this questionnaire. The questionnaire in this section is referred to as Card Number 2.

- **Home village**

In V4 it is indicated that respondents come from 17 villages. The highest number of respondents coming from the same village is 9. They come from village number 9. This is followed by 7 respondents who come from village number 1.

- **Father's occupation**

In V5 respondents had to indicate the type of occupation their fathers were involved in and they responded as follows:

The highest number of respondents showing that their fathers followed the same occupation is 9 and their occupation is Code 2 (teacher). This occupation is followed by 7 respondents showing that their fathers have died (shown by Code 01). This means that 22,6% of those who responded to this variable have their fathers dead.

- **Mother's occupation**

In V6 the respondents had to show their mothers' occupation and they responded as follows:

18,2% (6) of mothers are employed as labourers while 15,2% are housewives, 15,2% are unemployed. In essence, this means that 30,4% of respondents' mothers are not in any form of formally and

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commercially-active employment. 9,1% are in the teaching profession. There are 12 forms of employment choices given. 15,2% of respondents' mothers have died.

- **Respondents' occupation**

In V7 the respondents were requested to give their present form of occupation and the following data was given:

44,8% of the respondents are students, either repeating Standard 10 or furthering their education. Amongst those who are in employment, 17,2% are teachers, 10,3% are nurses and 6,9% are unemployed. The rest is shared amongst other forms of employment.

- **Standard 10 completion year**

In V8 the respondents were required to show in which year they had passed Standard 10. They responded in the following ways:

Most respondents (that is, 19,0%) completed Standard 10 in 1992, followed by 14,3% in 1989 and another 14,3% in 1993 and with 9,5% completing in 1980 and another 9,5% in 1991.

- **Mathematics symbols**

In V9 the respondents were asked to disclose the symbol they obtained in their Standard 10 mathematics. The results are:

The highest number of respondents (45%) obtained an E symbol. This is followed by 15% who obtained symbol C. Amongst the respondents there is only one who obtained symbol A. It is important to realise that very few students pass mathematics satisfactorily. This is shown by the fact that only 15% obtained above an E symbol out of the 20 who responded to the question.

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- **Attitude to mathematics**

In V10 the respondents had to indicate their attitude to mathematics and the following are the responses:

Three different options (1, 2 and 3) were given but the respondents confined their responses to options 2 and 3 which stand for the liking of mathematics and the having difficulty in understanding it, respectively. 75,7% show that they like mathematics while 24,33% indicated that they have difficulty in understanding it. The fact that 75,7% of the respondents have shown to have a positive attitude towards mathematics has specific and significant implications to both the teaching and learning of mathematics in the rural high schools. These implications and findings will be discussed in detail in chapter seven.

- **Mathematics studies in future**

In V11 the respondents were requested to show if they intend to study mathematics in future, and the results are as follows:

83,8% of the respondents intend to study mathematics in future, while 10,8% do not intend to do so. 5,4% were not sure of their future with regard to mathematics.

- **Main reasons for studying mathematics**

In V12 the respondents had to give main reason for studying mathematics in future by choosing one reason from five given options. The results are as follows:

89,2% regarded mathematics as an important subject. 5,4% felt that mathematics may not be applied in their lives.

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- **Importance of mathematics in home village**

In V13 the respondents were required to say if mathematics is important in their home village and they responded thus:

Out of 37 respondents, 78,4% gave "Yes" as their answer. 10,8% of all the respondents said "No", while another 10,8% were not sure. It is of noteworthy importance to discover that the majority of respondents (78,4%) in this questionnaire and in this variable corresponds and correlate with previously mentioned response in the Standard 10 mathematics questionnaire, in which 88,1% of respondents believe that mathematics may help to develop their communities. Both groups of respondents view mathematics as pivotal in community development.

- **Mathematics' influence in community development**

In V14, the respondents had to indicate if mathematics could influence the development of their communities. They responded in the following ways:

62,2% said that mathematics could influence their communities, while 18,9% disagreed and a further 18,9% were not sure.

- **Mode of mathematics influence on community development**

From V15 to V21 two options in each case have been given in Table 6.5 in which to say "Yes" or "No" on a given mode of mathematics influence to community development statement.

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TABLE 6.5: SUMMARY OF MODES OF INFLUENCE ON COMMUNITY DEVELOPMENT

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
15	18	1,4	0,5	9	6
				61,1%	38,9%
16	22	1,3	0,5	11	5
				68,2%	31,8%
17	19	1,26	0,45	14	5
				73,7%	26,3%
18	20	1,4	0,5	12	8
				60%	40%
19	15	1,9	0,26	14	1
				93,3%	6,7%
20	16	1,88	0,34	2	14
				12,5%	87,5%
21	20	1,45	0,51	11	9
				55%	45%

- **In V15 (Adults going back to school)**

  61,1% agreed by saying "Yes" and 38,9% disagreed by saying "No".

- **In V16 (Students teaching mathematics in the village)**

  68,2% of 22 respondents agreed by saying "Yes" and 31,8% disapproved of the statement by saying "No".

- **In V17 (Teachers applying rural concepts in mathematics)**

  73,7% agreed by giving "Yes" as an answer while 26,3% disagreed by saying "No".

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- **In V18 (Retarding community development)**

  60% of the respondents agreed with the statement by giving "Yes" as an answer while 40% disagreed by saying "No". It is surprising to realize that 60% agree with the above statement as opposed to the 93,3% disagreement in V19 below.

- **In V19 (Turning everyone into a thief or mugger)**

  6,7% agreed with the statement by choosing "Yes" as an answer while an overwhelming 93,3% disagreed by choosing "No".

- **In V20 (Making people unnecessary clever)**

  12,5% agreed with the statement by choosing "Yes" and 87,5% disagreed by choosing "No".

- **In V21 (Making people socio-economically active)**

  55% of the respondents agreed by choosing "Yes" as an answer and 45% disagreed by saying "No".

- **Mathematics enjoyment in class**

In V22 the respondents were required to say if they enjoyed mathematics lessons in their classes. Their responses were given as follows:

75% of the respondents said that they enjoyed their mathematics lessons in class by choosing "Yes" as an answer, 16,7% said that they did not enjoy the lessons, by choosing "No" as their answer. 8,3% said that they were not sure of such an enjoyment.

- **The importance of mathematics to the present job**

In V23 the respondents were required to indicate if mathematics is important to their present job. Their responses are:

75% of the respondents said that mathematics is important to their present jobs. 13,9% felt that it is not important while 11,1% were not sure.

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- **Application of mathematics in the present job**

In V24 the respondents had to indicate if mathematics is being applied in their present job and the results are:

72,2% of the respondents agreed by choosing "Yes" as an answer, thus making mathematics essential for job placement while 25% disagreed with the statement by choosing "No". 2,8% are those who were not sure.

- **Employed because of passing mathematics**

In V25 the respondents had to say if they got their job because of having passed mathematics in matric. The results are as follows:

40% said they were employed because of having passed matric mathematics. It is significant to note that a significant percentage such as 40% of the respondents got their employment through the assistance of mathematics. 51,4% disagreed with the statement by choosing "No" as their answer. 8,6% were not sure about this.

- **Importance of respondents knowledge of mathematics to the community**

In V26 the respondents were asked to say if their knowledge of mathematics is important to their communities. They responded as follows:

68,6% of the respondents said that their knowledge of mathematics to their communities is important. 14,3% did not regard their knowledge of the subject as important to their communities. 17,1% of the respondents were not sure.

- **Remarks on mathematics discussions**

In V27 a list of 8 people remarks presumably made by members of the community after discussing mathematics or related knowledge with the respondent(s) as linked to the subject's importance to the community, was given for respondents to choose the most appropriate to themselves. The

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respondents were required to choose any one or more of the remarks members of their communities made. The responses are as follows:

The highest number of cases associated with a remark is 58.3%. Such a remark is "That's good!". This is followed by 13,9% of those who do not make any remark. 11,1% of the members of the community who discuss the subject, request for encore by saying "What? Come again!". No one responded to 6, which is "Its irrelevant to me, but carry on". Similarly, no one responded to 9, which is in the case of no discussion taking place.

- **Discussion of mathematics with non-schooling members of the communities**

In V28 the respondents were required to indicate if they do discuss mathematics with the non-schooling members of their communities. The responses are as follows:

25%, which is the highest number, of the respondents indicated that they "always" discuss mathematics with non-schooling members of the community. The next is 19,4% of those who chose "often" as their answer. Another 19,4% is for those who chose "Not at all" as an answer. A further 13,9% said that they do not have chance to do so. The rest had low choice rates.

- **Remarks made by non-schooling members of the community**

In V29 a list of 9 options of remarks made by non-schooling members of the community after discussing mathematics with respondents previous mentioned, is given. The respondents were required to choose any one or more of them and the responses are as follows:

55,6% said the remark commonly made is, "That's good!", followed by 11,1% of those who say "It's relevant to our lives". Another 11,1% is for those who say that no discussion takes place. There are those who say "Don't disturb me!". These amounted to 5,6%. Those who feel it's

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irrelevant but allow the discussions to be carried on amount to a further 5,6%. A total of 8,3% have no comment to make after the discussions. No one responded to the code which stands for "Boring".

- **The rating of respondents' former Standard 10 mathematics teachers**

In V30, the respondents were requested to choose appropriate description(s) of their former Standard 10 mathematics teachers from 9 given options. Their responses are as follows:

37,1% rated their teachers as "Good in all respects". 17,1% said that their teachers were "Good but poor in language", while 14,3% regarded them as "Knowledgeable". Another 14,3% felt none of the above descriptions suit their teachers.

- **Mathematics in the home environment**

In V31 the respondents were to say if they believed there is a lot of mathematics in their home environment. The responses were given as follows:

41,7% agreed with the assertion and 38,9% disagreed. 19,4% were not sure whether mathematics exist or not in their home environment.

- **Rural mathematics teachers to use rural examples in their lessons**

In V32 the respondents were required to express their feelings about teachers having to use local and rural examples in their mathematics lessons on a regular basis. The following are their responses:

58,3% of the respondents agreed with the need, while 11,1% disagreed. 30,6% were not sure of such a didactical need.

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- **Examples from rural environment to make mathematics more interesting**

In V33 the respondents were to say if they agreed or disagreed with the notion that examples from the rural environment will make mathematics more interesting to the rural students or children. The response was based on a five point scale and the respondents had to choose only one. Here follow the responses:

33,3% chose "strongly agree" while 41,7% chose "agree". This amounts to a total of 75% of those who agree that examples should, as far as feasible, be extracted from the respondents' home environment. 25% disagree and none "strongly disagree". Another 11,1% were not sure of their position regarding this matter, with the rest 2,7% abstaining.

- **Adults from rural villages to offer mathematics lessons**

In V34, the respondents had to indicate on a five point scale, whether they agree or disagree with the notion that adults from the village should sometimes be allowed in class to share their experiences in mathematics with the pupils. The responses are as follows:

19,4% indicated that they "strongly agree" with the statement and 30,6% agree, giving combined total of 50% as those who go along with the statement. Those who disagree make a collective 2%, while those who were not sure of their choice amounted to another 25%.

- **Contribution made by adult lesson participation**

In V35, seven possible results of adult participation in sharing their experiences in mathematics with pupils in class (as discussed previously) were given for the respondents to choose from. The following responses were given:

5,9% claimed that this practice will "Distort mathematics learning". 14,7% felt that it will, "Confuse the students". Another 14,7% felt that it would,

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"Make mathematics biased to rural life". This gives a total of 35,5% being those who feel negative about (or disagree with) the practice.

26,5% felt that it would "Make students understand mathematics better". 5,9% felt that the practice would "Improve the link between the home and the school". 11,8% felt that it would "Make parents more interested in their children's education". All those regarded as positive or feel at home with participation by adults in mathematics lessons, make up 44,2% of all respondents.

Those who have not associated themselves with all the statements amount to 20,6% of the total.

It is thus significant to realise that the majority of respondents are willing and supportive of the notion of village-based adult participation in the teaching of mathematics in schools.

6.5.3 STANDARD 10 MATHEMATICS TEACHERS

In this questionnaire there were 78 variables which the respondents had to react and respond to. Each variable is consequently analyzed:

- **Number of respondents (V1)**

In VI it is shown that 48 respondents completed and returned the questionnaires.

- **School number (V2)**

In V2 the respondents were grouped according to three main education areas. (An area is made up of a group of circuits, which are in turn made up of a number of schools grouped together for purposes of administration). The following statistical information is given in accordance with arrangements of grouping and responses above:

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43,8% came from Area 1, 25% from Area 2 and 31,2% from Area 3.

- **Card number (V3)**

In V3, 48 cards which correspond to the number of responses were received. The questionnaire in this section is referred to as card number 3.

- **School's village (V4)**

In V4 the respondents (teachers) were requested to give the names of the village in which their schools are located. A total of 41 villages to which the teachers' schools belong were recorded. The following statistical information was recorded:

6,3% (3 teachers) of the teachers come from the same school and two teachers belong to one school in four different cases. In the rest (that is in 35 schools), each individual teacher comes from an individual school.

- **Mathematics qualifications (V5)**

In V5, the respondents were requested to disclose their highest mathematics quallfications and they gave the following information:

- 34,1% have Secondary Teachers Diploma (STD)
- 9,1% have Senior Primary Teachers Diploma (SPTD)
- None have Bachelor of Science (BSc) level Mathematics
- 18,2% have done Mathematics Bachelor of Arts (BA)
- 27,3% have done mathematics in Standard 10
- 2,33% have done mathematics in Junior Secondary Teachers Certificate (JSTC)
- 4,5% have done mathematics in Secondary Education Diploma (SED)
- 4,5% have other qualifications in mathematics.

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- **Professional qualifications**

In V6, the respondents were requested to give their professional qualifications, with mathematics as a major subject. They gave the Xollowing information:

- 60,4% of the respondents have Secondary Teachers Diploma (STD)
- 8,3% have South African Teachers Diploma (SATD)
- 2,1% have Bachelor of Arts in Education (BA)
- 16,7% have Junior Secondary Teachers Certificate (JSTC)
- A total of 12,6% have either Higher Education Diploma (HED), Secondary Education Diploma (SED), Bachelor of Education (BEd), Primary Teachers Certificate (PTC), Bachelor of Theology and Divinity (BTD) or University Education Diploma (UED).

- **Experience in teaching mathematics**

In V7 the teachers were asked to give their experience in years in the teaching of mathematics in Standard 10. The following information was collected:

73,3% (cumulative frequency) have up to 5 years experience in teaching mathematics to Standard 10 classes. 26,7% have more than 5 years mathematics teaching experience to Standard 10 classes.

- **Number of students in class**

In V8 the teachers were to give the number of students in their respective Standard 10 mathematics classes. The following information was given:

The size of the classes vary from 5 to 135. Two teachers shared 270 students amongst themselves in one instance. 10 Teachers had to contend with over 50 mathematics pupils in their classes and 6 teachers had their class averages within the 40-50 range. This leaves 32 teachers having class ratios of less than 40. The average pupil:teacher ratio in this sample is about 30 to 1.

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- **The reason for size of classes**

In V9 the respondents were required to give reasons why they have big numbers in their mathematics classes. The following were choices of responses made by the respondents to four main reasons:

56,5% of the respondents chose "They love the subject" as an answer to justification of their mathematics enrolment in this year (1994) of research. 10,9% believed that "They (pupils) hate the subject". 17,4% attributed the sizes of their classes to the roll at their schools by responding to the statement "Roll of the school is small". 15,2% indicated that they don't know the reason(s) for their mathematics rolls.

- **Student attitude to mathematics**

In V10 the respondents (teachers) were requested to identify what they regarded as their pupils' attitude towards mathematics. The following are their responses:

33,3% of the respondents regarded their mathematics students' attitude as positive. 8,3% regarded their students as having a negative attitude towards mathematics. 56,3% regarded the students' attitude as neither positively nor negatively inclined. This meaning that the students attitude in this category does not reveal how they feel about mathematics which implies that their attitude is not of a high profile nature. They neither like nor dislike mathematics. Circumstances may cause their attitude to change. Those who were not sure amounted to 14,6% and none did not know.

- **Mathematics is difficult for students**

In V11 the respondents were required to say if the mathematics that they teach is difficult for their class(es) to understand or not. They were to choose the correct answer from a five-point scale and the following information was collected:

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- **Mathematical concepts in the rural environment**

In V14 the respondents had to express their views on a five-point scale by agreeing or disagreeing to the assertion that "There are a lot of mathematical concepts in the rural environment". The following are their responses:

6,3% strongly agreed and 31,2% just agreed, thus giving a total of 37,5% to be those who believe that mathematical concepts do exist in the rural environment.

56,3% disagreed with the statement, while 2,1% strongly disagreed. This brings about a total of 58,4% being respondents who do not agree that mathematics does exist in the rural environment. Those who don't know amounted to 4,2%.

- **The naming of mathematical concepts**

In V15 to V19 the respondents who chose either "strongly agree", or "agree", those making up 37,5%, above were required to name any five mathematical concepts they believe existed in the rural environment, according to order of priority. The following responses were recorded:

- **Concept 1 (V15)**

  20% of the respondents identified "Measurement" as a mathematical concept, and being the most popular concept, is available in the rural environment. This is followed by 13,3% who identified "Interest" and another 13,3% identified "Geometry" and followed by another 13,3% who came up with "Areas", who thought these exist in the rural environment as concepts. Other concepts identified by single respondents are "Sequence", "Angles", "Ratio and Proportion", "Linear Programming", "Building Design" and "Graphs".

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- **Concept 2 (V16)**

  The most popular second concept identified is "Geometry". All other concepts identified were in no way common to the others. Each respondent gave a totally different concept from other respondents, such as Linear Programming, Analysis, Constructions, Equations and Trigonometry, to name but a few.

- **Concept 3 (V17)**

  26,7% of the respondents identified "Geometry" as a concept in abundance in the rural environment. All the other concepts were associated with individual respondents. They vary from calculus, increase/decrease to art, similarities, land features, capacity, volume, and interest, to name but a few.

- **Concept 4 (V18)**

  21,4% of the respondents identified "Calculus" as the next popular mathematical concept existent in the rural environment. The next popular one is "Distance or Speed". Other concepts include, amongst others, Sequence, Calculations, Equations, Vectors, Geometry, Shapes, Exponents and Tessellation, which were identified by individual respondents.

- **Concept 5 (V19)**

  All respondents gave different concepts. They are, Village Planning, Speed, Calculus, Area, Geometry, Functions, Ages, Buildings, Remainder Theorem and Depreciation.

- **Rural concepts in mathematics curriculum**

In V20 the respondents were requested to say "Yes" or "No" on the need for incorporation of mathematical concepts associated with the rural environment into the school mathematics curriculum. The statement to be responded to was given as:

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"Should mathematical concepts associated with the rural environment be incorporated into the school mathematics curriculum?". The responses were given as follows:

62,2% of the respondents agreed with the suggestion by choosing "Yes" as the answer. 35,6% disagreed with the suggestion by saying "No". 2,2% represent those who did not know.

- **Rural concepts to be included in the mathematics curriculum**

From V21 to V25 the respondents were required to show, according to order or priority, which rural concepts could be included in such a curriculum. The responses were given as follows:

○ **Concept 1 (V21)**

23,1%, which represent the highest response frequency, of the respondents identified "Land Form" as a rural concept that may be included in the mathematics curriculum. This is followed by "Measurement", with 15,4% feeling that it should be included. In all the other cases individual concepts given by individual respondents, with no commonality were given as Finance, Equations, Quantities, Integration or Calculus, Kinematics, Shapes, Basic Operations, Ratios and Slopes, to name them all.

○ **Concept 2 (V22)**

15,4% identified "Shapes" as rural concepts for inclusion in the mathematics curriculum. Another 15,4% chose "Measurement" as a concept that may be included in the mathematics curriculum. All other concepts were variably given by individual respondents, as follows: Demography, Fractions, Accounting, Logic, Statistics, Commuting, Basic Operations, Equations and People's Bodies.

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- **Concept 3 (V23)**

  20% identified "Basic Operations" as a rural concept that may be included in the mathematics curriculum. All other concepts were identified by individual respondents as: Geometry, Art, Statistics, Hunting, Programming, Drawings, Calculations and Farming.

- **Concept 4 (V24)**

  22,2% chose "Statistics" as a rural concept that may be included in the mathematics curriculum. All other concepts were given variably by individual respondents. Such concepts are Exponents, Distance, Building, Calculations, Basic Operations, Flowers/Shapes and Constructions.

- **Concept 5 (V25)**

  40% of the respondents identified "Calculus" as a rural concept to be included in the mathematics curriculum. All other concepts, variably given by individual respondents are: Planning, Calculus, Distance and Linear Programming.

- **Adults to address students on mathematical cultural experiences**

In V26 the respondents were required to give their opinion regarding the following suggestion: "Adults from the village near the school should sometimes be invited to address students on their mathematical cultural experience". The responses were based on a five-point scale and the information was collected as follows:

20,8% strongly agreed with the suggestion, while 64,6% just agreed. This makes up all the respondents who agree, or go along, with the suggestion, to be a total of 85,4% of all the respondents. It is significant to note that teachers are overwhelmingly willing to have adults allowed into the former's classes and augment mathematics teaching with cultural background and experience.

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Those who disagreed (4,2%) and those who strongly disagreed (4,2%) make up a total of 8,4% of respondents who oppose the suggestion above. 6,3% of the respondents were those who did not know the correct answer or choice.

- **The reason(s) for participation by rural adults**

In V27 to V33 the respondents had to give their opinions by encircling either "Yes" or "No" given alongside suggested areas. These are also summarized in Table 6.6:

TABLE 6.6: SUMMARY OF REASONS FOR PARTICIPATION BY RURAL ADULTS

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
27	12	2	0	0	15
				0%	100%
28	20	1,89	0,32	2	18
				11,1%	89,9%
29	20	1,75	0,44	5	15
				25%	75%
30	22	1,23	0,69	19	1
				86,4%	9,1%
31	27	1,07	0,27	25	2
				92%	7,4%
32	25	1,08	0,28	23	2
				92%	12%
33	13	1,92	0,28	1	12
				7,7%	92,3%

- **Distort mathematics learning (V27)**

  All 15 respondents chose "No" as an answer and thus saying that participation by rural adults in mathematics will not distort learning.

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This was included to find out if teachers believe that teaching is their own professional business and any form of interference by other external forces would bring their work into disrepute and distort it.

- **Confuse the students (V28)**

  11,1% of the respondents chose "Yes" as an answer. This means that they do not favour participation in mathematics lessons by adults from the village. 88,9% chose "No" in support of adult participation in mathematics lessons.

- **Make mathematics biased to rural life (V29)**

  25% chose "Yes" as their answer and thus disagreeing with participation by adults. 75% gave their answer as "No" and thus believing that this will not cause or make mathematics biased to rural life.

- **Make students understand mathematics better (V30)**

  86,4% of the respondents agreed with this reason by choosing "Yes" as an answer, hence agreeing that such a participation will help students to understand mathematics better. 9,1% disagreed with the belief, that such an adult participation will make students understand mathematics better, by choosing "No" as an answer. 4,5% did not know the correct answer.

- **Improve the link between the home and the school (V31)**

  92% agreed by choosing "Yes" with the notion that the home-school link will be improved. 7,4% disagreed by choosing "No" as their answer.

- **Make parents more interested in their children's education (V32)**

  92% supported the assertion by choosing "Yes" as their answer. 8% did not support such an assertion by choosing "No".

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- **None of the given reasons (V33)**

  7,7% thought none of the reasons given from V27 to V32 above is applicable. 92,3% disagreed and thus claiming that one or some of the reasons given from V27 to V32 is/are applicable.

- **Rural communities' say in mathematics curriculum design**

In V34 the respondents were to give their opinion on the rural communities contribution in mathematics curriculum design. Their responses, based on a five-point scale are as follows:

18,7% strongly agreed, while 53,3% did not agree. This gives a total of 72% of those who support rural communities' contribution and participation in curriculum design. 6,3% disagreed and 10,4% strongly disagreed, giving a combined total of 16,7% that represent those who oppose the suggestion. 6,3% said that they don't know the correct answer. This is in line with Kriek's (1996:189) views[33].

- **Representation of rural communities in mathematics committees**

In V35 a statement was given to the respondents to react to, on a five-point scale as follows: "Rural communities should be represented in all mathematics committees".

27,1% strongly agreed and 50% agreed, giving a combined total of 77,1% who are in agreement with the suggestion. 6,3% disagreed and 4,2% strongly disagreed, giving a combined total of 10,5% of respondents who are in disagreement with the statement. 12,5% of the respondents did not have a choice to make.

33 Discussed later.

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- **Students who pass matric mathematics do not struggle with getting employment**

In V36 the following statement was given: "Most students who studied mathematics in matric and passed the subject do not struggle to get employment". The responses were given on a five-point scale as follows:

31,2% of the respondents strongly agreed with this assertion and 50% agreed, giving a combined total of 81,5% respondents who agree. 14,6% disagreed with the assertion and no one chose strongly disagree. 4,2% did not know the correct answer.

- **Knowledge of employment statistics of former students**

In V37 the teachers (respondents) were requested to quantify how many of their former matric mathematics students were employed. The following statistical information was given:

19,6% of the respondents claimed that all their former matric mathematics students were employed; 23,9% claimed that at least 50% of their former students were employed; 13% claimed at least 25% of their former students to be in employment. 43,5% said that it is difficult to assess how many students are in active employment. No one chose "It is none of my business", as their answer.

- **Mathematics and the development of rural communities**

In V38 the respondents were required to indicate if they believed mathematics can develop the rural communities in which they are working. The following information was given:

79,2% of the respondents said that they believed mathematics can develop the rural communities in which they work. 20,8% did not believe in this assertion, while none of the respondents were unsure.

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From V39 to V45, seven suggested ways in which mathematics may develop the community were given to respondents to say whether they agree or disagree with, by selecting "Yes" or "No", respectively, as their answers. The following data was collected:

- **By adults going back to school (V39)**
  82,4% agreed that adults should go back to school and 17,6% disagreed.

- **By students teaching mathematics in the village (V40)**
  85% agreed that students should teach mathematics in the village. 15% disagreed with this feeling.

- **By teachers applying rural concepts in mathematics (V41)**
  93,1% supported this suggestion, while 6,9% disagreed.

- **By retarding community development (V42)**
  All respondents disagreed with this notion.

- **By turning everyone into a thief or smuggler (V43)**
  All the respondents did not agree with the notion.

- **By making people unnecessarily clever (V44)**
  All respondents did not agree with the notion.

- **By making people socio-economically active (V45)**
  93,1% agreed with the assertion, while 6,9% disagreed.

- **Changing mathematics syllabus to suit rural communities**

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TABLE 6.7: SUMMARY OF FEELINGS FOR CHANGING MATHEMATICS SYLLABUS

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
46	16	1,75	0,45	25	75
				25%	75%
47	16	1,94	0,25	1	15
				6,3%	93,8%
48	24	1	0	24	0
				100%	0%
49	32	1,09	0,3	29	3
				90,6%	9,4%
50	15	1,93	0,26	1	14
				6,7%	93,3%
51	16	1,75	0,45	4	12
				25%	75%
52	20	1,75	0,44	5	15
				25%	75%

From V46 to V52 the respondents were required to express their feelings about changing the present mathematics to suit rural communities. Seven possible reactions to such a change were given for respondents to indicate, by means of "Yes" or "No", how they feel about them. The following data was collected (Table 6.7):

- **I will resist it (V46)**
  25% of the respondents said that they will resist it by giving "Yes" as an answer. 75% disagreed by giving "No" as their answer.

- **I will quit teaching (V47)**
  6,3% answered "Yes" and thus threatening to quit if such a suggestion is carried out. 93,8% did not agree with quitting

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teaching (by giving "No" as an answer; and supporting possible change of mathematics content to suit rural communities as well).

- **I will accept retraining (V48)**

  All respondents accepted retraining if the present syllabus is changed to suit rural communities, as shown by 100% having chosen the option to accept retraining. There is a relationship between those who refuse to quit teaching in V47 and those who are willing to accept retraining in V48. Those not prepared to quit teaching amount to 93,8% while those willing to accept retraining amount to 100%. It should however be realised that in V47 only 16 of the 48 teachers responded to this statement and 24 responded to the statement in V48. Thus, those who threatened to quit teaching represent only one teacher in V47 and the rest (15) reject this latter action. They may therefore be regarded as having joined the group that is willing to accept retraining in V48.

- **I will support it at all costs (V49)**

  90,6% promised to support such a syllabus change for rural suitability. 9,4% rejected the suggestion.

- **I will just accept it without questioning (V50)**

  6,7% of the respondents indicated that they will support the move without questioning. 93,3% refused to accept the change without first questioning motives or reasons behind it.

- **I will just wait for the instruction (V51)**

  25% of the respondents said that they would wait for the instruction from above on the changing of the syllabus while 75% would not wait for the instruction before they take appropriate action.

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- **I will discourage this to occur (V52)**

  25% said that they would discourage such a syllabus change to occur and 75% said that they would not discourage it. Those who intend to discourage this change to occur amount to 5 teachers. This could possibly be linked to the resisting group in V46 and V47 previously who are ready to oppose change in the curriculum.

- **Progress enquiries by parents or guardians**

In V53 the respondents were required to express their feelings on the need for parents or guardians to always feel free to enquire about the progress of their children at school. The responses were given as follows:

83% of the respondents answered "strongly agree" and 17% answered "agree", giving a combined total of 100% agreeing on the issue.

- **Discussion of success or failure in mathematics between parents and children**

In V54 the respondents were required to say if they believed parents should be encouraged to discuss the students' success or failure in mathematics with their children. The responses were collected as follows:

78,7% of the respondents indicated that they strongly agree with the perception, while 21,3% just agreed. This makes a total of 100% agreeing with the expressed feeling.

- **Students-parents discussion times**

In V55 the respondents were requested to choose (from given time frames) suitable time limits within which students and parents should be encouraged to discuss their success or failure in mathematics with their parents or guardians. The following data was gathered:

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50% prefer that such discussions should take place on a daily basis; 19,6% on a weekly basis; 13,0% on a monthly basis and 15,2% felt there should not be a fixed time or have no definite opinion on the matter.

- **Own opinion**

In V56 those respondents who did not have their suggestion on discussion time limit(s) were requested to give their own opinions. Their responses were given as follows:

66,7% (two respondents) preferred the discussions to be done on a quarterly basis. 33,3% (one respondent) felt it should be left to circumstances to dictate.

- **Discussion results**

From V57 to V61 five possible results of the parent-student discussions were given for respondents to express their feelings about whether they agree or disagree with. The results corresponding with variables V57 to V61, are also summarized in Table 6.12 below. The effects (results) were connected with the statement as follows: "Discussions between the parent or guardian and the child will ...."

- ○ **Motivate the child (V57)**

  All the 31 respondents agreed with this result by choosing "Yes" as their answer.

- ○ **Demotivate the child (V58)**

  All the respondents chose "No" as their answer. This implies that all the respondents do not believe that parent-student discussions will serve to demotivate the students. "No" represents a positive inclination and will be represented by "No" in the following Table 6.8:

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TABLE 6.8: SUMMARY OF THE RESULTS OF DISCUSSIONS

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
57	31	1,0	0	100%	0
58	17	2,0	0	100%	0
59	16	1,63	0,5	62,5%	37,5%
60	35	1	0	100%	0
61	17	1,94	0,24	94,1%	5,9%

- **Make the child parent-dependent (V59)**

  37,5% agreed with the notion that discussions will make the child to depend more on the parent or guardian than on the teacher or himself (student). 62,5% disagreed that their discussions may make the child dependent on the parent or guardian.

- **Improve the link between home and school (V60)**

  All the respondents agreed that the discussions will improve the home-school relationship.

- **Destroy the future of the child (V61)**

  5,9% felt that the discussions will destroy the child's future (represents negative inclination), while 94,1% disagreed that the child's future could be destroyed (represents positve inclination), and will be thus represented by "No" and "Yes" in Table 6.8.

- **The relationship between mathematics teachers and parents**

From V65 to V69, five possible relationships between mathematics teachers and parents or guardians of their students were given. The respondents were required to say if they agree or disagree, accordingly, with such relationships.

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The following statement was to connect with the given relationship(s): "Mathematics teachers should regard parents and guardians". In all the cases there is overwhelming support in favour of the discussions as shown by either supporting a positive statement (in V66 and V69) or rejecting a negative statement (in V65, V67 and V68). The responses are summarized both below and in Table 6.9:

TABLE 6.9: SUMMARY OF THE TYPES OF RELATIONSHIP BETWEEN MATHEMATICS TEACHERS AND PARENTS/GUARDIANS

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
65	18	1,94	0,24	94,4%	5,6%
66	33	1	0	100%	0%
67	16	2	0	100%	0%
68	16	2	0	100%	0%
69	30	1	0	100%	0%

- **With suspicion (V65)**

  5,6% of the respondents supported this perception (represents negative inclination), while 94,4% rejected it (represents a positive inclination), and will thus be represented by "No" and "Yes" respectively in Table 6.9.

- **As co-educators (V66)**

  All the respondents supported this relationship.

- **As intruders in the educational process (V67)**

  All the respondents disagreed (assuming positive inclination) with the fact that parents or guardians should be viewed as intruders. This is represented as "Yes" in Table 6.9.

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○ **As being useless in the teaching/learning situation (V68)**

All the respondents rejected this feeling by all choosing "No" as their answer. This constitutes a positive inclination and it is thus represented by "Yes" in Table 6.9.

○ **As facilitators of meaningful education (V69)**

Respondents agreed with this view by all choosing "Yes" as an answer.

- **Teachers' participation in after-hours mathematics discussions**

In V70 respondents were required to express their feeling, on a five-point scale, about the suggestion that mathematics teachers should accept after hours invitations to participate in the discussions between parents and students on their students' progress or failure in mathematics. The responses were as follows:

57,4% of the respondents chose "strongly agree" and 36,2% chose "agree" as their answers. This gives a total of 93,6% of respondents being at home with the suggestion. None responded to "disagree", while 2,1% "strongly disagree" and 4,3% did not know which option to choose. It is of vital importance to discover that the vast majority of teachers are ready and willing to take part in family discussions in mathematics, if invited to take part. This is further revealed in the following responses.

- **Invitation to follow agreement**

From V71 to V75, five possible consequences were given following an agreement between teachers and parents and students on the invitation for discussions after hours. The respondents were to select an appropriate answers between "Yes" or "No" and they chose the following (also represented in Table 6.10):

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TABLE 6.10: SUMMARY OF RESULTS OF INVITATIONS

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
71	21	1	0	100%	0%
72	16	1,94	0,25	93,8%	6,3%
73	18	1,94	0,24	94,4%	5,6%
74	40	1	0	100%	0%
75	19	1,95	0,23	94,7%	5,3%

- **It will be successful (V71)**

  All the respondents agreed with this statement.

- **It will be rejected by either party (V72)**

  6,3% (stands for negative feeling) agreed by choosing "Yes" as an answer, while 93,8% (stands for a positive feeling) chose "No" as their answer, as represented in Table 6.10.

- **It will be full of suspicion (V73)**

  5,6% selected "Yes" to agree, while 94,4% rejected this perception. The same principle applies as in V72 above.

- **It will lead to motivation of the child (V74)**

  All the respondents agreed with this notion by choosing "Yes" as an answer.

- **It will lead to demotivation of the child (V75)**

  5,3% agreed with this notion, while 94,7% did not agree. The same explanation given in V72 above applies here.

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- **Mathematics teachers in community development programmes**

In V76, the respondents were required to give their opinions (on a five-point scale) on the suggestion that mathematics teachers should also take part in other community development programmes apart from their mathematics teaching responsibilities. The responses collected are as follows:

46,8% of the respondents chose "strongly agree" as their answer and 51,1% chose "agree", giving a cumulative frequency of 97,8% of those who support the idea. There were no respondents who chose disagree, but 2,1% chose strongly disagree. None chose "I don't know".

- **Problem-solving as an essential part of mathematics**

By problem-solving it is meant that approach in mathematics where students relate to everyday problems and use the skills acquired to solve them, which will enable them to interact with the environment meaningfully and effectively. The concept of problem-solving in mathematics encompasses quite a number of processes which are listed by Ewen in Posamentier (1996:1) when he indicates the complexity of defining problem-solving:

> *The process of studying ill-defined problem situations — posing and prioritizing questions, investigating and modifying courses of analysis, investigating and developing alternative solutions, generalizing results, and going off in new directions — would benefit from a rubric more suggestive than 'problem-solving'.*

In V77, the respondents were required to say whether they believe that problem-solving is an important part of mathematics teaching. The responses to this assertion were given on a five-point scale as follows:

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66% said that they strongly agree and 34% said they agree, giving a total of all respondents agreeing that problem-solving is an important part of mathematics.

- **Problem-solving assisting students in everyday problems**

In V78 the respondents were to express their opinions on whether a problem-solving approach used in mathematics will help students to solve everyday problems. A five point scale was used for respondents to react to, and the following information was gathered:

63,8% of the respondents selected "strongly agree" as their correct answer and 31,9% selected "agree", giving a total of 95,7% being in agreement with the perception. 4,3% disagreed while there were none who strongly disagreed and none who did not know. It is important to note that teachers view this approach as important in addressing and solving everyday life problems for socio-economic development.

- **The rural mathematics syllabus should include problem-solving activities**

In V79 respondents had to agree or disagree on a five-point scale on whether the rural mathematics syllabus should include problem-solving activities. The following information was collected:

51,1% chose "strongly agree" while 40,4% chose "agree", giving a total of 91,5% being those who support the suggestion above.

- **Extent to which problem-solving approach should be adopted in the rural high schools**

In V80, being the last variable in Questionnaire 3, the respondents were given six possible options from which to choose, in order to indicate their feeling as to what extent problem-solving should be adopted as an

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approach to the teaching of mathematics in the rural high schools. The following data was collected:

69,6% felt it should be taught to a **very large extent** and 26,1% chose that it should be done to **an average extent.** 2,2% felt that it should **not at all be adopted** while another 2,2% indicated that they don't know the answer.

6.5.4 PARENTS OR GUARDIANS OF THE PRESENT (1994) STANDARD 10 MATHEMATICS STUDENTS

In this questionnaire there were 57 variables to which parents or guardians of the students doing Standard 10 mathematics in 1994 were requested to respond to. The following responses are discussed briefly:

- **Respondent number**

In a total of 156 parents or guardians responded and returned the completed questionnaires.

- **Card number**

In V2 cards were recorded. Each questionnaire is referred to as a card.

- **Residential village**

In V3 the respondents were requested to give the name of their village and the information supplied showed that they come from a variety of villages.

A total of 29 different villages were recorded to have been shared by 156 respondents. Each village was given a quote in the form of a number ranging from 1 to 29. (In all the variables in this questionnaire the same procedure will be followed to give information).

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Most of the respondents come from village number 12 (Eiseleben), with 21,3% of the respondents residing there. This is followed by a concentration of respondents at village number 27 (Matseke) with 11,6%, followed by smaller concentrations such as 7,7% at village number 25 (Ramatsowe), 6,5% at village number 26 (Sekhokho), 6,5% at village number 1 (GaMaja), and so on.

- **Occupation of parent or guardian**

In V4 the respondents were required to give their occupation or mode of employment. 25 different forms of occupation were identified in the sample. The following information was recorded:

Most of the respondents practice occupation number 6 and 14, which mean "unemployed" and "housewife", respectively. Each of them have 16,2% of the respondents associated with it. The next occupation with the highest percentage (14,6%) is occupation number 18, which stands for "students" which, in turn, means that the respondent is a student. This is followed by number 5 (teacher) with 10,8% of respondents. This is followed by smaller percentages such as occupation 10 (labourer) with 9,2%, occupation 2 (driver) with 4,6% and so on. 26 respondents were not recorded which implies that they did not indicate any form of employment they may be associated with.

- **Relationship with Standard 10 mathematics students**

The information required in V5, was ascertain what the relationship exists between the Standard 10 mathematics students and the respondents (parents or guardians) in the questionnaire. Three different relationship options were given as father, mother, or guardian. The following data was collected:

30,1% of the respondents are mothers of the students, while 41,8% are fathers. It is to be noted that 71,3% of the respondents are the parents

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of the students. Those who have relationships other than being biological parents of the students make up 28,1% of the respondents.

- **Children studying for Standard 10 mathematics**

In V5 the respondents were requested to say if any of their children were doing Standard 10 mathematics. There were three options given to choose from, namely, "Yes", "No", or "Not sure". The following data was gathered:

84,4% indicated that their children were doing Standard 10 mathematics by choosing "Yes" as an answer. 14,9% chose "No", which implies that they may be merely guardians and not parents of the pupils doing Standard 10 mathematics, as the question did not make provision for those who act as guardians in this questionnaire. 0,6% said that they were not sure if their children were doing Standard 10 mathematics.

- **Number of children doing Standard 10 mathematics**

In V7 the respondents were required to indicate how many of their children were doing Standard 10 mathematics. The following information was gathered:

The number of students doing Standard 10 mathematics ranged from 1 to 11 in the same family. Most of the concentration (73,4%) was found in 1 child doing Standard 10 mathematics. This was followed by a surprising 8,4% who showed to have six children from the same family doing Standard 10 mathematics. This is followed by 4,9% with 3 students, then 3,5% with 5 children, 2,8% with 4 children, 1,4% with 2 children. It is of noteworthy importance that there are parents who indicated that they have 8 and 11 children at school doing Standard 10 mathematics. These are remarkably high numbers, which may be as a result of polygamous families (which is a common practice in some rural family set-ups) or lack of understanding of the question.

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- **How information was known by parents or guardians**

In V8 the respondents who answered "Yes" or "No" in V6 above, were requested to indicate how they got to know if their children were doing Standard 10 mathematics. They were given five options from which they were to choose the appropriate one. The following data was collected as discussed below:

59,4%, which is the highest number of the respondents indicated that they got the information from their own children. This is followed by 23,2% who indicated that they discovered the information by themselves. 18,6% were informed by the teachers or principals from their children's schools. 3,9% of the respondents knew through methods other than the ones mentioned. Lastly, 1,9% of the respondents were informed by their spouses. This refers to either of the sexes of the spouses. It should, however, be noted that the 1,9% represent 3 respondents who happen to know the information through this method.

- **Liking of mathematics**

In V9 the respondents were required to indicate whether they like mathematics or not. This implies finding out the attitude of respondents to mathematics. They were given three options to choose appropriately from, and the following data was collected:

92,3% of the respondents showed that they like mathematics by choosing "Yes" as an answer, while 1,3% do not like mathematics. Lastly, 6,4% said that they are not sure of their position with regard to attitude to mathematics.

- **Proud of child doing Standard 10 mathematics**

In V10 the respondents were required to indicate if they are proud of their children who are studying mathematics in Standard 10. They were

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required to indicate their feeling by selecting either "Yes", "No" or "Not sure" and the results were as follows:

97,4% of the respondents indicated that they are proud of their children who are doing mathematics in Standard 10. Only 0,6% said that they were not proud of their children doing Standard 10 mathematics. 1,9% of the respondents said that they were not sure of their position with regard to the above issue.

- **Encouragement of children to study mathematics in Standard 10 or beyond**

In V11, the respondents were requested to say if they will encourage all their children to study mathematics in Standard 10 or beyond Standard 10, in future. They were to respond by choosing from "Yes", "No" or "Not sure" and the following information was collected:

92,9% of the respondents (parents and guardians) indicated that they will encourage all their children to do mathematics in Standard 10 or beyond matric in future. Only 1,9% said that they will not do it, while 5,2% said that they were not sure of their position regarding this issue.

- **Reasons for encouragement**

From V12 to V20, the respondents were given reasons for encouraging their children to study mathematics in Standard 10 or beyond it. In each case a possible reason was given to which the respondent had to choose "Yes" or "No" in agreeing or disagreeing with such reason. The information was collected in each case as follows (see Table 6.11):

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TABLE 6.11: SUMMARY OF THE REASONS FOR ENCOURAGEMENT

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
12	35	1,97	0,17	97,1%	2,9%
13	33	1,94	0,24	6,1%	93,9%
14	58	1,03	0,18	96,6%	3,4%
15	63	1,03	0,77	96,8%	3,2%
16	35	2	0	100%	0%
17	33	1,90	0,29	90,9%	9,1%
18	53	1,02	0,14	98,1%	1,9%
19	78	1,01	0,11	98,7%	1,3%
20	34	1,94	0,24	14,7%	85,3%

- **It will destroy their lives (V12)**

  2,9% agreed with this reason by choosing "Yes" (negative response) as an answer. 97,1% of the respondents did not agree with this reason by choosing "No" (positive response) as their answer, and will thus be respresented in Table 6.11. The question was included to find out if there were parents who regarded mathematics as an unsuitable subject because of its richness in the preparation of children to cope with everyday problems, in which they (parents) might believe that they might easily be cheated by their children, which would negatively affect the morality of their children.

- **They will cheat me easily (V13)**

  6,1% of the respondents agreed with the reason by choosing "Yes" as an answer, while 93,9% disagreed with the reason by choosing "No" as their answer. The same principle applies as in V12 above.

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- **They will become useful citizens (V14)**

  96,6% agreed with the reason by choosing "Yes" as an answer, while 3,4% disagreed by choosing "No" as an answer.

- **They will uplift our community (V15)**

  96,8% of the respondents agreed with the reason by choosing "Yes" as their answer and 3,2% disagreed by choosing "No".

- **They won't have respect (V16)**

  All the respondents (100%) chose "No" as an answer and thus wholly disagreeing with the reason. The same principle applies as in V13 above.

- **They won't get jobs quickly (V17)**

  9,1% of the respondents agreed with the reason by choosing "Yes" as an answer, while 90,9% disagreed by choosing "No" as an answer. This means that 90,9% of the respondents believe that mathematics knowledge acquisition will offer their children opportunities to find jobs quickly. The same principle as in V13 above is used in this case. The question was included to find out if parents and guardians do associate mathematics with employment opportunities. This has indeed been the case. Rural people attach significance to mathematics achievement for higher employment opportunities.

- **They will get jobs quickly (V18)**

  98,1% of the respondents selected "Yes" as their answer and thus agreeing with the reason. 1,9% of the respondents disagreed with the reason by choosing "No" as an answer.

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○ **They will excel in future (V19)**

98,7% of the respondents agreed with this reasoning by choosing "Yes", while 1,3% disagreed by choosing "No".

○ **I am not sure (V20)**

14,7% of the respondents agreed with the statement by saying "Yes", which implies that they are not sure of why they should urge their children to pursue mathematics in both Standard 10 and after. 85,3% disagreed by selecting "No" as their correct answer, which implies that they have one reason or the other, why they will urge their children to learn mathematics.

- **Encouragement of other children to study mathematics in Standard 10 or beyond**

In V21 the respondents were requested to indicate, by means of choosing "Yes", "No" or "Not sure", if they would encourage children, other than theirs, to study mathematics in Standard 10 or beyond. The following data was collected:

87,6% of the respondents agreed that they would encourage other people's children to study mathematics. 5,2% chose "No" as an answer, while 7,2% indicated that they were not sure of the correct answer.

- **Reasons for the choice in V21**

In V22 to V28 the respondents who selected whichever option in V21 above were requested to indicate the reason or reasons for their choice on whether they would allow children, other than theirs, to study mathematics in, or beyond, Standard 10. The information gathered is as follows wherein the respondents chose "Yes" or "No" against each given reason. The responses are also represented in Table 6.12 below:

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TABLE 6.12: SUMMARY OF CHOICE OF STANDARD 10 OR BEYOND

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
22	36	1,89	0,32	88,9%	11,1%
23	34	1,94	0,24	94,1%	5,9%
24	91	1,04	0,21	95,6%	4,4%
25	71	1,01	0,12	98,6%	1,4%
26	46	1,0	0	100%	0%
27	31	1,97	0,18	96,8%	3,2%
28	36	1,72	0,45	27,8%	72,2%

- **They will beat off my children (V22)**

  11,1% of the respondents agreed with the statement by choosing "Yes" as an answer, while 88,9% disagreed with it, by choosing "No" as their answer. This was included in order to find out how parents regarded their children's performance viz-a-viz their neighbours' children's performance. The same principle of swapping negative for positive and vice versa is applied, as in V13 above.

- **They will not respect adults (V23)**

  5,9% of the respondents chose "Yes" as their answer, which implies that they feel that by encouraging such children to study mathematics, they are likely not to be in the position to respect adults. 94,11% of the respondents opposed the statement by choosing "No" as an answer, convincingly rejecting the notion or perception of probable adult disrespect. This was also included in order to find out the perception of parents regarding whether mathematics is viewed as a subject that may destroy morals in children due to the degree of cleverness it is able to induce through problem-solving and other intricacies which adults were

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never exposed to and are unable to perform. The same principle of swapping negative for positive (as in V23 above) is applied here.

- **They will be useful to our community (V24)**

  95,6% of the respondents agreed that such children will be of use to their communities by choosing "Yes" as an answer. 4,4% of the respondents disagreed by choosing "No".

- **They will uplift our standard of life (V25)**

  98,6% of the respondents agreed with the statement by choosing "Yes" as an answer, while 1,4% disagreed by choosing "NO" as their answer.

- **They will get jobs quickly (V26)**

  All (100%) the 46 respondents unanimously agreed with the statement (or reason) and by so doing believing that by encouraging children from other families will reduce chances of unemployment.

- **They will struggle to get jobs (V27)**

  3,2% of the respondents agreed with the statement by choosing "Yes" as their answer. 96,8% disagreed with the statement and chose "No" as their answer. The same principle used in V24 above is used here.

- **Because I am not sure (V28)**

  27,8% of the respondents indicated that they were not sure why they would encourage other children to learn mathematics. 72,2% did not agree by choosing "No" for an answer. This means that the latter group is sure of the reasons and may have identified with one or some of the reasons given above.

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- **Can mathematics develop your community?**

In V29, the respondents were required to indicate if they believe mathematics can develop their communities. They were to choose either "Yes", "No" or "Not sure". The results were as follows:

96,6% of the respondents agreed that mathematics can develop their communities, by choosing "Yes" as an answer. 3,4% of the respondents said that they were not sure of the fact that mathematics can develop their communities by choosing "Not sure" as an answer. None of the respondents chose "No" and, hence, meaning that no one outrightly disagrees that mathematics can develop their communities.

- **Mode of community development**

From V30 to V34 the respondents were asked to indicate in which way they believe mathematics can develop their communities. They had to choose either "Yes" or "No" against a suggested mode of community development through mathematics. The data was collected thus, summarized in Table 6.13:

TABLE 6.13: SUMMARY OF MODES OF COMMUNITY DEVELOPMENT

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
30	49	1,20	0,41	79,6%	20,4%
31	36	1,44	0,50	53,6%	44,4%
32	73	1,04	0,20	95,9%	4,1%
33	73	1,07	0,25	93,2%	6,8%
34	57	8,26	7,25	86%	14%

- **By ensuring that all children study mathematics (V30)**

  79,6% of the respondents agreed with the statement by choosing "Yes" as an answer. 20.4% opposed the statement by choosing "No" as an answer.

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- **All adults should study adult mathematics education courses (V31)**

  55,6% believed adult mathematics education courses will be an answer to community development by choosing "Yes" as an answer. 44,4% disagreed with this notion by choosing "No" as an answer. It is important to note that those who said "Yes" and those who said "No" differ marginally (by 11,2) in terms of percentages.

- **Children should share their knowledge of mathematics with adults (V32)**

  95,9% of the respondents agreed by selecting "Yes" as an answer that there should be exchange of mathematics knowledge between children and adults for community development. 4,1% disagreed with this argument by choosing "No" as an answer.

- **Mathematical ideas should be practically applied in the village (V33)**

  93,2% of the respondents agreed that mathematical ideas should be practically applied or utilized in the villages for the communities to be able to develop through mathematics. They have done this by choosing "Yes" as an answer, while 6,8% disagreed by choosing "No" as an answer.

- **Mathematical ideas at school should be linked with those occurring at home (V34)**

  86% of the respondents agreed that a closer link should be established between mathematical ideas at school and those available in the home environment. They did this by choosing "Yes" as an answer in this case. 14% of the respondents disagreed by choosing "No" as an answer.

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- **Other ways of community development through mathematics**

In V35, V36 and V37, the respondents were requested to give other modes of community development through mathematics, other than those discussed from V30 to V34 above. The information was given as follows:

- **Modes given in V35**

  The highest concentration, which amounts to 26,8% of respondents were found to have given code 5 as their answer. In other words, the most favoured mode of community development was found to be the fact that adults should be exposed and encouraged to learn mathematics. 12,5% believe that the community may develop if they have acquired access to knowledge. 10,7% believe that the community will develop by having easier and more likely prospects of employment or employment opportunities. Other modes of development vary from the establishment of learning centres for adults, to children having to start with mathematics or mathematical activities from early stages of childhood.

- **Modes given in V36**

  The highest number of respondents (21,4%) believe that mathematics will develop the community by providing them with employment opportunities. The next highest number (14,3%) is for those who said that the community could be developed by having children in the villages being able to help adults to acquire mathematical skills. Other modes of development given include mathematics being in a position to improve the lives of many adults; children studying mathematics from the lowest standards of schooling, et cetera.

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- **Modes given in V37**

  The highest number (23,5%) of respondents have indicated that mathematics can develop the community if it is applied and practised in the village, by those who already have acquired some basic knowledge in the subject. The next highest percentage (20,6%) is for those who believe that the community may be developed through mathematics knowledge offering them employment opportunities. Other modes of development, such as adults being able to count money and so forth, were shared by a very low number such as 5,9% or less.

- **Should adults share traditional and practical mathematical ideas with their children?**

In V38, the respondents were requested to indicate their views about whether adults should share their traditional and practical mathematics with their children. They were to choose "Yes", "No" or "Not sure" and the following information was collected:

68,9% of the respondents agreed with the assertion by choosing "Yes" as an answer. 11,9% chose "No" in order to disagree with the argument. 19,2% of the respondents said that they were not sure whether this should be the case or not.

- **Do you discuss mathematics with your children?**

In V39, the respondents were given 8 possible answers, from which to choose, regarding the question as to whether parents or guardians do discuss mathematics with their children. The following were given as answers:

43,4% of the respondents said that they "sometimes" do it. This is followed by 17,1%o who said that they would like to discuss it with their children but have no time. This is followed by 11,8% being those who

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"always" do it. The next largest percentage is for those who believe that it is their "duty to do it". Other results are:

8,6% are those who "rarely" do it.
5,9% is those who do "not at all" do it.
1,3% is those who say they would like to do it, but their children are disinterested.

Lastly, and equally to the latter (1,3%), are those who say they don't want to interfere with their children.

- **Who starts the discussion?**

In V40 the respondents were given four options in which they had to choose one answer. They were to tell who starts the discussions that were described in V39 above. The following responses were given:

47% of the respondents indicated that the discussions are usually started by their own child or children. This is followed by 39,1% who indicated that the discussions are started by the parents or guardians themselves. 2% said that someone else starts the discussions. Lastly, 11,9% said that there is no discussion at all.

- **How do you regard the mathematics discussions?**

In V49 the respondents were required to express their feeling about the effect of the discussions conducted in V39 and V40 above. They were given seven options from which to choose the one that interests or appeals to them most. The following data collected:

1,3% of the respondents said that the discussions were boring; 2,0% regarded them as useless; 48,0% felt they were useful; 16,7% found them interesting; 22,0% found them to be motivating their children and 10,0% said that they conduct no discussions.

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- **Adults from the village can play a role in teaching mathematics**

In V42 the respondents were to indicate, on a five-point scale, whether they believe adults can play a role in the teaching of mathematics. The following data was gathered:

29,3% strongly agreed with the statement while 34,0% agreed. This amount to a total of 63,3% being parents or guardians who agree with this assertion. 8,5% disagreed and 0,7% strongly disagreed, amounting to 9,4% who do not agree with the statement. 27,3% of the respondents indicated that they were not sure of their position regarding the matter.

- **Adults from the village to share knowledge with students and teachers in mathematics**

In V43 the respondents were required to express their feelings, on a five-point scale, about whether adults from the village should sometimes be invited to share their cultural and practical mathematical knowledge with students and teachers during school mathematics lessons. They responded as follows:

25,7% strongly agreed with the above suggestion. 41,9% agreed. Both groups amount to a total of 67,6% who do not disagree with the suggestion. This leaves 16,9% who disagree and 3,4% who strongly disagree, giving a total of 20,3% who do not agree with the suggestion. 12,2% indicated that they were not sure about their position regarding this matter.

- **The reasons for participation by adults**

From V44 to V50 the respondents were given seven reasons to which they had to say "Yes" or "No" in order to determine if they were applicable to the suggestion of adults having to participate in sharing their knowledge with students and teachers, as discussed in V43 above. The following data was collected (also summarized in Table 6.14):

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TABLE 6.14: SUMMARY OF THE REASONS FOR PARTICIPATION BY ADULTS

V	Number of respondents	Mean	Standard Deviation	Number Yes	Number No
44	42	2,62	1,58	69%	31%
45	49	1,65	0,48	65,3%	34,7%
46	36	1,81	0,40	80,6%	19,4%
47	67	1,09	0,29	91%	9%
48	54	1,09	0,29	90,7%	9,3%
49	62	1,15	0,36	85,5%	14,5%
50	33	1,88	0,33	12,1%	87,9%

- **Distort mathematics learning (V44)**

  31% chose "Yes" as an answer (represents a negative feeling) in, claiming that this would distort the mathematical learning in class. 69% disagreed with this reason by choosing "No" as an answer (represents a positive feeling) and will thus be swapped from "No" to "Yes" and vice versa in Table 6.14.

- **Confuse the students (V45)**

  34,7% of the respondents agreed with the statement by choosing "Yes" as answer and by so doing believing that this practice would confuse the students. 65,3% disagreed with this reason. The same swapping principle in V44 above is used in this case.

- **It will make mathematics biased to rural life (V46)**

  Those who believe that this practice would make mathematics biased to rural life amounted to 19,4% and those who believed it will not, amounted to 80,6%. The same principle used in V45 above is used in this case.

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- **It will make students understand mathematics better (V47)**
  91% believed, by choosing "Yes" as an answer, that the practice mentioned above would make the students to understand mathematics better. 9% did not believe in it by choosing "No" as an answer.

- **It will improve the link between the home and the school (V48)**
  90,7% of the respondents indicated that they believe that the practice will improve the link between the home and the school, by choosing "Yes" as an answer. 9,3% did not believe in this reason by choosing "No" as an answer.

- **It will encourage parents to be more interested in their children's education (V49)**
  85,5% of the respondents believed that the practice would encourage parents to be more interested in their children's work by choosing "Yes" as an answer. 14,5% disagreed with this reason by choosing "No" as an answer.

- **The practice will accomplish none of the above reasons (V50)**
  12,1% of the respondents agreed that none of the reasons discussed above will be accomplished. 87,9% did not agree with this notion.

- **Mathematics will help in changing some of our community's practices**

In V51 the respondents were requested to indicate if they believe mathematics would change some of their communities' cultural practices. A five-point scale was used for gathering their responses.

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32,7% of the respondents chose "strongly agree" and 40,8% chose "agree". This gives 73,5% respondents who believe that mathematics may serve to change some of their communities' practices.

7,5% of the respondents chose "strongly disagree", while 1,4% chose "disagree", giving a total of 8,9% to be those who do not believe that mathematics could change their communities' practices. 17,7% of the parents or guardians said that they were not sure.

- **Rural mathematics should be developed as a subject for rural pupils**

In V52 the respondents were required to indicate their feelings, on a five-point scale, about whether rural mathematics could be developed as a subject for rural pupils and the following results were recorded:

24,1% of the respondents chose "strongly agree" and 26,9% chose "agree". This amounted to 51% being those who believe that rural mathematics should be developed as a subject for rural pupils. 24,1% chose "strongly disagree" and 15,2% chose "disagree". These amounted to 39,3% to be those who do not agree that rural mathematics should be developed into a subject for rural pupils. 9,7% are those who do not know the correct answer.

- **The present school mathematics syllabus does not represent the rural culture of our communities**

In V53 the respondents were requested to express their feelings about whether they believed the present school mathematics syllabus does not represent the rural culture of their communities. The following data was gathered:

16,4% chose "strongly agree" and 20,5% chose "agree". These amount to a total of 36,9% to be those who feel that the present school

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mathematics does not represent the rural culture of the communities. 25,3% chose "disagree", while 6,3% chose "strongly disagree", making it 31,6% to be those who do not agree with the statement. This means that 31,6% of the respondents believe that the present school mathematics syllabus is reflective of rural communities' culture.

A sizeable 30,8% said that they do not know the correct answer or do not have knowledge of the syllabus contents.

- **The Standard 10 mathematics syllabus should be changed to suit rural pupils**

In V54, the respondents were to give their opinions on the need for the changing of the Standard 10 mathematics syllabus to suit the rural pupils, by using a five-point scale. The following information was gathered:

23,6% of the respondents chose "strongly agree" as their answer, 19,6% chose "agree" as their answer. These amount to 43,2% to be those who feel there is a need for the present Standard 10 mathematics syllabus to change in order to suit the rural pupils.

29,1% chose "disagree" while 17,6% chose "strongly disagree", amounting to a total of 46,7% not agreeing to the change in the syllabus to suit rural pupils.

10,1% of the respondents did not have a position regarding the matter.

- **Rural communities should be consulted when a relevant mathematics syllabus is compiled**

In V55 the respondents were required to express their feelings on the need for rural communities being consulted when a relevant mathematics syllabus is compiled. A five-point scale was used to compile the following information:

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31,8% of the respondents chose "strongly agree" and 29,7% chose "agree", amounting to 61,5% being those who support the fact that rural communities ought to be consulted when a relevant mathematics syllabus is being compiled.

17,6% chose "disagree" and 5,4% chose "strongly disagree", which amount to a total of 23% being those who do not feel that rural communities ought to be consulted when a relevant mathematics syllabus is being compiled.

15,5% did not know the correct answer.

- **Rural people should be represented on all committees dealing with mathematics curricula**

In V56, the respondents were required to express their feelings on the need for rural people to be represented on all committees dealing with mathematics curricula. A five-point scale was used to gather the following information:

34,2% chose "strongly agree" and 36,2% chose "agree". This amount to 70,4% being those who believe that rural communities should be represented on communities dealing with mathematics curricula.

16,8% of the respondents chose "disagree" and 2% chose "strongly disagree". This makes up 17% to be those who do not believe in rural communities' representation on matters dealing with mathematics curricula.

10,7% of the respondents did not have a position regarding the options given.

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6.6 CONCLUSION

In this chapter, the research data was summarised, analyzed and (provisionally) interpreted.

Chapter seven will concentrate on elucidating findings, in which it will be determined, amongst others, if the null hypothesis and other related hypotheses, as stated in chapter one, were relevantly and correctly addressed. After the findings have been discussed, recommendations, based on the findings, will be made in chapter eight. These recommendations will be put forth for consideration in educational practice, educational planning and socio-economic development programmes to be undertaken by both the public and private sectors.

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CHAPTER 7
FINDINGS OF THE SURVEY

7.1 INTRODUCTION

In the foregoing chapter, the methods of data processing, statistical analysis and interpretation of the results were discussed. In this chapter the findings from the analyses and recommendations will be made and discussed according to the following sequence:

- Findings based on responses to the Standard 10 mathematics students' questionnaire.

- Findings based on responses to the former Standard 10 students' questionnaire.

- Findings based on responses to the Standard 10 mathematics' teachers' questionnaire.

- Findings based on responses to the parents or guardians of present Standard 10 mathematics students' questionnaire.

- Specific findings, focusing specifically on the null Hypothesis and the other three related hypotheses described in chapter one and chapter six. This section forms the focus or hub of this research, because it is here that the data available in the research will show if the research has managed to achieve its objectives or not.

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7.2 SPECIFIC FINDINGS

7.2.1 FINDINGS BASED ON THE STANDARD 10 MATHEMATICS STUDENTS' QUESTIONNAIRE

The findings in this section are based on the analyses of responses of students in the 1994 Standard 10 mathematics classes. The following findings are discussed briefly:

- **Parental occupation**

The majority of parents or guardians in the rural areas in this research are unemployed, as shown by figures hovering between 35% and 60%. This includes males (35%) as well as females (54%). These figures are indicative of the extent to which rural people are economically inactive and this may have a bearing on the ability of parents to keep their children in school up to, and beyond, matric. It may further be one of the causes of the low achievement in mathematics (or in all other subjects) in school, if there is no employment or no certainty of employment opportunities in the home of the child. The example given by Essen and Wedge (1982:87) helps to explain this problem:

> *For example, a child who is disturbed at night by the proximity of crying younger siblings may become overtired; or one who is worried because her parents are anxious about their financial state may find school an annoying irrelevance which is preventing her from helping her parents by earning money; or a 16 year old who knows he must leave school soon anyway in order to help out at home will naturally be less concerned how well he does in his school work than another child whose immediate future depends on level of success at school.*

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It is however encouraging to note that the other 46% or more are spread across other existing employment opportunities for people such as manual or unskilled labourers, domestic workers, teachers, nurses and so forth.

- **Number of people at home**

The number of people staying in one family household may also have a bearing on the attitude of students towards mathematics and its role in the development of the community around them. The problem has its roots in matters such as availability of study accommodation, study time available, and so forth.

It has been established that most students (59%) in the research stay with less than five people in the same family. The fewer the number of people at home, the better for the student; for they will have enough chance and less disturbance to concentrate on their studies in mathematics. The likelihood of a better attitude and better result in mathematics is likely to be increased under such conditions.

- **Number of pupils in class**

The number of students in one class, or pupil teacher ratio, is one of the determinants of good or poor performance of pupils in that class and in the subject taught. Mathematics requires smaller pupil teacher ratios for pupils to perform better.

It has been discovered in this research that a disturbing 27,6% of students belonged to a class or classes with over 140 students each. This is worrying because chances of proper attention by teachers to individual students in such a class or classes are remote and this may contribute towards poor performance in mathematics in such an environment.

It should however be noted that there were some favourable ratios indicated by 9,4% of the respondents.

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- **Attitude to mathematics**

Attitude to mathematics forms a crucial requirement for acceptability of the subject to any community or group of people. A community needs a positive attitude to mathematics to be able to see any meaningful role mathematics could play in their developmental activities.

It has been empirically revealed that the rural students have a fairly positive attitude towards mathematics. 54,3% of the students were found to have a positive attitude, as opposed to 0,6% of those with a negative attitude, while 45,1% were undecided over their attitude towards mathematics.

It is therefore encouraging to see that rural students, notwithstanding the minimum facilities available in their areas for the teaching and learning of mathematics with more understanding are receptive and at ease with the teaching and learning of mathematics.

- **Further studies in mathematics**

Because of the positive attitude of the rural students, they have shown the willingness and readiness to proceed with post-matric studies in mathematics. This has been revealed where 62,9% of the students indicated the willingness to undertake such further studies.

- **Reason for study**

Most of the students (60,7%) have chosen to study mathematics beyond matric because they believe that mathematics is an important subject in their lives. This importance is further revealed in the role that is attached to mathematics below.

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- **Mathematics' role**

The importance of mathematics cited by the rural students[34] is further related to the role of mathematics in developing the rural communities, as cited by the students.

The majority (68,9%) of students see an important role played by mathematics in developing their communities. They believe that for their communities to have any substantial development in order to be on par with other developing or developed communities, rural students should study mathematics, beyond matric. The null hypothesis in this section is therefore rejected.

The null hypothesis in this research revolves around this perceived role, and all the findings so far discussed, together with those to be discussed, have a bearing on this issue.

- **All students to study mathematics**

For mathematics to have any meaningful impact on the development of their communities, students in the rural villages believe that they need to study mathematics as much as possible.

The opinions of students were divided on this issue. 22,9% felt it was necessary for all students to study mathematics and 32,2% felt it was unnecessary. This division is further revealed by 44,8% who believe that the matter should be left to individuals to decide, in other words, the notion of compulsory mathematics studies is not endorsed by the present Standard 10 mathematics students.

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[34] See par. 7.2.6.

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- **Mathematics and community development**

Tied to the role of mathematics is whether it may or may not develop rural communities. The vast majority of students (88,1%) believe that mathematics may help to develop their communities. The fact that students who are still at school studying mathematics believe that this subject can develop their communities, is an important revelation for education planners or those engaged in curriculum development.

How this subject (mathematics) may play this role is another important issue. The modes below serve to give an indication as to how mathematics may be utilized to fulfil such a developmental role.

- **Mode of development**

The ways in which mathematics may develop the communities were recorded as follows:

- **Encouraging students to study mathematics**

  All students should be encouraged to study mathematics. This was agreed to by as many as 90,1%, of the students who responded to such a statement in support thereof. It is indeed a surprising shift by students in this questionnaire[35]. The students' response earlier indicated that only 22,9% supported this notion and 44,8% felt that the matter should be left to individuals to decide.

- **Home-school relationship**

  A closer relationship between the home and the school should be developed. 84,5% of the students agreed that this is necessary.

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[35] See par. 7.2.8.

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○ **Appointment of qualified teachers**

For mathematics to be able to develop rural communities, there is a need to appoint more qualified teachers to teach mathematics in rural schools. An overwhelming 93,3% of students comply with this requirement.

- **Discussion of mathematics with parents or guardians**

For mathematics to have any meaningful impact on the rural communities, it has to reach all members through various channels. One of the channels could be to have a contagious influence through interactive means, such as discussions of mathematics between students and their parents or guardians.

It was revealed that 49,5% of the students discuss their work with their parents or guardians. This is an encouraging figure, though much more discussion would contribute even more positively to the improvement of performance by the students in mathematics.

- **Parents to start the discussion of the work of students**

It is also important to know who, amongst the students and parents or guardians, starts the discussion as it shall be revealed below.

The need for parental involvement in their children's work and the gains made in such an activity are summarized by Berger (1987:19) as follows:

> *Parenthood is an essential role in society. The support given by parents, interrelated with other agencies — particularly the school — should be integrated and continuous. Parent programs that respond to parent needs range from infancy, preschool an primary and intermediate graded to secondary and young adult programs.*

It was empirically revealed that close to half (46%) of the students take the initiative to start the discussions with parents.

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- **Remarks made by parents or guardians**

During, or after, discussions of mathematics work, there are remarks or comments made by parents or guardians which may serve as a source of motivation or demotivation. The following remarks were gathered in the research:

- The majority of parents or guardians, according to the study (89,4%), did not feel that the work done by students was "boring!".

- Many parents or guardians felt that the work is good or appreciable.

- 55,9% of parents or guardians did not feel disturbed by the discussions, but however, a worrying 44,1% in the same category felt they were being disturbed.

- Many parents or guardians (71,1%) regarded the work being discussed as relevant or meaningful to their lives.

- **Mathematics in the home environment**

Communities in the rural areas do come in contact with, or practise, mathematics in one way or the other, on a daily basis. It was however discovered that not so many of them are aware of its existence, let alone its abundance of opportunities. 42,5% of the students were able to say that a lot of mathematics does exist in the rural areas. A total of 57,5% either did not agree or were not able to identify mathematics in the rural environment.

- **The use of local examples in mathematics by teachers**

Another requirement for mathematics to penetrate into the daily lives of the rural community is to incorporate local mathematical examples and

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activities into the daily didactical activities in the classroom. This was found to be done at a limited scale (38,5%), according to the observation of students. However, this makes an important starting point because it makes the educational researchers aware that there is this awareness of mathematics in the rural environment, which is waiting to be tapped as a source of meaningful education to take place[36].

- **Examples from the environment to make mathematics interesting**

Many (69,3%) students are of the opinion that the use of local examples would make mathematics a more interesting subject.

It is important to note that the expectations of students, concerning the use of mathematics examples from the environment in making it a more interesting subject to learn, are disappointed by the fact that teachers use these examples to a limited extent[37] and are thus subjected to either abstract examples or examples that are remote to their daily lives. This could make mathematics difficult or not so interesting to them.

- **Adults to demonstrate mathematical concepts**

The majority of the respondents, amounting to 75%, are not comfortable with the involvement of parents in their classroom lessons. They either disagree (33,1%) or feel it is unnecessary (44,4%) and thus together making 75% of the responses. Only 22,5% of the respondents agree with the suggestion.

- **Parents to know their children's performance in mathematics**

This suggestion is overwhelmingly supported by 91,9% of the students in this research. This implies that parents may have free access into their children's work in mathematics. This implies that parents may request

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36 To be discussed later in this chapter.

37 See par. 7.2.15.

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their children to show them their work on a regular basis. They will then be able to assist their children where possible. Parents may also be in the position to visit schools on a regular basis and discuss the problems encountered by their children in their work in mathematics with the children's teachers. It is an interesting development in education because it comes from the students themselves. This has either a motivational effect in the student's learning capacities or brings about a closer relationship between the home and the school. Such a relationship helps to boost the input made by teachers in the development of the child.

- **Teachers to discuss with parents**

The respondents were divided on this issue as 46,6% agreed with the suggestion and 41% disagreed, though those agreeing with it are in the slight majority. It may be deduced that this was caused by the fact that students were not sure of what purpose this practice would serve. Maybe it is best left to teachers and parents to see the necessity of their relationship.

- **Mathematics in community development**

The respondents regarded mathematics as a subject that may develop their communities in the following ways:

- ○ **Makes us find work quickly**

  Mathematics is looked at with a utilitarian value as a solution to the unemployment problem of the many people in the rural areas as indicated by high figures in rural communities[38]. Mathematics is seen as a vehicle towards the study of courses, or development of skills, that may be in higher demand in the labour market as perceived by the rural students.

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[38] See par. 7.2.1.

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- **Changing our way of thinking**

  The majority (62,5%) of students believe that mathematics will have an influence on their communities' minds that may make them think more scientifically and productively. By changing the communities' thinking, mathematics will thus make such people more marketable and able to secure employment or develop their own employment opportunities[39].

- **Making us think more scientifically**

  An overwhelming 93,8% agreed likewise[40].

- **Making rural people to think more productively**

  This is also supported by the majority (75,5%) of the respondents. The 24,5% that disagreed, form a significant figure that may not be overlooked. This figure represents people who do not believe mathematics can make people productive. It is the use thereof that may develop people productively.

- **Making rural people to earn more money**

  The majority (74,8%) of students agree that mathematics can assist in helping them earn more money. This is linked to the discussion in which mathematics is regarded as having utilitarian value[41]. The respondents see it as a subject that may boost them economically.

- **Other opinions**

  Respondents cited the following reasons with lower percentages why they believed mathematics may develop their communities:

  * mathematics will provide better future life

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39 This is linked to later discussion.

40 This supports the assertion made later.

41 Discussed previously.

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* mathematics will help students gain admission to universities
* mathematics makes rural people brilliant
* mathematics is important for development.

○ **Summary of findings**

To summarize the findings it seemed that rural students regard mathematics as an important subject that may assist them in alleviating rural hardships, such as unemployment and poverty. This could be done by offering them skills that would make them economically competitive and able to be absorbed into the skilled and semi-skilled labour market. This can be done by developing both critical and productive thinking.

• **Mathematics and the training of the mind**

Many respondents felt that mathematics may retard (57,2%) their mental development and make them socio-economically inactive. It seems that the question on retardation was not clearly understood by the respondents, as later on they overwhelmingly supported the fact that the same subject would enable them to be socio-economically productive. They also refuted the fact that mathematics would make them thieves or *tsotsis*.

• **Mathematics and the changing of rural communities' uncivilized practices**

The majority (77,6%) of the respondents believe that mathematics' natural laws will have an influence on the changing of superstitious practices within their communities. Very few respondents opposed this notion. This cause the research to extrapolate that rural people regard subjects such as mathematics as being capable of salvaging them from the darkness of superstitious thinking, to more enlightened and sophisticated conditions of living. This is a significant revelation for the educational planners, practitioners and socio-psychologists. The fact that mathematics is

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believed to have a potential role in changing the mindset of many rural people in this regard, serves as an important challenge to many governmental and non-governmental organizations, who are engaged in projects that are dealing with the changing of culturally oriented mindsets that have a negative effect on the socio-economic development of rural communities in South Africa, and worse, in the whole of Africa[42].

- **Mathematics bias towards urban communities**

It is interesting to realise that few (26,9%) respondents believe that mathematics content is biased towards urban communities. Mathematics may be regarded as a subject that is at home in all communities because of its natural laws[43]. Natural laws are there for every individual, irrespective of ethnological background, the problem is to apply it meaningfully. This implies that the usage of, say, local examples or resources to extricate and understand the underlying principles of mathematics is a necessity for meaningful understanding of the subject.

Textbooks and other material used in rural mathematics lessons will need to have examples that are familiar and relevant for the students. This will help to promote context in learning mathematics which is important for the understanding and utilization of mathematical concepts. This notion is supported by Hoyles in Dowling and Noss (1990:116) when she says *... context is needed merely to provide illustration*; for example, Brown (1989:125) argues:

> *... criteria should be accompanied by examples both to communicate the meaning to fit the criterion and the types of context intended.*

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[42] The effects of such beliefs were discussed previously.

[43] This point were discussed previously.

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Edmonds and Ball in Pimm (1988:127) also support this argument when they say that:

> *'relevant' skills are best learned in the context in which they are relevant, and that teachers can never be certain that their pupils are acquiring the ability to cope in any particular context unless they see them operating in that context.*

- **Changing of Standard 10 mathematics syllabus**

Many respondents, 49,5% as opposed to 36,7%, are not in favour of having the present mathematics syllabus changed to accommodate the aspirations of rural people. This is in line with the rejection of the notion of "rural mathematics" as a subject[44].

- **Consultation of rural communities**

While the respondents reject "rural mathematics" as a subject, or the changing of the mathematics syllabus to suit rural communities as discussed previously, a feeling is expressed by over 50% of the respondents that rural communities and pupils should be consulted when a decision to compile relevant mathematics syllabus is taken. This represents a feeling for the need to have rural communities represented in forums that address curriculum issues in mathematics.

- **Rural community structures in mathematics committees**

More than 50% of respondents see the need to include rural communities in any mathematics subject committee. This will help to make mathematics acceptable to rural communities instead of being regarded as something imposed on to rural communities by urban-based educational bureaucracies.

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[44] Discussed previously.

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If exposure to information is to remain as a prominent influence on values, and values in turn influence behaviour, then manipulating the type, amount and quality of information Black children receive, will help them to develop a value system that is more consistent to their African culture. Such values might include, for example, the principles of Nguzo Saba in Karenga (1976). These include *umoja* (unity), *kujchagulia* (self-determination) *ujima* (collective work and responsibility), *nia* (purpose), *kuumba* (creativity), and *imani* (faith). Presentation of, and teaching about, Africentric value systems may be an important strategy in helping Black children to develop the will and intent to achieve.

Ethnomathematics comes in handy here as a vehicle through which cultural experiences of rural people may be articulated to render this culture useful and relevant in the positive development of rural communities.

- **Rural mathematics as a subject**

It is of vital importance to note that a sizeable number of respondents (over 50%) see the need to develop rural mathematics as an independent subject. This argument has a number of implications. The most important implication is that to develop rural mathematics as an independent subject may best cater for, and address, the needs of the rural communities more carefully and clearly.

Rural communities will also be more actively and fully involved in developing a subject that closely examines and addresses their needs.

It should, however, be considered that such a move will be a fragmentation of a subject that is regarded as coherent and addressing the needs of all communities irrespective of socio-economic and geographical background. Other opponents of this school of thought will argue that rural communities' mathematical aspirations are encapsulated in the branch of

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mathematics called Ethnomathematics. This is a subject for further debate.

- **Consultation before implementation of the new syllabus**

The respondents (46,4% as opposed to 35%) do not see the need for consultation of the rural communities even if they are represented in curriculum decision committees. The respondents do not see the importance of this practice, probably, because of the existing level of illiteracy amongst the rural communities and many other reasons already discussed, such as the rejection of the concept of rural mathematics as a subject.

7.2.2 FINDINGS BASED ON THE DATA OBTAINED FROM THE ADMINISTRATION OF THE FORMER STANDARD 10 STUDENTS' QUESTIONNAIRES

Responses to the following aspects are important:

- **Father's occupation**

Most former students in the rural area whose parents are employed have their fathers or male guardians either as teachers (29%) and followed by those having their fathers dead (22,6%). Those whose fathers are lawyers (24,3%) also feature prominently in the research.

- **Mother's occupation**

A large number of mothers (21,3%) are classified as labourers and housewives. Together they are doing menial work. 15,2% have their mothers dead.

An important deduction to be made out of the above information is that mortality rate in the rural communities amongst fathers and mothers is high. Employment is also confined to unskilled labourers. These two factors may have a negative bearing on the general performance of

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students in school or even in mathematics itself. The fact that the mother or father are not in active employment may result in unsettled lifestyles or even family disputes that lead to general family violence that may create psychological impairedness in the child. This mental instability may lead to indifference in the child, which may in turn negatively affect the school work of such a child, including performance in mathematics.

- **Respondents' occupation**

The achievements gained by the former Standard 10 students in mathematics, together with their application of the knowledge gained in mathematics, to boost their livelihood and development of the socio-economic base of their communities, may be understood from the employment opportunities or income generating ventures they have acquired since they left school.

In the research it was discovered that 44,8% were either repeating Standard 10 or furthering their education at technikons, universities or colleges of education. This is an important involvement as upon completion of higher or tertiary education, such students may serve as an essential source of motivation to both students in the high schools and communities in the villages. The latter may do so if they see their children as advisors to their socio-economic developmental ventures. That is, if their own children or children coming from their own villages are meaningfully engaged in the upliftment of their own communities.

It is further noted that some of those who completed Standard 10 mathematics in the rural schools are employed as teachers (10,3%) and as nurses (6,9%). There are also those who are employed as social workers; lecturers and hawkers or small business persons among others, which are viewed with high regard in terms of socio-economic development in rural communities.

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- **Achievement in mathematics**

Mathematics is a difficult subject to pass in the rural areas as exemplified by the low achievement in the research sample. The majority of students obtained either symbol E (45% of them) or lower. It was, however, encouraging to discover that about 15% obtained C symbols or above. Even an A symbol existed in the sample (all in higher grade).

The implication of the achievement exemplified is that there is evidence that rural students may do better in mathematics provided the right and conducive atmosphere is created. Such an atmosphere may be created by providing adequate resources such as well-qualified and insightful teachers in mathematics, together with relevant equipment, including modern technological facilities in schools.

- **Attitude to mathematics**

Attitude is one of the important cornerstones in the learning of mathematics by students. Without the correct and positive attitude, all learning may become meaningless and learners will be subjected to rote memorization of facts which may not be applied anywhere in life. This view is supported by Costello (1991:141) when referring to the studies conducted by Head (1981) when he:

> *... draws attention to the lack of evidence or understanding of any clear link between personality variables and performance in mathematics, even though there is a popular assumption that personality variables play some role, especially in motivation and the formation of attitudes.*

It was of significant value in this research to discover that the majority of former students in the survey (75,7%) have a positive attitude towards mathematics. This type of attitude is conducive to the receptivity of students towards the learning of the subject, and with this attitude they

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Linked to attitude, is the intention of the majority of students who wish to study mathematics further. One important outcome of this survey is to discover the vast willingness of the rural former Standard 10 mathematics students (83,8%) to study the subject further, provided opportunities exist, despite the state of neglect rural communities have been systematically subjected to, in the form of lack of and other relevant resources or fewer bursaries.

- **Importance of mathematics in the home village**

Many former students (78,4%) regard mathematics as an important subject in their villages. They believe that it plays an important part in influencing the development of their communities. This notion of influence is supported by about 62,2% of the respondents. The centre pin[45] is thus rejected in this category of the research sample, since the majority of the respondents believe that mathematics has a role to play in the development of the rural communities.

It is, however, important to know how mathematics can influence development in the rural communities. In other words, it is important to know the modes of development. A number of such modes were given to the sample to respond to.

- **Application of rural concepts**

  The most popular response (73,7% support) tendered was that teachers should apply rural concepts in mathematics.

- **Students to teach mathematics to rural communities**

  Application of rural concepts is followed by the fact that students should embark on the teaching of mathematics in the village. Another mode of development is that of adults having to go back

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45 This implies the null hypothesis as stated in chapter one.

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- **Students to teach mathematics to rural communities**

  Application of rural concepts is followed by the fact that students should embark on the teaching of mathematics in the village. Another mode of development is that of adults having to go back to school, as supported by 61,1% of the respondents mentioned in the previous chapter.

- **Merger of paragraphs 7.3.6.1 and 7.3.6.2**

  The two modes are closely related because, by adults going back to school does not necessarily mean going back to formal mainstream schooling, but, amongst others, by attending informal classes that may also be conducted by students, or other better equipped village adults.

- **Employment availability**

  Another mode of development supported by (55%) respondents is that the developmental influence may be induced by making people socio-economically active. This implies that, by making people acquire financially gainful employment, more skills and socio-economic independence will be established in communities.

- **The relationship between present employment and mathematics**

Another important dimension of the role of mathematics to former Standard 10 students in the rural areas is whether there is any correlation between their present employment and their mathematical achievement.

75% of the respondents indicated that there is an important contribution mathematics made to their present employment or job. In another question based on whether mathematics is being applied in their present jobs, the

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respondents (72,2%) indicated that it is, indeed, being applied and that it is helpful too[46].

It is also noteworthy to realize that about $^2/_3$ of the respondents believe that they secured their present jobs because of having passed mathematics in Standard 10[47].

It is vital to realize that the former Standard 10 mathematics students who are in employment, see mathematics as a vital tool which assists them in solving day to day employment-related problems. It may be concluded that mathematics is thus important and needed in solving day to day problems encountered by various people from different walks of life. This conclusion was similarly reached in Britain by the Cockroft Committee (1981:10). They recommended as follow:

> *Therefore, whilst realising that there are some who will not achieve all of them, we would include among the mathematical needs of adult life the ability to read numbers and to count, to tell the time, to pay for purchases and to give change, to weigh and measure, to understand straightforward timetables and simple graphs and charts, and to carry out any necessary calculations associated with these.*

- **The importance of former Standard 10 mathematics students in their villages**

68,6% of the former Standard 10 mathematics students believe that their knowledge of mathematics has a noteworthy significance for their villages[48]. It is significant to note that these former students may have a significant role to play in assisting other members of their rural

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46 Discussed previously.

47 Discussed previously.

48 Discussed previously.

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communities to acquire the knowledge and skills brought about by the application of mathematics in the development of the latter's conditions of life.

- **Mathematics discussions within the rural communities**

Discussion is one of the important mechanisms of information flow and social interaction especially within communities that are not so literate. The interaction through "socio-cultural" interactions approach, proposed by Rogoff and Gardner (1984) is recommended. The remarks mostly made by members of the communities after discussing mathematics role of importance were an indication of how communities regard the contribution made by this subject to their own development.

The majority (58,3%) of the community members regard mathematics as good for development[49]. Some (11,1%) ask for even more (or encore of) discussions. This shows a majority of 69,4% being in support (or in favour) of the discussions.

The support for discussions is given by a further 66,7% of the non-schooling members of the community (former Standard 10 students)[50]. This is an important sector of the community because it includes the illiterate group that would normally have no dealings with mathematics because of ignorance. The fact that they also regard it as important, paves the way for mathematics educators to think of creating a partnership with parents or guardians of students in a more cost-effective joint venture, in the teaching of mathematics to their students, than it seems to be the case now.

- **Teacher rating**

The former Standard 10 mathematics students' rating of their former mathematics teachers is another important dimension of showing where

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49 Discussed previously.

50 Discussed previously.

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improvements are necessary in the teaching skills of the rural mathematics teachers.

The fact that only 37,1% of teachers are rated as "good" and 17,1% as "good but poor in language" is not surprising[51]. This correlates with low achievement in mathematics generally nationally, but specifically, in the rural schools. This pattern is, to a large extent, confirmed by the low mathematics qualifications teachers possess in the rural high schools[52]. There is a need for something urgent to be done to solve this problem (some suggestions or recommendations are dealt with later).

- **Mathematics and the rural environment**

To enhance the teaching of mathematics in the rural schools there was a need to find out whether the former students in Standard 10 perceive its existence and usability within the rural socio-pedagogical context.

It is important to note that the confinement of the teaching of mathematics to the acquisition of a set of isolated skills prescribed by the syllabus has been attacked by countries[53] such as Britain as illustrated by Wain in Rayner (1989:31) he says:

> *It is common now to consider limiting the syllabus while at the same time enriching the curriculum. In other words expecting less in the way of technical skill but much more in terms of application, understanding and exploration of ideas.*

The implication of Wain's argument in the context of this research lies in the fact that the inclusion of rural concepts in mathematics will serve to widen the scope of relevance and applicability of mathematics to rural

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[51] Discussed previously.

[52] Discussed previously.

[53] Problem-centred approach is preferred.

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The respondents were, to a large extent, divided about the existence of mathematics in their home environment. 41,7% believed it existed, while 38,9% believed it did not exist and the rest were divided on the issue.

It is furthermore worth noting to discover that most respondents (58,3%) as opposed to 11,1%[54] see the need for teachers in mathematics to use local and rural examples in their mathematics classes. This is likely to make mathematics more interesting for the students[55].

It was further noted that a half supported the idea of adults being invited, on occasional basis, to share their rurally or ethnically-based mathematics knowledge with students, by participating in the formal teaching lessons[56].

Those who supported this proposition (amounting to a combined 44,2%) ranged from those who believe it would make students to understand mathematics better (26,5%), to those who thought it would improve the link between the home and the school, to those who thought this would make parents more interested in their children's education.

Those who did not support the idea (amounting to 35,5%) ranged from those who fear that it would distort mathematics learning to those who thought it would confuse the students; to those who believe that it would create a bias, in mathematics, towards rural life.

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54 Discussed previously.

55 This is supported by 75% of the respondents discussed previously.

56 See par. 6.5.2.28 as well.

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7.2.3 FINDINGS BASED ON THE STANDARD 10 MATHEMATICS TEACHERS' QUESTIONNAIRE

The following responses are discussed briefly:

- **Teachers' qualifications in mathematics**

According to the findings in this research the teaching force available in the rural schools have insufficient qualifications in mathematics. Many teachers' qualifications stand at the Secondary Teachers Diploma[57]. Some (18,2%) have only done this subject at B.A. level as one of the ancillary subjects or as a major subject. **A disturbing 27,3% have only done mathematics up to matriculation level. It is further worrying to note that none of the teachers surveyed have done a B.Sc. degree.**

The low level of qualifications in mathematics will undoubtedly correlate well with the prevailing poor achievement in mathematics, generally, and in rural areas specifically[58].

- **Experience in teaching mathematics**

Another important factor in the teaching of Standard 10 mathematics is the level of experience in teaching such classes. This may have a particular role to play in influencing both the attitude of students and achievement in, mathematics. The role of experience in the teaching of mathematics is given by Jaworski and Watson (1994:125) when they say:

> *The process of development does not stop when a student-teacher gets a teaching job. Some teaching approaches and strategies develop naturally during the practice of teaching. Changes occur. Any experienced teacher is a **different** teacher to the one who first began.*

[57] Discussed previously.

[58] Discussed previously.

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It has been discovered that the vast majority (73,3%) of mathematics teachers have experience in teaching mathematics in Standard 10; that is, ranging from 1 year to 5 years. 26,7% have more than 5 years of teaching mathematics[59]. While teachers' experience may not be the main determinant of how students perform in mathematics, it may have a correlational value and influence.

- **Class sizes**

The smaller the class, the larger the output. This is a notion prevailing in many educational sectors.

The research conducted in this work shows that many teachers have to do with overwhelmingly large classes. There are cases where two teachers had to share a class consisting of 270 students. These are some of the extreme cases. It was otherwise discovered that the sample showed an average of 30:1 pupil/teacher ration. This ratio is still high for any notable mathematical achievement to take place.

One important reason given by teachers for such large Standard 10 mathematics classes is the fact that many children love the subject. If this is anything to go by, a serious challenge can be put to education planners to give rural education a closer look.

- **Students' attitude**

The students' attitude towards mathematics as expressed by students themselves, was found to be on the positive end of the scale.

It is of paramount significance to note that 33,3% of teachers regard students as having a positive attitude and 56,3% regard it as average. The most important thing is to realize that if attitude is average and 33,3%

[59] Discussed previously.

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think of it as positive, then teachers are comfortable with the degree of receptivity of their students, with regard to mathematics.

- **Difficulty of mathematics to students**

Teachers' surveyed in this research do not believe that the mathematics that they teach to their students is difficult for them (students) to understand. As much as 60,4% of teachers find the subject easy for their students to understand.

Many of these teachers (54,2%) believe that the reason why mathematics does not present any difficulties for them is because the students regard it as an important subject. Others (14,6%) attribute their success in making it less difficult to their good methods of teaching the subject.

- **Urban-bias in mathematics**

Most of the teachers (76,6%) do not believe that mathematics is biased towards urban life[60].

- **Rural concepts in mathematics curriculum**

A large percentage of teachers[61] did not believe that mathematical concepts are available in the rural environment. However, another notable group[62] argued that various mathematical concepts exist in the rural environment. This implies that many teachers fail to relate mathematics to the many features of mathematical nature readily abundant in the rural environment of their schools.

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60 This has already been discussed.

61 58,4% recorded previously.

62 Giving 37,5% previously.

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Such existing concepts were further identified (presumably by those amongst the 37,5% above) as amongst others, Measurement, Geometry, Calculus, Remainder Theorem, and Functions.

Many teachers (62,2% of the total of 45 teachers surveyed), who believe in the existence of mathematics in the rural environment, believe that the mathematics associated with the rural environment should be incorporated into the school mathematics curriculum.

Concepts nominated for inclusion in the school mathematics curriculum are Land Form, Measurement, Demography, Fractions, Logic, Art, Programming, Flowers, Shapes, et cetera, to name but a few[63].

- **Members of the communities' participation in mathematics lessons**

Most teachers[64] do not see any problem in the involvement of adult members of the community in sharing rural experiences of mathematical nature with their students during the lessons.

This will further alleviate the problem of leaving the entire burden of bringing new, and some unfamiliar ideas, into the hands of teachers who may lack the same insight as the villagers in the particular mathematical topic(s) under consideration, as put forth by Huberman and Miles in Carlson and Awkerman (1991:55):

> *This paves the way for a wealth of ideas from the rural environment, some with a cultural inclination, such as in the decorating art and crafts of the Southern Ndebeles, to be brought into the classroom. This will boost the level of understanding of mathematics in rural schools, as well as achievement.*

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63 Discussed previously.

64 Discussed previously.

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The reasons for such participation range from "Make students understand mathematics better"[65] through "Improve the link between the home and the school"[66] to "Make parents more interested in their children's education" (92%).

Other negative reasons such as it will "Distort mathematics learning" were rejected[67].

- **Rural communities in mathematics curriculum design**

Many teachers[68] believe that rural communities should be actively involved when a mathematics curriculum is being designed. This is an important position taken by teachers as it is a general belief that rural communities have been systematically left out in curriculum decision-making processes, particularly in mathematics.

77,1% of teachers believe that this involvement should become even more visible and apparent. Such communities should be represented in the various curriculum committees on the subject[69].

- **Mathematics-employment relationship**

There is a strong feeling that there is a link between chances of finding employment and achievement in mathematics[70]. This correlates closely with such a feeling expressed by the former Standard 10 mathematics students in which they indicated that they secured their present

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65 Discussed previously.

66 Discussed previously.

67 Discussed previously.

68 72% recorded previously.

69 Discussed previously.

70 Discussed previously.

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employment due to the fact that they have passed Standard 10 mathematics. Teachers and students concur on this issue.

Teachers have proved this assertion by providing statistics which indicate that at least 50% of their former Standard 10 mathematics students are in active employment, while a combined 56,5% show that 25% of their students are in active employment. The rest constitute, primarily, those who do not know.

- **Development of rural communities through mathematics**

Teachers in the rural communities believe that mathematics has an important role to play in the socio-economic development of such rural communities, as shown by 93,1% of teachers who were surveyed[71]. This view was expressed by 79,2% of the teachers who were surveyed in this research. It is generally believed that mathematics has either a direct or indirect influence on the development of these communities to have their life styles and day-to-day lives improved.

It is believed that certain modes of development need to be supported by the members of the community if development is to be achieved in such an environment, as exemplified below.

- **Adults to go back to school**

  An important suggestion is made by mathematics teachers, that adults who did have the opportunity of schooling need to be given opportunities, for example, to provide tuition in mathematics at adult education or literacy centres. They will get an opportunity to improve their literacy or numeracy capacity, which will in turn spread through the villages and influence the majority of the

[71] Discussed previously.

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villagers. This notion was supported by 82,4% of the teachers in the sample.

- **Students teaching mathematics in the village**

  It is further believed that the contribution that can be made by students in improving the lives of villagers in the community should never be underestimated. The suggestion is that students from the villages should participate in adult informal numeracy programmes. In other words, the knowledge gained through the formal schooling could be filtered through the community fabric by engaging students in knowledge-sharing discussions or informal classes with other members of the community. This viewpoint is expressed by 85% of the teachers who were surveyed.

- **Teachers applying rural concepts in mathematics**

  It is significant to note that 93,1% of teachers surveyed believe that rural concepts in mathematics are important for rural people in the understanding and internalization of mathematics for purposes of development.

- **Changing of rural mathematics syllabus**

  One of the ways in which mathematics can bring about socio-economic betterment of the rural communities is believed to be the fact that there should be a change in the way in which mathematics in the rural schools is taught at the moment. The support for this suggestion[72] was revealed when teachers reacted to the statement on the need for syllabus change.

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72 An average of the records is 89,85%.

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Most teachers were in support of syllabus change to accommodate rural concepts or **rural-centric** ideas in mathematics. 75% indicated that they would not resist such a move, while 93,8% indicated that they would remain in teaching if such a didactical/pedagogical paradigm shift is undertaken.

This is further supported by, 100% of teachers surveyed, who indicated the willingness and readiness to accept further training in order to be ready and have the capacity for challenges that would accompany such changes. There are also the majority (90,6%) of those who feel that they would radically support it[73]. The importance of the involvement of teachers in such curricular development matters has also been supported by the former Department of Education and Culture (1992:10) when they encouraged their teachers in those days:

> *Teachers often tend to see curriculum development as the task of little men in ivory towers who have long since lost touch with the realities which have to be faced in the classroom. With some resentment, these teachers feel that syllabuses based on fine education theories are forced on them "from above" and that no provision is made for their own experience and initiative. This is far from the truth as teachers themselves in fact effect curriculum development on a micro level when they implement the syllabus in a particular classroom situation in a manner suited to the particular needs and abilities of their pupils.*

Teachers in this research think contrary to those who were attached to the above mentioned former department, as shown by statistics already referred to.

73 Discussed previously.

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- **Parental Involvement**

Many teachers in rural schools feel that the performance and attitude of their students may be boosted by the involvement of parents or guardians in their children's school work in mathematics on a regular basis. Such involvement may be done by parents or guardians by making direct enquiries with the teachers or the management of the schools involved. All teachers surveyed[74] on this issue supported the suggestion.

The supporters of the home-school relationship approach see it as an opportunity for teachers to view parents, or be viewed by parents, as co-educators or partners in the pedagogical development of the child (or the educand). Parental contribution is an important aspect of the educational development of their children because according to Atkin, Bastiani and Goode (1988:87):

> *... parents have a more intimate knowledge of their own children than teachers can ever hope to have, and it is this intimacy which develops in all the different settings of family life, and as the child changes, develops and matures, that enables parents to develop the skills to motivate each child in a different way ...*

Munn (1993:1) goes on to support parental involvement by saying:

> *The importance of parental involvement in schools is now generally recognised. A number of studies of school effectiveness identify parental involvement as one of the key variables associated with effectiveness in general and with pupil attainment in particular. The more involved parents are with their children's schooling, the greater it seems are the chances of their children doing well.*

94,4% of surveyed respondents regard parents or guardians as

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[74] 100% is recorded previously in this respect.

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trustworthy and 100% as co-educators[75]. All teachers also see parents as facilitators of meaningful education[76]. None of the teachers see parents as intruders in their field, nor as useless in the teaching-learning situation[77].

- **Teachers and after hours mathematics discussions**

The parental involvement in their children's work through discussions[78] may further be boosted by the informal after hours participation of teachers in the discussions at the various homes of the students. An overwhelming support[79] of this need was given by teachers who took part in the research. Most respondents, generally, indicated that they would accept the invitations for taking part in the discussions as shown by 100% who said that the invitation will be successful, and 93,8% who said that the invitation would not be rejected. 94,4% claimed that the invitation would not be regarded with suspicion and 100% who said that it will lead to motivation[80].

- **Mathematics teachers in community development programmes**

The majority of teachers who took part in the research overwhelmingly concurred, as shown by 97,8% who agreed, with the notion that mathematics teachers should also take part in other community development programmes in the communities they are serving.

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75 As shown previously.

76 Discussed previously.

77 As given previously.

78 As discussed previously.

79 93,6% recorded previously.

80 Discussed previously.

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This supports the fact that education, and mathematics education in particular, should not be viewed only as a separate entity, but a holistic process in the development of the person. According to Costello (1991:141) when referring to Pask's (1976) distinction between holism and serialism:

> *Holism involves the attempt to achieve a global description or understanding of a system or structure, while serialism concentrates on one goal at a time, resulting in the mastery of topics in a step-by-step fashion.*

It is the notion of the linkage of what goes on in the classroom with what goes on in the home that will assist in developing the intellectual capability of the child. The child will see the relevance and the compatibility of mathematics to his real-life situation.

The support for parental involvement is further supported by way of the need for parents or guardians to be encouraged by teachers or other members of the community, who already practise it, to discuss their children's work with the latter.

All (100%) the teachers who took part in the research[81] supported this idea.

It is further suggested that the discussions be held on a daily basis, if circumstances allow[82]. This is suggested by 50%, as opposed to those favouring weekly basis (19,6%) or monthly basis (13%) and those who are not prescriptive concerning time.

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81 Discussed previously.

82 As suggested previously.

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The need for such discussions was motivated by the teachers as having the following results:

- **Motivation of the child to learn further, or more of, the subject**
  All respondents who took part supported this assertion.

- **The link between the home and the school will be improved and maintained**
  This will create an atmosphere of mutual trust and positive attitudes in the learning environment. All the respondents who took part in the research supported this school of thought[83]. 92% of teachers also supported the home-school relationship[84].

  There are, however, those teachers who raised a sceptical concern by indicating that the children may become parent-dependent; as shown by 37,5%. This group of teachers warning proponents of this philosophy to be on the lookout never to overemphasize the home-school linkage and lose the equilibrium.

  It is equally important for teachers to have the necessary and positive attitude towards the very people they will be assisting in the school community relationship initiatives, in order to have any tangible results, as advised by Hallak (1990:248):

  > *The teachers' attitudes, and their relations with a community, are as important as knowing what they are talking about.*

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83 Discussed previously.

84 Discussed previously.

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- **Problem-solving as an essential part of mathematics**

It sounds to be a fact that problem-solving is a *sine qua non* for the meaningful teaching of mathematics from the arguments put forth by proponents of this approach, such as Stoker (1992:135), when he says:

> *Good teachers attempt to provide an environment that promotes problem-solving development because they realise the importance of such an environment for their pupils.*

Problem-solving may be defined by referring to the statement quoted by Branca (1980:7) from the paper of the National Council of Supervisors of mathematics (1977):

> *Learning to solve problems is the principal reason for studying mathematics. Problem-solving is the process of applying previously acquired knowledge to new and unfamiliar situations. Solving word problems in texts is one form of problem-solving, but students also should be faced with non-textbook problems. Problem-solving strategies involve posing questions, analysing situations, translating results, illustrating results, drawing diagrams, and using trial and error. In solving problems, students need to be able to apply the rules of logic necessary to arrive at valid conclusions. They must be able to determine which facts are relevant. They should be unfearful of arriving at the tentative conclusions, and they must be willing to subject these conclusions to scrutiny.*

All teachers in the research regard problem-solving as an essential part of mathematics, as shown by 100% positive response[85]. The importance attached to problem-solving as an essential instrument for solving problems encountered by students in everyday life, is depicted by 95,7% of teachers who agree with this belief.

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85 Discussed previously.

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The suggestion that the syllabus for mathematics that is taught to rural students should include problem-solving, which is supported by 91,5% of the respondents[86] is a further indication of the importance attached to the problem-solving approach.

It is of particular interest to note that the vast majority of teachers (85,7%) say that problem-solving should be taught to, collectively an average extent. This figure includes 69,6% who felt that it should be to a very large extent[87].

Such a need for serious consideration of problem-solving within the mathematics curriculum is emphasized by Charles and Lester (1982:13):

> *There is an ever increasing demand for people who can analyze a problem and devise a means of solving it. Thus any mathematics curriculum that does not give direct, serious attention to developing problem-solving ability in students is no longer satisfactory.*

7.2.4 FINDINGS BASED ON THE DATA OBTAINED FROM THE ADMINISTRATION OF PARENTS' AND GUARDIANS' QUESTIONNAIRES.

The following findings are important.

- **Occupation**

Most of the parents or guardians, based on the 29 different villages, are either unemployed or labourers. This combination makes up 41,6% of the labour force amongst the parents and guardians[88]. The other 58,4% is

86 Discussed previously.

87 Discussed previously.

88 See par. 6.5.4.4.

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shared by various other forms of employment such as teaching (10,8%), driver (4,2%) and so forth.

The employment situation of the rural parents or guardians will undoubtedly have a bearing on the affordability rate of the communities in the affected villages inside the research scope (and outside). In other words, many parents may be experiencing problems in either keeping their children at school up to matric level or may be unable to let their children proceed with mathematics at a higher or tertiary education level. This employment picture seems well balanced within the gender factor as shown by the figures within the sample. 30,1% of the respondents are mothers and 41,8% are fathers. This also means that 71,9% of the respondents are biological parents while 28,1% are non-biological parents or guardians.

- **Children doing Standard 10 mathematics in a family**

Most of the parents[89] whose children were doing mathematics in Standard 10 indicated that only one child was in such a class. The rest had more than one doing Standard 10 mathematics.

It is encouraging to learn that most of the parents[90] got the information about their children doing Standard 10 mathematics from their own children, because this is an indication of the amount of interest rural parents have in their children's work. This augurs well for the degree of parental involvement[91] in which former Standard 10 mathematics students were supportive of the notion. The other complement (40,6%) indicated that they got the information through other methods than the one above.

89 73% of the parents supported this.

90 59,4% of the parents supported this, as discussed previously.

91 As suggested and discussed previously.

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- **Attitude to mathematics**

Most of the parents or guardians surveyed[92] showed to have an affinity with, or positive attitude towards, mathematics. This serves as one of the cornerstones of the importance attached to parental involvement in mathematics. The remaining percentage may be the result of general illiteracy or lack of much the needed communication flow between the home and the school.

This positive attitude is further elucidated by the majority of parents[93] who indicated that they are proud of their children who are doing Standard 10 mathematics.

The combination of the liking of mathematics by 92,3% and the pride of their children doing Standard 10 mathematics (97,4%) equals a positive attitude towards mathematics, which is the basis for accelerated achievement and performance in mathematics.

- **Encouragement of children to study mathematics further**

It is not surprising to discover that 92,9% of parents or guardians indicated that they will encourage their children to study mathematics beyond Standard 10[94]. The attitude towards mathematics expressed by parents and guardians previously, tie well with the readiness of parents to encourage their children to learn mathematics further.

The reasons fielded by parents on why their children should study mathematics further are[95].

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[92] 92,3% of the parents supported this as discussed previously.

[93] Discussed previously.

[94] See par. 6.5.4.11.

[95] Discussed previously.

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- That mathematics will build their children's lives (97,1%).
- That mathematics will not cause the children to cheat their parents (97,1%).
- That they will become useful citizens (96,6%).
- That the children will uplift their communities (96,8%).
- That the children will have respect (100%)
- That they will find jobs quickly (90,9% and 98,1%).

- **Encouragement of other children to study mathematics in Standard 10 or beyond**

It is important to note that the majority of the parents or guardians are prepared to encourage children, other than theirs, in the village to study mathematics in Standard 10 or beyond. This is perhaps also an indication of the awareness and sensitivity of the rural communities of their situation of being educationally underprivileged, and lacking in basic educational development they have been subjected to, the answer to which they see as *Kgomo go tsoswa yeo e itsosago* in Northern Sotho. (The English translation being "If you want help, please try to help yourself first".)

The reasons forwarded by parents or guardians for encouraging other children to study mathematics in matric or beyond are[96]:

- That they will be useful for their communities (95,6%).
- That they will uplift their communities' standard of life (98,6%).
- That they will get jobs easily (100% and 96,8%).

- **Community development through mathematics**

The vast majority of parents or guardians regard mathematics as an important instrument that may be utilized to develop rural communities. 96,6% of all the parents or guardians supported the notion that

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96 Discussed previously.

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mathematics is essential in accelerating development. Wain in Wiegand and Rayner (1989:18), is even more emphatic on the undeniable usefulness of mathematics to society:

> *Survival in modern society requires the ability to use mathematics with ease and confidence in many everyday situations. The usefulness of mathematics is undeniable.*

Such views are supported equally by other groups already surveyed, as shown by Standard 10 students with 88,1% concurrence, former Standard 10 students with 78,4% and teachers with 93,1%, respectively.

Parents or guardians believe that mathematics may develop the communities through the following modes[97]:

- Ensuring that all children study mathematics (79,6%).
- All adults to study adult mathematics courses (55,6%).
- Children to share their mathematical knowledge with adults (95,9%).
- Practical application of mathematical ideas in the village (93,2%).
- Linking of school-based and home-based mathematical ideas (86%).
- Other comments given by some parents (with lower percentages) include, amongst others, the following:
  - Adults should learn mathematics.
  - Mathematics will make it easier for members of the community to get employed, and thus boost their socio-economic status.
  - Children should study mathematics from their earliest standards of schooling.

[97] Discussed previously.

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- **Adults sharing culturally-based mathematical ideas with their children**

Quite a significant number of adults believe that it is important, for community development purposes, to have adults sharing the basic cultural mathematical knowledge, they already possess, with their children or other children in the village. 68,9% of the parents or guardians supported this idea.

It is of particular importance to note that only 11,9% opposed the suggestion, while the rest constitute those who are not quite sure about the suggestion. This makes it conclusive to believe that knowledge-sharing in the village is one of the factors that may contribute significantly to community development.

- **Discussions of mathematics with children**

Additional to mathematical knowledge-sharing[98] is the practice of adults discussing mathematics and mathematics performance of their children, or children in general, in the village. A large degree of parents support this practice, generally, though differing concerning the frequency of such discussions. Such frequencies vary from parents or guardians who do or prefer to do it sometimes (43,4%) to those who would like to do it but have no time (17,1%); to those who always do it (11,8%); also those who rarely do it (8,6%) and those who would like to do it but are disappointed by their children's lack of interest in this practice (13%)[99].

All the parents who have an interest in discussing their children's mathematics work, despite the hindrances such as lack of expected cooperation by the other party (that is, their children) in some cases,

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98 Discussed previously.

99 Discussed previously.

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amount to 82,2% of the number of parents (152) who took part in the survey.

The importance of discussion in mathematics teaching has been shown by the amount of research conducted by various researchers. Discussion or interaction has been given many different terms as described by Nelissen and Tomic (1993:27):

> *Several authors have pointed out the importance of this interactive, or social dimension of learning. Bishop (1988) has argued to replace **impersonal learning** and **text teaching with mathematical enculturation,** thereby emphasizing the relationship between education and culture. Pimm (1990) uses the term **mathematical discourse,** while Salomon (1989) speaks of **cognitive partnership.***

- **The starting of the discussions**

Another important aspect of the discussions described above is to know who, between the parents and guardians, starts the discussions. It has been discovered that in most of the discussions conducted, the children are the initiators. They get the discussions going in order to get the parents involved.

The above was claimed by some of the parents or guardians. Not far from the same figure is the fact that 39,1% of the parents or guardians start the discussions. This observation is important for the significance attached to the discussions, as there is no vast difference in as far as involvement of both parents or guardians and the children is concerned. The fact that both children and adults start the discussions show how seriously both parties regard their discussions. This is a recipe for insight in the subject (mathematics) and motivation of students to take the subject seriously. The importance of the discussion of the students' work with parents or by

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parents with students or teachers is given by Christiansen, *et al.* (1986:43) when they say that:

> *... there is a need to explain to and to discuss with parents the school's policies concerning mathematics teaching. Also there is a need to discuss pupils' progress with parents.*

- **Feelings about the discussions**

It was also discovered that most of the parents regarded the discussions with a positive attitude. This is shown previously by 48% of parents or guardians who regarded such discussions as useful, 16,7% found them interesting and 22% found them to be motivating. This constitutes a total amount of 86,7% of parents or guardians who regard these discussions with a positive outlook.

- **The role of adults from the village in the teaching of mathematics**

It was discovered in the research that parents and guardians substantially believe that adults from the village can play an important role in making mathematics interesting and easier to understand by assisting in the teaching of the subject (mathematics). 63,3% (discussed previously) agree with this involvement. They believe that this will boost performance in mathematics.

Those who supported this idea, suggested that it could be done by the mathematics teachers inviting interested and knowledgeable adults from the village to the mathematics classes. These adults would be given the opportunity to teach students the mathematical concepts that they come across in their day-to-day village life. Teaching would be conducted on a more practical and experiential basis than is the case with the conventional syllabus-based approach teachers are required, by pedagogical imperatives of the curriculum, to follow.

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It should, however, be noted that there are parents or guardians who objected to the parental involvement discussed above, as they probably regard it as an intrusion of parents into the spheres of operation, reserved for the teachers. This objection was raised by 9,4% of the parents or guardians, and 41,9% objected to adults doing actual teaching.

It is important to consider the fact that the majority of students (75% in par. 7.2.16) differ tremendously with their parents or guardians concerning this involvement.

Those who supported this idea gave the following motivations, for their support, by claiming that such an involvement will:

- **Not distort mathematics learning**
  69% agreed as opposed to 31% who disagreed.

- **Not confuse the students**
  65,3% agreed as opposed to 34,7% who did not support it.

- **Not make mathematics biased toward rural life**
  80,6% in support, and 19,4% not, in support of it.

- **It will make students understand mathematics better**
  91% are in support of, and 9% not in support of it.

- **It will improve the link between the home and the school**
  90,7% are in support, and 9,3% are not in support of such involvement by parents or guardians.

- **It will make parents to be more interested in their children's education**
  This has 85,5% support, as opposed to (14,5%).

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- **Mathematics and the changing of some of the rural communities' practices**

Rural people have their own culture which in many ways differs from the urban culture. They have various forms of beliefs within their culture, which are normally characterized by elements of unsophistication such as, superstitions based on voodoo, sorcery or witchcraft beliefs and, to a large extent, jealousy and suspicions concerning one another. This, sometimes, breeds notions of witchcraft, sorcery, magic, unreliable and unproven unscientific traditional healings and self-protection. This type of belief exists in most typical African rural settings such as villages. Such an experience was described by Father Matota (1984:1, 45) who was a missionary in Kisantu Diocese in Zaire as related by Lagerwerf (1985:40) when the latter says:

> *Facing a case of death or other miseries, the people in the village blame the* ***bandoki****. Instead of taking their own responsibility they attribute unnecessary accidents to sorcery. Even intellectuals have not always left this behind them. In spite of formal education and an unflagging struggle of missionaries Kindotie is more alive than ever*

The author (Lagerwerf, 1985:42) refers to another study conducted by Eggen when he says:

> *In his anthropological study of the pastoral activities of the Roman Catholic Church in the Central African Republic, Eggen also raises the question of mutual suspicion as an impediment to development. The belief in sorcery blocks every initiate, because success is considered a threat to the community.*

Such a problem is also endemic in the rural villages of the Northern Province where this research was concentrated. The culmination of such beliefs was the appointment of a Commission of Inquiry into Witchcraft Violence and Ritual Murders in the Northern Province of the Republic of

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South Africa (Ralushai, 1996). The findings of this commission concur with the beliefs discussed above.

It is important to discover in this research, that the vast majority of parents or guardians, who represent the adult village communities, see mathematics as a redeeming instrument to save rural communities from such traditional beliefs and practices. 73,5% of such adults supported this notion. Only 8,9% did not agree with the notion, while 17,7% did not have a fixed opinion regarding the matter.

The belief harboured by the rural communities researched, that mathematics may lead rural communities away from such practices, is an indication that these rural people are fully aware of the unsophisticated practices they indulge in. They are keen and ready to renunciate this by changing their life styles supported by the nature of mathematics that is based on natural laws that are not influenced by any mind sets.

- **Rural mathematics as a subject for rural pupils**

Parents and guardians do not see mathematics as representative of the rural culture of their communities. This is represented by 36,9% who do not believe that it represents the rural culture. This figure is not far from those who believe it does represent the rural culture which are represented by 32.1% who disagree. It may thus be concluded that parents in the rural areas, as a result of their state of illiteracy, may not be in a proper position to judge if mathematics represents or does not represent their culture because they may not understand the content of the subject, as a result of lacking in deeper understanding of educational concepts, due to literacy or numeracy problems.

The view expressed by parents who believe that mathematics should have elements of cultural representation gets support from views such as the one expressed by Costello (1991:156):

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It is emphasised that teachers need to devise examples and illustrations, within the National Curriculum framework, which relate to the cultural background of pupils.

The argument, for and against, cultural consideration in mathematics as argued on the international level seems to tie well with the balanced views expressed by parents in this research on this matter as expressed further by Costello (1991:157):

There are, it seems, two ways of avoiding any racial or cultural concerns in mathematics education. The first is to assert mentality and abstractness of mathematics and argue that culture and context are not significant. The second, which is taken apparently by the National Curriculum, is to recognise the possibility of a multicultural approach but to decide for the most part not to adopt.

The idea of ethnomathematics comes in handy here in support of the rural community in having the mathematics curriculum to reflect their culture, as put forth by Orton and Wain (1994:29):

The term ***ehtnomathematics*** *has been coined to describe that mathematics which is locked into a culture and which is used to accomplish many ordinary, everyday tasks.*

This type of mathematics seems an appropriate field of study to institute and pursue in the rural context.

- **The Standard 10 mathematics syllabus change**

Tied to the argument of the effect of illiteracy posed above, is the reliability attached to the answers given by parents on the need for syllabus change, in order to suit the needs of the rural communities concerning mathematics. 43,2% of the parents or guardians feel there is a need for syllabus change, while 46,7% do not agree that such a need is

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justified. The views of the parents or guardians are balanced on this issue. It may thus be concluded that parents are not concerned about this issue.

It is, of course, important to note that the majority of the parents or guardians feel the need for their consultation if the syllabus is changed. Carlson and Awkerman (1991:253) have warned against ignoring the community or all relevant stakeholders, when undertaking curriculum change through a data-gathering process when they said:

> *Unfortunately, parents and teachers often feel that their wishes have been ignored - either because they were not given the chance to make their wishes known, or because someone did not take them seriously. This is particularly true after decisions have been announced that relate to emotional issues such as closing schools, reducing or eliminating curricular or co-curricular program.*

The authors go on (1991:253) to emphasize the fact that:

> *Stakeholders ask for real communication and involvement, not just lip service to the concept of participatory planning. Issues of lack of trust and respect are raised, often for good reason.*

Such a demand for consultation is represented by 61,5% of the parents, as opposed to 23% who do not see the need for consultation and as opposed to 18,8%, while 10,7% constitutes those who do not know. This stresses further the need for parental involvement in educational matters.

Such involvement is further shown in the case where 70,4% of the parents or guardians feel that rural people should be included in or represented on all the committees set up to deal with mathematics relating to curriculum design, development, and so on. This is an important revelation: **that rural communities need to get involved in educational**

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and their children, as a large degree of importance of the subject is attached to rural people for their development.

7.3 GENERAL FINDINGS IN TERMS OF THE HYPOTHESES

The research has, so far, managed to reveal findings based on the various items as required by each of the four questionnaires in pursuance of the four hypotheses mentioned in chapter one, with special reference and emphasis to the null hypothesis. Each individual questionnaire response reflected a specific perception in the four samples which attempted to reflect towards the null hypothesis, which reads as follows: **The present mathematics taught in the rural high schools does not play an important role in developing the rural and tribal communities in South Africa.**

The other three hypotheses form an important link with one another and this link helps to answer the questions that are asked concerning the acceptance or rejection of the null hypothesis. Such a link is tested by means of variance and correlation methods. The link findings will be discussed in this section. The questions referred to previously are:

- Does mathematics have an important role in developing rural and tribal communities in South Africa[100]?
- What is their attitude towards mathematics[101]?
- Are they (rural communities) aware of mathematical ideas available in their rural environment[102]?

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[100] This is the null hypothesis.

[101] This is Hypothesis 1.

[102] This is Hypothesis 2.

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- Do they (rural communities) wish to be involved in forums (committees) that discuss and/or make decisions in mathematics curricula[103]?

7.3.1 HYPOTHESES : FINDINGS

This section will identify common findings across all the questionnaires that lead to the establishment of whether the major null hypothesis and the other three hypotheses were accepted or rejected.

It is important to establish the general findings of the four samples (groups of respondents) in the four questionnaires before the inter-hypotheses link is discussed.

7.3.1.1 Attitude to mathematics

When all the positive responses on the attitude of the four groups are put together they show an average of 78%, those with a negative attitude towards mathematics, show 30,7%. This indicates a positive attitude towards mathematics across the four groups.

7.3.1.2 Awareness of mathematics in the rural environment

The general response of the rural communities regarding this item shows an average of 59,6% who are aware of mathematics in their rural environment and 39,5% who are not.

103 This is Hypothesis 3.

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7.3.1.3 **Involvement of rural communities**

82% of the four groups regard involvement of rural communities in mathematics discussions and decision-making forms as important, as opposed to 25% who do not support this notion.

7.3.2 DISCUSSION OF THE FINDINGS BASED ON THE VARIANCE AND CORRELATION METHOD

The Kruskal-Wallis non-parametric tests were used to determine the significance of the four hypotheses concerning their means. The Kruskal-Wallis test was found to be suitable for this exercise because according to Borg and Gall (1979:429):

> *Kruskal-Wallis tests are non-parametric substitutes for the test for uncorrelated means and the test for correlated means.*

The means in this research are uncorrelated because each group of means deal with a specific factor, namely, attitude, involvement, awareness and role.

7.3.2.1 **Attitude to mathematics (Hypothesis 1)**

The definitions of attitude are summarized by Chapman (1992:12) in what he calls a classic definition:

> *The classic textbook definition says that* ***attitude is a mental set that causes one to react to a given stimulus in a characteristic and predictable manner.*** *This definition indicates that we develop a large and larger constellation or bank of mental sets that causes us to interpret what we see or sense in our environment in a predictable way. In other words, our reactions to situations are increasingly predetermined as a result of the mental sets — attitudes — that we have formed.*

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The general attitude of the rural communities, according to this research, has been established to be highly positive as indicated by 82% of the respondents. It is however noted that there exist variations on the degree of attitude which each of the four groups have displayed towards mathematics, as the null hypothesis on attitude indicates by the acceptance of the hypothesis.

The rural communities are therefore willing to accept mathematics as an important subject taught in their schools, as shown by positive attitude measurement, and they attach a significant value to the role that mathematics plays in the development of their daily lives.

The link between attitude and the other hypotheses show a significant correlation. There is a significant correlation between attitude (Hypothesis 1), involvement by rural communities (Hypothesis 3), and the role of mathematics (null hypothesis). There is no correlation between attitude and mathematical awareness in rural communities (Hypothesis 2).

7.3.2.2 **Mathematics awareness in the rural environment (Hypothesis 2)**

According to this research there is a notable awareness of the existence of mathematics wealth in the rural environment by members of the rural community. This is confirmed by a 60% average of the four groups put together. There is generally no relationship between the awareness of mathematics towards the rural environment and the other two hypothesis across the groups, but the present students perceive a significant link between mathematics awareness in the rural environment and the involvement of rural communities in mathematics forums as confirmed by a significant correlation with a probability value of 0,0313.

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7.3.2.3 **Involvement of rural communities in mathematics forums (Hypothesis 3)**

According to this research, 82% of all the groups together regard the involvement of the rural communities in mathematics discussion forums as important. There is a balanced correlation on the involvement of rural communities in mathematics forums, with special reference to the other hypotheses. Significant and insignificant correlations show that 50% of all the groups compare equally with another 50% on the matter.

7.3.2.4 **The role of mathematics in developing rural and tribal communities in South Africa (null hypothesis)**

It is crucial to note that an average of 83%, as opposed to 5,5%, of the four groups in the research regard mathematics as having an important role in developing the rural and tribal communities in South Africa. Rural communities see mathematics as an important catalyst in their rural upliftment struggle.

The link between the role of mathematics in developing rural and tribal communities in South Africa (null hypothesis) and the other three hypotheses is important because the latter serve to give a direction of which important factors, or answers to questions that may be asked, lead to the conclusion on the null hypothesis itself. Before a conclusion can thus be drawn on the null hypothesis of this research the following relationship factors should be taken into consideration.

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7.3.3 CORRELATION OF THE FOUR HYPOTHESES

7.3.3.1 Attitude to mathematics versus the role of mathematics in tribal communities

The positive attitude to mathematics, as indicated by the four groups, is a crucial factor to the role of mathematics in community development. The balanced relationship between attitude and the significance or non-significance of mathematics is also important in the outcome of the research. This dispels the notion that may exist that the four factors would all correlate with one another. The attitude of the present Standard 10 students and the parents in the research tends to correlate insignificantly in comparison to the attitude of former Standard 10 students and the teachers. This forms an important basis for the conclusion that may be drawn.

The present Standard 10 students and their parents show attitude as an important factor towards the role played by mathematics in rural and tribal communities in South Africa, while former Standard 10 students and teachers do not see any link between the two aspects.

7.3.3.2 Mathematics awareness in the rural communities versus the role of mathematics in developing rural and tribal communities in South Africa

The response of 60% across the four groups of the mathematics awareness in the rural communities is another important factor. Though this awareness has not received a high response level, it gives an important indication of the degree to which rural communities have a sensitivity to their own environment and the role of mathematics in developing their lives. The link between this awareness and the role of

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mathematics is indicated by the significant correlation of 9,15762 and the p-value of 0,0057.

7.3.3.3 **Involvement of rural communities in mathematics**

There seems to be a general agreement amongst the four groups, as shown by about 60% average, about the need for involvement by members of the rural communities in matters that concern curricula in mathematics. Although there is a significant difference of the means amongst the four groups on the degree of agreement on the above mentioned consensus, the four groups agree on the matter. The contribution made by families or communities in curriculum matters is unequivocally supported by Swan (1993:38) in a model of home-school relationship that she refers to as Curriculum Enrichment Model:

> *The goal of the Curriculum Enrichment model is to expand and extend the schools curriculum by incorporating into it the contributions of families. The assumption is that families have important expertise to contribute and that the interaction between parents and school personnel and the implementation of the revised curriculum will enhance the educational objectives of the school.*

She goes further to give two major reasons for this involvement by families (or communities) which are viewed as equally important to the rural South African communities in as far as mathematics is concerned:

> *One of these (reasons) has been to make the school more accurately reflect the views, values, history and learning styles of the families represented in the school, particularly those of immigrant minorities and castelike minorities (Ogubu's distinction, 1983, 1990.) ... A second reason for parents to be involved in curriculum enrichment occurs when schools can improve their curriculum by drawing on the special expertise that parents may have to share by virtue of their education and background.*

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The correlation between the attitude to mathematics and involvement of communities is not significant in the case of present Standard 10 students, but significant in the case of parents. The other two groups, former Standard 10 students and teachers, like parents, do not see any relationship between the two variables. There is thus very little correlation between attitude and involvement, as far as the research is concerned.

There is a significant correlation associating mathematical awareness of rural communities with involvement of rural communities in mathematics forums. This correlation is noticed in the cases of present Standard 10 students and parents. In the two cases positive correlations are expressed.

These correlations indicate the degree of importance with which students and parents regard involvement of rural people in mathematics decision-making for the benefit of their own development.

7.3.3.4 **The role of mathematics in developing rural and tribal communities in South Africa**

The centre of this research is summarised by the null hypothesis:

> *The present mathematics that is being taught in the rural high schools does not play an important role in developing rural and tribal communities in South Africa.*

There is a significant difference between the means of the four samples concerning the fact that mathematics plays an important role in developing rural and tribal communities in South Africa.

The four groups have emerged with a general consensus of 82% on average on the role of mathematics. The four groups have also shown, however, a significant difference existing amongst themselves on the

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matter. This difference is particularly shown by the former Standard 10 students who have shown a very high average of difference in this regard. The null hypothesis was accepted at the 5% level.

There is an agreement between the present Standard 10 students and parents that attitude to mathematics and the role it (mathematics) plays in developing rural and tribal communities are comparable and correlate significantly with each other, with p-values of 0,0279 and 0,0085 at the 5% level, respectively. There is also a relationship between mathematics awareness in the rural environment and the role of mathematics in developing rural and tribal communities in South Africa, as expressed by positive correlations in respect of the present Standard 10 mathematics students.

There is a further correlation expressed in respect of teachers and parents between involvement of rural communities in mathematics and the role played by mathematics in developing rural and tribal communities in South Africa. Both groups show correlations of 0,0018 and 0,0171, respectively.

The fact that mathematics has a role in developing rural and tribal communities in South Africa, is generally accepted by the four groups, with degrees of differences within the groups and across the groups. This general consensus or agreement is in conflict with the null hypothesis stated in chapter one. **The null hypothesis is thus rejected.**

The rejected null hypothesis leads to the following conclusion that may be drawn from the research above, based on the perceptions of the four groups that represent the various categories of the rural communities:

The present Standard 10 mathematics taught in the rural high schools plays an important role in developing rural and tribal communities in South

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Africa. The rejected null hypothesis gives an indication that mathematics is regarded by rural communities as having a developmental effect on their lives. It is on the basis of this general perception that recommendations will be made. Such recommendations should serve not as blue prints, but as guidelines which may be used by all those who have an interest in the educational, as well as socio-economic development of the rural people. Such recommendations will guide those who intend to involve or empower the rural people in areas such as participatory decision-making in educational matters, technological advancement and life-long educational competency.

7.3.4 GENERAL FINDINGS

This research has managed to unearth the perceptions, as well as the aspirations, of the rural communities, in as far as the role of mathematics in developing their lives is concerned. The information which has been established will serve to assist those who will be involved in the planning of educational programs, in curriculum planning, and in educational research for both urban, and in particular, for rural communities, now or in future. It will serve to make such planners better informed about the views and needs of the rural people in pedagogical and didactical activities in mathematics. The recommendations which are going to be made hereunder will serve as guiding stars for planning or research activities, on the educational needs of some sectors of the communities, such as rural people, whose needs have been so poorly researched in the South African context. The recommendations are made with the main discovery or null hypothesis taken into full consideration.

7.3.4.1 The role of mathematics in developing rural and tribal communities in South Africa

The information established in the research gives a direct indication that

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the rural people, despite their low educational knowledge, have a special regard for the contribution made by mathematics to their socio-economic developmental needs. They tend to regard mathematics as one of the few subjects in the school curriculum that helps to empower them for development. They see it as a subject that could pull them out of their rural socio-economic impoverishment. This perception is in line with the general perception harboured in even more developed countries that mathematics is taught or learned for its addressing of the needs of the society, as articulated by Daniels and Anghileri (1995:18):

> *As well as addressing the changing needs of society where there is need for confident independent thinking in mathematics, this emphasis on the construction and communication of mathematics is fundamental to the construction paradigm for learning.*

The importance of mathematics to the needs of the rural community is also supported by Charles and Lester (1982:3) when referring to society at large:

> *... as adults we do use a variety of mathematics skills and processes on a daily basis. We tell time; we read graphs in the newspaper; we decide on the best products to buy; we figure gas mileage; we attempt to balance our checkbooks; and we estimate many quantities, distances, and prices. Of course, these are but a few of the many instances where mathematics is useful, and no reasonable adult questions the usefulness of mathematics in everyday life.*

Charles and Lester (1982:3) summarize the importance of the aim of teaching mathematics by saying:

> *The study of the subject (Mathematics) should provide students with certain basic life skills and processes that will prepare them to be productive members of society.*

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Orton and Wain (1994:14) take this argument a step further by emphasizing the need for mathematics by the society:

> *It would seem to be a legitimate aim for educators to wish that pupils will come to an understanding of how society works, and this implies an understanding of how mathematics provides support.*

It is thus recommended that those who are involved in the present and future curriculum development programs for the rural communities should take such rural aspirations into consideration. These programs will assist, as perceived by rural communities, to empower them and allow them to move on the same level with their urban counterparts toward social and economic transformation. This view is supported by Jeevanantham (1993:126) when he refers to the role of education to mankind (in general) as:

> *"...voices in the conversation of mankind" which suggests that education allows people who are educated to be active participant members in the social interchange that creates, sustains and transforms society.*

This need for consideration of rural people is put in the African development context by Anderson and Anderson in Pollen (1987:258):

> *Whatever the prevailing ideology, efforts are being made to bring communities together, to establish learning strategies and thus enable people to tackle their own problems. In the **third world,** particularly since countries achieved independence, there is ongoing debate about the role of schools and what constitutes relevant education for community development, particularly in rural areas.*

This debate should be extended and encouraged in mathematics education for rural schools and communities. The mathematics curriculum meant for

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the rural masses should lay a more technocratic and constructivist rather than theoretical, emphasis in approach. The curriculum should be relevant and useful to the rural masses rather than mere theories that have to be learned, irrespective of the need thereof for socioeconomic survival. It has to address the needs perceived by the rural communities ir line with the way Seal and Harmon (1995:124) describe:

> *Understanding the realities and the potential of rural school reform may mean that someday students will not need to leave the rural area to find work. And living the good life in a rural community will exemplify how residents think globally but act locally as caring neighbours.*

The rural communities need to have what Orton and Wain (1994:25) call survival mathematics, when they say:

> *... that is, the mathematics that is required to make sense of normal everyday situations. The definition is still elusive and will depend completely on the normal activities of the society.*

The competencies of such a curriculum should render themselves both applicable and implementable by rural people to better understand, appreciate and make better use of their rural environment for survival and socio-economic development. It must be a curriculum for economic empowerment. A further recommendation is the fostering of a balanced development policy between urban and rural distribution of educational resources, concerning equipment necessary in teaching Mathematical concepts. Such balanced and positive discrimination policy are called for in other developing countries by people such as Ahmed (1991:251) when they advise:

> *It is high time that the policy direction of positive discrimination in favour of the less developed regions is unequivocally pursued. Since it is clear that the present trend and rate of growth in the comparatively developed areas cannot be slowed down just by*

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diverting resources to the less developed areas for the accelerated growth of the latter, there is an urgent need to evolve a balanced regional development policy where educational backwardness should also be treated as an indicator of the backwardness of a region.

The reason for this balanced educational developmental policy is given by Thomas (1991:104) when he says:

Schools influence students in a multiple of ways. For instance, if the school climate is negative, and if students skip school regularly, students are more apt to achieve less and elect fewer mathematics courses. Poorly equipped, overcrowded, and run-down schools fail to motivate minorities or any other students to study mathematics.

Just as it is suggested in the Russian educational reform that youth be prepared for global market economy, so should the South African rural youth be prepared through, amongst others, a relevant and intensive mathematics curriculum that will help them to face the socio-economic imperatives of modern life in the year 2000 and beyond. The recommendation is made by Zajda (1993:6) when he says:

The reform also emphasises the importance of the preparation for the global market economy which is already influencing youth and their attitude to education, training and their future careers.

Ruggiero (1988:72) goes on to point out that:

Certainly it is not an easy assignment to change students' long-standing characteristic attitude towards novelty, nor are there any special techniques for doing so. The best prescription is to demonstrate your interest in novelty and reward students' attempts to produce novel ideas. Be especially careful not to stifle

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the adventurousness of young students with warnings about "carrying novelty too far."

Such advices are especially crucial to those who will be dealing with the fostering of positive attitudes to mathematics amongst the rural students, and the community at large.

7.3.4.2 **Development and sustenance of the positive attitude towards mathematics in the rural and tribal communities in South Africa**

Attitude is regarded as one of the factors that influence achievement in mathematics, as supported by Ruggiero (1988:71) when making this point clear by referring to the work done by Martindale:

It has long been hypothesized that people with negative attitudes toward novelty are likely to feel uncomfortable in situations challenging their creativity.

It has been established that for any meaningful learning and comprehension of the subject such as mathematics to take place within the rural communities, or any other communities, a conducive or positive attitude to the subject in question is necessary. Communities or students involved in such a learning environment should possess the correct attitude, or lest, such learning will become meaningless, parrot-talk and irrelevant to the learners or those who are directly or indirectly affected.

An important comparison, characterizing the contribution made by attitude and other factors to mathematical achievement, is made by the studies conducted between Japanese and American students as cited by Reynolds, Creemers, Nesseldrodt, Schaffer, Stringfield and Teddlie (1994:229) from the studies conducted by Stevenson and Stickler (1992):

... the apparent superiority of Japanese students over American students on mathematics achievement may extend also to areas

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such as attitude towards school, possession of an internal locus of control and indeed, even the exhibition of psychosomatic illnesses and/or symptoms of stress.

According to Gammage (1982:160), it is important to establish the values and attitudes of children for any meaningful learning to take place. He expresses this in broad educational reference:

Any system is embedded in a system of beliefs and values. When such a system is not in harmony with beliefs and values of the children, or at least able to draw upon some of their concerns, the curriculum is in danger of becoming less effective, and at worst almost useless. Thus knowledge of the values and attitudes of the children, while not the only information to be heeded, has long been considered essential if one is to plan an effective curriculum.

The need to support values attached to better performance in any subject, including mathematics, is given more creed by Berry and Asamen (1989:128) when they emphasize participation by all stakeholders in making this goal realizable:

Families, schools, churches, community organizations, and peer groups must come together in a collective voice and support efforts toward excellence. In absence of a unanimous consent for this idea, there must be enough support from particular significant others in the child's life, in order for that value to be internalized and practised by the youngster.

Charles and Lester (1982:4) have gone as far as giving advice on some of the factors that attribute to poor, negative or repellent attitude to mathematics:

Despite the importance of maths and the potential enjoyment that students can experience from it, it is a fact that the majority of students grow to dislike maths (or become indifferent to it) by the

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time they complete elementary school. We attribute this state of affairs to the overemphasis on drill and practice, to the general absence of attempts to involve students in real-world applications of maths, and to the lack of attempts by teachers and textbooks to engage students in real applications and problem-solving activities.

The rural communities have been found in this research to have this type of attitude. Their attitude has indicated the readiness to learn mathematics or to have it prevailing within their curriculum framework. The parents and former Standard 10 mathematics students, together with teachers, have displayed an attitude that should serve as the basis for the motivation of students from the rural background to learn more seriously and with dedication, for socio-economic development of their communities. The teachers should themselves serve as the source of motivation in their mathematics lessons, which should in turn permeate through the students into their families, as May (1995:26) advises:

There is one proviso to all of this, however: If you want your students to be enthusiastic, you've got to show a lot of enthusiasm yourself. Never act as though these were just so many workbook activities. Rather, act like a cheerleader as you move around the classroom. Remember, excitement is contagious.

Teachers, parents and other educational practitioners should therefore campaign for the maintenance and further encouragement of this developmental attitude. This viewpoint is shared by Berry and Asamen (1989:222) when indicating what should be done to promote the conducive quest for achievement and persistence in learning when they say:

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> *By actively knowing, caring for, respecting, and being responsible for students, college personnel can do many significant things to promote students' persistence and achievement.*

It should be borne in mind here that mere reliance on positive attitude will not necessarily result into higher achievement in mathematics. Other variables should be taken into consideration, as discussed below in this chapter. Costello (1991:122) brings forth this assumption more vividly:

> *There is a common and reasonable belief that positive attitudes, particularly liking for, and interest in, mathematics, lead to greater effort and in turn to higher achievement while there is evidence to support this assumption, the link between attitudes and achievement is not so close as might be expected; and there are obviously other variables which affect both attitude and achievement. What is more clear is the strong relationship between attitude and the choice of mathematics for further study; pupils who claim to enjoy the subject are more likely to choose mathematics courses in the sixth form or in higher education.*

This research has equally revealed this latter correlation, where students who showed a positive attitude towards mathematics tended to have a desire to continue studying mathematics in higher or further education. Students in the rural areas should be encouraged to choose mathematics right from the lower classes up to university or technikon level. The attitude prevailing within the rural communities will serve as one of the important factors contributory to the readiness, within the rural student population, for learning and acquiring of mathematical knowledge and skills for development and the reshaping of the rural cultural and socio-economic patterns of life.

The encouragement of this attitude amongst the rural students and members of the rural communities by the various educational authorities

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and the non-governmental organizations interested in rural educational matters, should form the basis for a new vision into educational development. New approaches and new concepts in the world of mathematics, and mathematical educational development, should be made available to the rural communities, with the emphasis on the relevance and possible applicability within the rural context. Attitudinal potentialities within the rural communities should be developed and maximised to allow the rural learning force to fit into the new trends, thoughts and didactical framework with little or no difficulty. The mathematics curriculum and the general school curriculum should be revisited and redesigned to, as far as possible, reflect the ways in which it will influence the students and their rural communities culturally and socio-economically, without necessarily being ethnocentric. This notion is better brought to light by Gillborn (1990:160), quoting Lord Swann when the latter was stating a point in favour of multicultural education for all as one of the recommendations from his committee:

> *The committee described its primary aim as: bringing about a fundamental reorientation of the attitudes which condition the selection of curriculum materials and subject matter and which underlie the actual teaching and learning process and the practice and procedures which play such an important part in determining how the educational experience impinges on the lives of pupils.*

The summary of the curriculum reform in the Russian context made by Nikandrov (1993:28) put more relevance to this perception within the South African rural context discussed above:

> *A new curriculum is only part of any country's educational reform. But, in fact, all changes in education in the general ideology and in practical implementation are reflected in the curriculum. This ought to be the case in the overhauling of the mathematics curriculum for relevance and implementation in the rural communities.*

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7.3.4.3 **Parental involvement in mathematics**

Prinsloo, Vorster and Sibaya (1996:262) summarize the need for parental involvement in education as follows:

> *A school belongs to the parents and the immediate community. It is necessary therefore to develop networks between the school, home and community.*

The authors identified two ways in which parents can be involved in the educational matters of their children (Prinsloo, Vorster & Sibaya, 1996:263):

> *Guidelines for parental involvement in the learning event at school covers two areas, namely administration (participation) and instruction or learning (involvement).*

This research has equally identified the two approaches in which parents can become part of the educational process of their children, with special regard to mathematics.

Since it has been established how much the rural communities put value into the role played by mathematics in the development of their rural background, it has been further established how positive the attitude of the rural communities is, with regard to mathematics learning. It is therefore crucial to realise how important the rural people regard parental involvement in mathematics. Parental involvement needs to be encouraged to foster the prevailing attitude of all the sectors of the rural communities, with regard to mathematics' role and the need to encourage the learning thereof, as Rogers and Rogers (1990:90-91) put it:

> *It is equally important to incorporate parents as partners into this process, a position supported by several perspectives. The first stems from contemporary changes in the school's views of community. As Psyzkowski (1989:286) observes, administrative*

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attitude have evolved from an ***exclusionist philosophy*** *to one seeking parental involvement. Parents represent, in her view, not only a potential, supportive voice for education, but a caring capacity capable of enhancing cooperative and constructive relationship between home and school.*

In this involvement parents should not only be treated as contributors or participators, but as partners in the educational interactive process. Parents should take part in the following two ways suggested in this research:

(a) Parental involvement in own children's work

It is important to note that, generally, all the sectors of the rural communities agree on the role of parents in getting involved in their own children's work. This type of involvement is corroborated by various studies conducted in other countries, as pointed out by David in Cosin and Hales (1983:245):

> *In the last twenty years or so, a vast quantity of research evidence has been amassed, most of which points out that parents are far more influential than schools over their children's educational progress.*

The discussion approach to accomplish this goal can assist in the amplification of the vast amount of cultural knowledge and expertise amongst their children as suggested by Bliss, Askew and Macrae (1996) through the argument put forth by Rogoff and Gardner (1984):

> *Two proponents, Rogoff and Gardner (1984), argue that social interaction is an important "cultural amplifier" to extend children's cognitive processes, with the adult serving the role of expert in introducing children to societal, material and conceptual tools. The socio-cultural approach sees context and cultural practice as the fundamental units within which cognition has to be analyzed.*

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Human mental functioning is seen as emerging from and located in social practices. Such a theory of culture and cognition resists the separation of the individual from the daily life environment, focusing on activity within socially assembled situations.

Such parental involvement should be encouraged within the rural communities, as it forms one of the cornerstones of meaningful learning in mathematics. It contributes to the development and fostering of positive attitudes described above. The curriculum planning authorities or forums should, therefore, involve parents by way of somewhere, in the mathematics syllabi, calling for their direct participation in the teaching of some of the concepts, as it has been the case in the example used by Orman (1993:306) in which she used the idea of mathematics backpacks to induce interest amongst the parents in their children's work:

So I decided to develop something that would help the students teach their families while also furthering their own understanding of mathematics concepts. If parents became actively involved in their children's learning, then both the parents and students would benefit.

It is of interest to note how Orman (1993:306) used the mathematical activities designed for family-student involvement in drawing families into the children's day-to-day mathematical activities:

Through the process I was pleased to discover that the backpacks did meet my three initial goals. The anticipation of the students as I drew names out of a basket to see who would get to take the backpacks home next and the stories they shared with their classmates when they returned let me know that the activities were being used by the families and that everyone was having fun. Furthermore the comments written by parents and students in the journals gave me the knowledge and satisfaction that the backpacks were a success.

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Such concepts could be the ones with a more rural bearing in their context, content or application. According to Swan (1993:38) in support of such parental involvement, this involvement may yield fruit as assumed:

> *Interaction between parents and school personnel can result in, for example, the installation of a computer lab, instruction for teachers in the use of computers in the classroom, the addition of mathematics or science curriculum that is more experience-based, the integration of the newest technology in a vocational training program, or instruction in music competition.*

The culture of interactive information gathering through discussions between parents and students may also develop a by-product through which students may develop discussions amongst themselves too. This is referred to as cooperative learning and an important process of resource-sharing by Terwel, Herfs, Mertens and Perrenet (1994:229):

> *The process of cooperative learning is a resource-sharing process. students may benefit from the collective supply of concepts and strategies in their group and class. By implication they become more dependent on the qualities of their fellow students and more dependent on their own strengths and weaknesses.*

Parents could also be encouraged to get involved in the evaluation of their children's work, either by allotting marks for certain aspects of evaluation or by co-checking or co-signing of assignments, tests and so forth.

(b) Parental involvement in mathematics decision-making forums

One other parental involvement supported by the research, is the fact that parents should have, or be encouraged to have, representation on curriculum matters that affect their children or their own lives in mathematics.

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While appreciating the fact that the literacy rate of the rural adult population is quite low, and may serve as a handicap in more meaningful involvement matters, the rural people should be encouraged to participate in mathematical curriculum development matters and be empowered to do so.

Kriek (1996:189) appreciates this possible handicap in parental involvement in curriculum matters:

> *Alhoewel meeste ouers nóg vak nóg kurrikulum-kenners is, kan hul bydrae tot die daarstelling van doelwitte en tot kritiese evaluering van bestaande kurrikula nie misken word nie.*

This handicap is also noted by Fullan and Stiegelbauer (1991:244) when they indicate that:

> *Communities in which parents are less educated are not as able to translate their doubts into concerted efforts to combat change for the sake of change.*

The level of illiteracy prevalent in the entire country stands at least at 7,5 million as shown by the recent figures released from a study undertaken by the Joint Education Trust at the Centre for Adult Education at the University of Natal (Sowetan Education: 2/8/1996:2) in which one of the researchers puts it:

> *A recent research commissioned by the Joint Education Trust has found that the number of illiterate adults in South Africa is at least half the commonly quoted figure of 15 million.*

But Swan (1993:39) gives an important departure point when emphasizing the need for parental involvement:

> *Relationship between home and school are based on mutual respect, and both parents and teachers are seen as experts and resources in this process of discovery.*

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In other words, middle- and upper-class communities are more able to keep school districts honest than disadvantaged communities, as Bridge (1976:377) puts it:

> *The unfortunate fact is that* ***disadvantaged*** *families are usually the least informed about matters of schooling and the result is that advantaged clients will have the largest impact on school innovations unless extraordinary efforts are made to involve others.*

Hamilton goes further to shed light in this direction, in Carlson and Awkerman (1991:40-41) on the importance of participation or involvement:

> *Participation becomes a means of facilitating the development of mutual understanding and shared meaning of events and activities.*

Members of the community representing the rural people should see their involvement as meaningful and fruitful to the constituency they represent because rural people see a school or education as a source of development services important to the betterment of their lifestyles, as confirmed by Gould (1993:110):

> *Schools have a social and political impact. It is the school as an innovation, the most obvious artefact of modernization, that most commonly attracts the interest of rural communities. It is often the only tangible link the rural community has with the state and the services provided by the state. It therefore represents a world outside the community that links it with the broader national or regional economic and social aspirations for development that are wrapped up in the ideology and theoretic of the state.*

Till (1978:346) observed the trend in parental (or community) participation in the United States of America as far back as in the late 1970's:

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Participation by community members in the education of young people is increasing.

This involvement or participation should not be limited to a mere tokenism, or window dressing, but real meaningful participation. This involvement should be based on serious and organized collaborative basis for it to bear any fruit, as argued by Reaves and Griffith (1992:94) when referring to the restructuring of schools:

Genuine restructuring for improved school results is neither a top down or a bottom up decision-making process — it is both! It is both tight at the strategic level and loose at the operational level, but most of all it is collaborative at both levels between the school board, teachers, parents and citizens of the community.

Beattie (1985:249) summarizes the need for meaningful participation by emphasizing the importance of openness amongst the role players to avoid, amongst others, inhibitions and suspicion:

At a more concrete level or policy each of the four sets of actors involved in formulating education policy in democratic societies (politicians, administrators, teachers and parents) has to make decisions which ultimately affect the welfare of children. The more openness there is about such decisions, and the more information about the constraints upon them, then the less fear, suspicion, defensiveness and misunderstanding there will be — and the more likelihood of all parties eventually being able to participate in processes of advising, ensuring and deciding.

Whitbread (1992:37) stresses mutual understanding, respect and trust from all parties involved, as a recipe for meaningful parental involvement in school matters when saying:

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Partnership demands mutual understanding, respect and trust, with a significant degree of consensus on general aims and intent. The successful management of a school requires recognition of the perceptions of those who have a stake in its success as a public enterprise serving the educational needs of its community. Its governors bring a diversity of personal experience and skills to bear on that general management task, while variously and collectively representing the main stakeholders. A successful school, which all can be proud of, must be their common purpose.

Rural people should therefore, be empowered to actively participate in decision-making. Crash-courses or crash-programs should be designed to develop skills needed by the rural people to participate in forums that address the backlogs and imbalances concerning participation in the development of the national and local mathematics curricula.

For those who doubt the participation and involvement of the less-literate rural community representative in school curricula matters, Whitbread (1992:37), who was involved in the training of governors in Leicestershire and a governor for several schools, including a polytechnic, gives the following advice on how to go about this problem:

Schools and teachers have much to gain from building an effective working partnership with their governors. There is no blueprint for achieving this; but ensuring that lay governors are informed, and a willingness to share anxieties and concerns with them, are vital to the process. Presentations on aspects of the curriculum and other educational matters by appropriate teachers to the Governing Body are welcomed. Sub-committees and Working Parties set up by the Governing Body can include teachers or parents who are not governors. Sometimes it is useful for teachers' planning teams to invite a lay governor to attend.

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> *Such practices extend the partnership and build working relationships.*

This involvement is likely to encourage parents to have even more interest in their children's work. By so doing this will strengthen the confidence needed by their children to learn mathematics further. It will also foster the positive attitude available and that is required of the rural students to learn and understand mathematics even further.

Chevigny (1996:21) argues for fully committed involvement by members of the community, and other stakeholders in curriculum development projects in mathematics:

> *Even the best maths projects can't make change happen alone. How many voices have to wake how many stakeholders to turn around a country before it does itself in?*

7.3.4.4 **Further studies in mathematics**

It has been found, in this research, that because of the positive attitude to mathematics prevailing within the various sectors of the rural communities, students and former students are willing to learn mathematics beyond the secondary school level. Parents (and teachers) are also supportive of this aspiration within their children. Because of the value attached to mathematics, it has a cardinal placing in the Russian secondary school curriculum, as Nikandrov (1993:28) explains:

> *In the complete secondary education maximum use is made of the electives as the principal means of differentiating education. They take almost half of the school time. Another specific thing about the complete secondary school is integrated courses. Only mathematics is studied as a separate discipline, because of its cardinal importance as a means of communication in the computerised world. As to physics, chemistry, biology,*

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> *geography, they can present various combinations in any schools working curriculum, there is a need for the encouragement of furthering of studies in mathematics or mathematically inclined field amongst the rural students and other members of the rural communities.*

It is recommended that educational authorities, non governmental organizations and further, or tertiary, education institutions should make opportunities available and conducive for rural students to acquire access into mathematics studies beyond high school level. Because of the lack of facilities amongst the rural communities in the past, **it is recommended that affirmative action principles should be used by various institutions in the country to access such post-high school learning facilities to rural students to pursue their studies in mathematics**. Such affirmative action should not only be made to mass-produce incompetent rural mathematicians or technologists, *per se,* but should be applied to develop skills that will assist such rural students to assist their communities. Less teacher-oriented and more learner-oriented methods[104] are necessary to make mathematics more meaningful and interesting to the students. Cooperative methods should be used to encourage interaction amongst the students, teachers and parents, as supported by Harber (1989:195):

> *Cooperative learning based on teaching methods such as group work and discussion, is likely to provide the educational environment necessary for the development of such values as empathy, reason and toleration, than authoritarianism and excessive competition.*

Problem-solving skills should be developed to allow rural students to develop their own communities in developing the potential to participate in socioeconomic activities at national and international levels.

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104 Learner-oriented methods are based on the initiatives and abilities of the learner and teacher-oriented method is the reverse thereof (Vrey, 1979).

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7.3.4.5 The fostering and utilization of the mathematics awareness in the rural environment

The research has established an important dimension of mathematical existentialism within the rural communities. The notion that mathematics is everywhere, or anywhere, forms the solid basis for participation of rural communities in mathematics. The various forms of mathematics within the home environment form the basis for rural people to have a realization that mathematics is an everyday subject that directly affects their lives, as established in the research. What they have regarded in the past as *non-grata* should be formalised into conceptual and well-crystallized concepts that show a clear bearing on their everyday life.

The concern expressed by Lindquist of the National Council of Teachers of mathematics (NCTM) and the findings of the National Science Foundation in the United States also should hold water for our situation in South Africa, particularly in the rural teaching environment, with limited resources as pointed out in the Journal of Massachussets Institute of Technology (1993:17):

> *Most current maths programs teach students only what they need to know to pass national tests, says Mary Lindquist, president of the National Council of Teachers of mathematics. Unfortunately, according to a recent National Science Foundation study, these tests don't assess the basic techniques for applying maths concepts to real-life experiences, which is essential for a true understanding of mathematics.*

A more open-ended approach to the teaching, or contextualization, of mathematics is recommended as an approach that will help students understand mathematics with a utilitarian purpose in mind. Such an approach may follow some of the principles adopted and presently widely

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evangelised in the United States of America by the NCTM as indicated by Eiser (1993:52) when he says that:

> *... the movement from a traditional textbook-centred course ("Today is Tuesday, so we must be on Chapter 2") to a more free-flowing, open-ended course is happening, and a large number of states are revising their curriculum frameworks to meet the NCTM standards.*

The fact that rural people are aware of the abundance of mathematics around them, forms an important departure-point for inclusion of rural concepts in the curriculum, in line with the free flowing or open-ended approach advocated by NCTM above. Mathematics education should be geared towards the realization and acceptance of the fact that mathematics forms an important aspect of the rural people's lives. Such a view is shared by scholars such as Freudenthal (1993) and his colleagues. Nelissen and Tomic (1993:21) put forth the new way in which mathematics is regarded as opposed to the "absolutist" way in which it was previously regarded:

> *Mathematics is often seen as a school subject concerned exclusively with abstract and formal knowledge. According to this view, mathematical abstractions must be taught by making them more concrete. This view has been opposed by Freudenthal (1983) among others. In his opinion, we discover mathematics by observing the concrete phenomena all around us. That is why we should base teaching on the concrete phenomena in a world familiar to children.*

Children in the rural mathematics classes should have their lessons taught with a view towards their practical lives, and it should help them to solve everyday life problems[105]. Their lessons should take the form that

[105] This point was discussed in par. 5.4.2.

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Moniuszko (1991:16) call reality maths when she argues for its place in the regular curriculum:

> *Reality - maths activities are used to augment the district's regular mathematics curriculum, not supplant it. Thus, by experiencing reality maths, my students experience real-life problem-solving situations and prepare themselves as future consumers.*

The contribution of rural communities, based on their rural environmental experiential awareness of mathematics, should have a place within the national education curriculum framework in mathematics and its related subjects. The application of mathematical concepts towards the betterment of life in general should recognise the contribution that can be made by rural people with their richly diverse culture. Just as Lynch (1987:16-17) argues it in the case of consideration of imperatives of multicultural education, the same argument applies when considering rural educational imperatives:

> *... multicultural curriculum derives its aims from the ethical and social imperatives of a democratic, culturally diverse society. By "ethical imperative" I mean the need to respond to and be guided by the aim of "respect for persons"; as to the social imperatives, I argue that, because a society espouses democratic values, is characterised by scientific/industrial modes of thought and organisation and offers a broad measure of individual and group freedom, so its curriculum must respond to those dimensions in its aims, processes, content and evaluation.*

Theobald and Nachtigal (1995:134) argue for a more specific response to the needs of rural communities:

> *To appreciably attend to the "needs" of students, schools must contribute to the recreation of communities. Understanding one's own place is critical to this recreation. It ought to be the chief curricular focus in schools for several reasons. First, it promotes*

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the time-tested power of combining the intellect with experience. Second, the study of place addresses the shortcomings inherent in our overly specialized, discipline-based view of knowledge. Third, it has significance for re-socializing people into the art of living well where they are. Finally, knowledge of place — where you are and where YOU come from — is intertwined with knowledge of self.

The authors (Theobald & Nachtigal, 1995:135) go on to advise for a more integrated approach in teaching within the rural schools in their second recommendation:

Education is not just about improving standardized test scores or being first in the world in maths and science. It is also about learning to live well in a community. This means explaining to an unaccustomed public that the community and its environs can serve as a laboratory for learning and that students will be out in the community during school hours.

7.4 CONCLUSION

In this chapter a focus was laid on the finding of the study. Such findings were based on the interpretation of data collected during the research.

The findings deduced in the research will form the basis for recommendations for further research and other curriculum activities engaged in either curriculum design or planning for rural, as well as urban communities. The recommendations will be made and discussed in chapter eight.

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CHAPTER 8
SUMMARY AND RECOMMENDATIONS

8.1 INTRODUCTION

Mathematics is regarded as an important subject for all communities to learn and understand their world, in order that they may use it in everyday life. Mathematics is also regarded as an important subject in the rural communities of South Africa. The role of mathematics in such rural communities has a special place to occupy amongst the rural people, in that it is perceived to have either a direct or an indirect influence in terms of the socio-economic development of such communities.

This research has formed the basis and has provided guidelines of how a mathematics curriculum should be designed in order to cater for the needs of the rural communities. The research has laid a foundation which may be used by curriculum planners and developers who could be charged with the responsibilities of designing a mathematics curriculum. Such a curriculum would be both relevant and useful to the rural communities, instead of a curriculum that would suit the description given by Glencross and Fridjhon (1990:309) when they say:

> *There is also evidence of wide and significant differences between the* ***intended curriculum,*** *compiled by the curriculum developer, the* ***implemented curriculum*** *taught by the teacher, the* ***perceived curriculum,*** *as viewed by an outside observer, and the* ***achieved curriculum,*** *absorbed by the pupil.*

This gap between theory and practice in curriculum planning needs to be closed. The written curriculum should be practised in such a way that it

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takes into account what the rural people are familiar with, so that it should have meaning for the rural children in the classroom.

One of the main aims of this research is to attempt to emphasize the need for a relevant mathematics curriculum. Such a curriculum should prepare pupils for employment and life in general, as Christiansen (1986:14) puts it:

> *Demands change as society and technology change. What was appropriate ten years ago is no longer so now. Almost everyone in a developed country has ready access to a calculator. The question of what comprises the basic numeracy which every citizen ought to have, has now to be answered in a completely new context.*

Kriek (1996:274) supports what Christiansen said above about relevance and usability of knowledge acquired by pupils in mathematics when he says:

> *Kurrikuluminhoude moet leerlinge voorberei vir die beroepswêreld. Die vinnig ontwikkelende samelewing plaas verdere eise en verantwoordelikhede op die kurrikuleerder en onderwyser.*

In order to conclude by making recommendations, a summary of this research is made.

8.2 REPORT OF THE HYPOTHESES VERIFICATION

Research through questionnaires and quantitative analysis forms the kingpin of this research process. In this research it is confirmed that the

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four hypotheses[106] have been thoroughly investigated through the research methods[107].

8.3 SUMMARY FOR PURPOSES OF RECOMMENDATIONS

Before making recommendations it is necessary to make a short overview of this study.

8.3.1 CHAPTER ONE: TITLE AND INTRODUCTION, MOTIVATION FOR STUDY, STATEMENT OF THE PROBLEM, HYPOTHESES FORMULATION, AIMS OF THE RESEARCH AND METHODOLOGY

In order to get a perspective and to understand what is to be achieved in this study, namely: **The role of mathematics in developing rural and tribal communities in South Africa**, the title and other relevant concepts are discussed and explained. A historical perspective of mathematics teaching in the rural areas is explained. From such perspectives, the null hypotheses and other hypotheses were discussed. The methodological framework are also highlighted.

8.3.2 CHAPTER TWO: THE RELEVANCE OF SOME LEARNING THEORIES AND LEARNING/TEACHING MODELS OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

In chapter two, emphasis is laid on the following learning theories which are discussed and highlighted: child's mental development, games and objects in learning inquiry, problem-solving discussion. A distinction in learning theories in mathematics are made between theories which focus on mathematics as arithmetic and theories which focus on mathematics as

[106] See chapter one, par. 1.4.

[107] See chapter five.

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an accumulation of concepts, problem-solving and information processing. In the first group is included, inter alia, theories of Brownwell, Skinner, Gagné and Thorndike, and in the last group are included theories of Bruner, Dienes and Piaget.

The concepts such as constructivism and cooperative models and their influence on mathematics teaching and learning are highlighted.

8.3.3 CHAPTER 3: THE RELATIONSHIP BETWEEN DIDACTICS, SUBJECT DIDACTICS AND THE SUBJECT DIDACTICS OF MATHEMATICS AND THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

In chapter three the emphasis is laid upon the concept of didactics as a scientific study of teaching, with special reference to the teaching of mathematics in the rural areas. As a result of the teaching and learning process, the learners are formed in different ways. These are formal forming, material forming and categorical forming.

Subject didactics and its relationships with the subject didactics of mathematics are highlighted. The implications for the rural communities of each of the concepts discussed in this chapter, are also highlighted and discussed.

8.3.4 CHAPTER FOUR: THE IMPLICATIONS OF DIDACTIC PRINCIPLES FOR TEACHING AND LEARNING OF MATHEMATICS WITH SPECIAL REFERENCE TO THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

In this chapter, a set of didactic principles which are most commonly used in the teaching of mathematics are defined and discussed. The concept

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principle and the content of each of the six principles are discussed with special reference to the teaching of mathematics in the rural high schools.

The six principles discussed are motivation, individualization, totality, perception, environmental teaching and mother tongue.

8.3.5 CHAPTER FIVE: THE EMPIRICAL RESEARCH DESIGN

In chapter five a research model which was to be followed in order to gather data about **the role of mathematics in developing rural and tribal communities in South Africa** is discussed.

Amongst the aspects covered are description of the method of research, sampling, the research instrument, distribution method, data gathering and interpretation of data.

8.3.6 CHAPTER SIX: DATA PROCESSING AND STATISTICAL ANALYSIS OF THE RESULTS

In this chapter the method of data processing and statistical analysis of the results were made in order to make sense out of the data that was collected from the samples.

The null hypothesis and the other three hypotheses[108] were re-stated in order to make it easier to relate them to the data that was to be processed and analyzed.

Aspects discussed under data processing and data analysis were the storing of responses, data processing method, distribution of responses, data interpretation, analysis and interpretation of the results.

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108 See chapter six, para. 6.1.1 and 6.1.2.

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Data gathered from the responses in each of the four questionnaires[109] used in this research were analyzed and interpreted according to the aspects mentioned above.

8.3.7 CHAPTER EIGHT: THE FINDINGS OF THE SURVEY

In chapter eight findings and conclusions based on the data analyzed and interpreted in chapter six, are discussed. Findings based on each questionnaire are made before conclusions and deductions are made. Such deductions and conclusions were made with special reference to the role of mathematics in developing rural and tribal communities in South Africa.

Since the predominant method in the statistical research method employed in extracting data was the use of **percentages**, most of the conclusions drawn were based on the percentage responses in each of the study groups and in each of the aspects/norms included in the questionnaires.

This research has managed to focus attention on the perceptions and aspirations of rural communities on the role of mathematics in developing such communities in South Africa. This forms the basis for the understanding of the feelings of rural communities on the aspects of life that affect them. The research has been limited to the extent of exposing these aspirations and their rationale. The role of mathematics in socio-economic development, attitude to mathematics, further studies, parental involvement and awareness of mathematics within the rural environment are all important to consider as rural community aspirations when educational planning and didactical considerations are made for the rural people now and in future, as Reynolds *et al.* (1994:192) advises in a broad sense that:

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[109] See chapter five, par. 5.5.2.

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... a basis for effective instruction can be created by emphasizing educational elements that are inherent to curricula and are acknowledged by teachers as such in the design of curricula. These elements are the subjects to be taught in classroom instruction, the structuring and ordering of educational objectives and subject matter, and related to these, evaluational procedures.

This realization could be achieved through modern approaches available, in which there is, amongst others, Total Quality Management (TQM) which seems to be the generally preferred approach as elucidated by Prawat (1996:92):

TQM is said to involve "expect and inspect" approach to management (Sergiovanni, 1992). The quality of work is monitored through the use of various formal and informal assessment geared to agreed-upon expectations or goals. In TQM care is taken to build in feedback loops so that ***customers*** *(that is students, parents, school board members) can continue to make their needs known to "producers" (that is school staff).*

An approach that combines the **pull and push** strategy for rural development, as used in one rural development project in India, seems to be one of the relevant and viable methods that may be used in conjunction with the TQM approach, in this context, as it is explained by Matthai (1985:30-31):

The common strategy used is, of course, a mixed "pull and push" strategy so that the product is pulled by consumer demand and pushed by the channels. In making the school system relevant to rural development, it was decided to adopt a similar approach, that is attempt to influence the school system directly to become involved with rural development (push) and simultaneously influence the elements involved in rural development to make the demands on the educational system (pull).

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What is further needed is for educational researchers to focus on the implementation and the realization of these aspirations or ideals by focusing attention on the practicability of some, or all, of the recommended aspects of the findings. More work is needed to establish the efficacy of the role attached to mathematics in realising the development of rural communities to arrive at the aspired socio-economic level, concomitant with national or international standards. Another aspect for future consideration, as revealed by the research in the previous chapter, is the shortage of qualified (let alone suitably qualified) teachers in the field of mathematics teaching. The acute shortage of qualified mathematics teachers in the rural high schools is a serious cause for concern, especially if viewed against the background of the fact that even today, in more industrially advanced countries such as Britain, this is still one of the major concerns in education. This is revealed by researchers such as Bullock and Scott (1992:177) when summarizing the British historical perspective concerning the shortage of mathematics, physics and technology teachers:

> *Concern about the supply of well-qualified teachers who are entering the maintained education system is not a new phenomenon, and could indeed, be considered a persistent response to an endemic problem. Teacher shortages have been an issue of discussion and debate for almost 50 years, with the problem invariably being most acute in secondary school subjects such as Physics, Mathematics and Technology.*

One of the major causes of this shortage is identified by the authors Bullock and Scott (1992:177) as being the linkage between economic activity in the country and teacher supply in the technological area, as they explain and advise:

> *There is one recurrent through this period — that of the linkage between economic activity and teacher supply in the technological area. Because of competition for the same limited and scarce supply of graduate talent, when the economy has been buoyant,*

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teacher supply has been adversely affected. This is, in part at least, a reflection of the greater ability and willingness of the business community to offer attractive salaries. There is a need to learn from this historical lesson and to encourage flexible targets for enrolment in teacher education courses. These should be realistic in times of economic expansion and advantageous in time of recession.

This research provides the basis for what Romberg and Price, 1983, in Goodman (1995:2) call the radical reform:

> *... a radical school reform project would confront the cultural and pedagogical traditions and beliefs that underlie current practices and organizational arrangements.*

Goodman (1995:25) goes further to mention the need for meaningful school or curriculum reform which is essential in our rural set-up in South Africa, as recommended in this research by indicating that:

> *If we are to engage in discourse about transforming schools, then we must move beyond both superficial reforms and structural arrangements. Working at the core of school change requires us to address the value commitments that undergirds schools in our society. Only within this context can we determine if we are truly making substantive rather than ameliorative changes in the ways children learn and teachers teach.*

It is for this reason that this research is closed with the reiteration of the need for a balanced attention between rural and tribal communities on the one hand, and urban communities on the other, as espoused in the first chapter by the researcher. Such reiteration is also made by Singleman (1996:143) when raising concern over the possible neglect of the development of the rural communities by the international expertise in the 21st century:

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> *My call for continued concern with rural areas has two objectives. First, even when rural areas will account for a minority of the world's population — and most developing countries are decades away from this situation — rural people, like other minorities, should not be forgotten. The urban bias past development efforts serves as a reminder that rural areas are easily overlooked. Second, many, if not most, social processes take place in rural as well as urban areas, although often with different manifestations. Social and economic development is a social process in urban and rural areas. If social science research were to adopt the urban bias present in many development policies, it would not only produce a false understanding of these processes but contribute to the continuation of rural neglect and, thereby, the precarious situation of rural people around the world.*

A further emphasis in the direction of the need for more community participation in self-generated involvement in mathematics is made by Ahlgren (1991:147) when citing a few observations made by Malcolm when evaluating the policy goal once made by the former United States of America, President George Bush, and the nation's governors that the United States' students shall be first in the world in science and mathematics in the year 2000:

> *Still, Malcolm and others cite a host of small-scale efforts from community computer centres in Detroit to family maths classes held at churches in Washington, D.C.* ***Schools have to find ways to help parents, businesses and other institutions, everyone from the Girl Scouts to churches to universities, support the effort. They have to be brought in and brought along and viewed as part of the solution,*** *Malcolm says.*

This American attempt should be made part of the attempts that have to be made by all parties concerned in developing a sound basis for

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mathematical knowledge acquisition and the mathematization (Nelissen & Tomic, 1993:23) process necessary for the empowerment of the South African rural and tribal communities.

All forms of barriers in school should be avoided or minimised in order to afford the rural people a chance for development and self-reliance. Some of these barriers are given by Presseisen (1988:84):

> *Barriers in school include inflexibility of school structure, abuses of tracking and ability grouping, misuses of testing, narrowness of curriculum and teaching practices, limits of vocational education, lack of support services for youth, lack of early childhood programs and lack of democratic governance.*

Bohan and Bohan (1993:86-87) are even more specific, on the need for the creation of conducive opportunities, when they refer to the work done by Smith:

> *In his book, To Think, Smith (1990) suggests that all of us think all the time, freely and effortlessly. The main block to thinking and creating in a specific subject stems not from an inability to think but rather from a lack of knowledge about that subject. If we want students to be creative, we must offer them something to be creative with — knowledge.*

Rural people should be encouraged to study mathematics in order to strengthen their understanding that it will strengthen their socio-economic empowerment. They should see themselves as contributing to the well-being and the development of the entire nation in South Africa, as opposed to the development of the self-hater image described by Rowan (1993:63):

> *The self-hater is the inner representation of oppressive power — the kind of power which dominates, and which goes with the pattern of hierarchy which we have been identifying. We have*

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> *internalized it, not just from our parents, but from every institution in society with which we have contact. It is the structure in the psyche that perpetuates domination. It reminds us of our helplessness, our powerlessness. It blames the victim; it tells us we are bad when bad things happen to us.*

The role of mathematics educators or teachers in bringing about such desired change within the rural communities is emphasised by the Committee on Teacher Education Policy (1996:7):

> *Teachers will have to be empowered to become change-agents in those areas where change is necessary i.e. teachers will have to facilitate adaptation to a modern society. Teachers will also have to be empowered to establish and maintain a culture of teaching and learning.*

Rural people should be encouraged to realize that change of attitude and long internalized inhibitions is a process that needs to be maintained and developed through self-confidence and appreciation of help from the immediate surroundings, in line with the observations made by Turner (1991:24):

> *As an adult, I am continuing to learn about my abilities and inhibitions in living up to my values and beliefs. My ability to act outwardly and contribute to change is related to my ability to explore inwardly and find where the appropriate confidence really resides. My ability to do either of these things seems to depend heavily upon my feelings about the immediate situation I find myself in.*

It is encouraging, from the research, to realise that despite the prevailing socio-economic poverty and slim chances for employment amongst the rural communities, rural people still display a notable amount of enthusiasm and confidence in making a positive contribution in life. This must be

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encouraged through various forms of pedagogic, social and economic re-engineering projects, in order to foster development and self-reliance within the South African rural and tribal masses.

To achieve all these, a holistic[110] approach to the entire educational milieu is necessary. Nash (1980:125) first makes an assault on the educational *status quo* in the rural communities:

> *The educational system is poorly geared to the problem of socio-economic development, either in content or method, is ineffective as an agency of rural improvement, is extremely costly and incapable of generating radical change.*

Later Nash (1980:126) suggests that:

> *The whole educational system must be linked to rural progress through conventional agricultural extension services but also through community development, or, in the French term, animacion, and through cooperation with other institutions to promote long term development based on the mass of the population. Only in this way can the rural people participate in the business of creating and sharing in economic growth and if they cannot, they will not stay.*

In support of the suggestions put forth by Nash above, London (1994:49) comes with an even clearer description of the vision of realistic involvement and empowerment of the local community:

> *A major characteristic of the new vision, therefore, is cooperation between and among several agencies, and collaboration between State and local community is one of the methods by which the new linkages are to be forged. State-community partnership is of particular importance in view of the traditional imbalance in the*

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110 Holism or holistic approach refers to the development of the entire personality.

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> *distribution of the distribution of power and authority between these two agencies.*

Nash (1980:124) argues further about the possibilities that rural youth are likely to be attracted to urban lifestyles:

> *Urban-based industrial development, which outstrips the rural sector, results in out-migration of the younger elements of the population most of whom will be unemployed or underemployed and a burden in the urban system at the very time when they might be contributing to rural development. The loss of these young people further weakens the rural economy sometimes to the point where it is no longer able to supply the urban population with food, as is now the case in more than one African country.*

This seemingly common tragedy in Africa must be pre-empted in South Africa. This should be done by equipping the rural communities with mathematical knowledge and skills, amongst others, that will be beneficial in uplifting the socio-economic standard of the rural and tribal communities in South Africa.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

BIBLIOGRAPHY

AHLGREN, N. 1991. Closing the math and science gap: Education from agenda; America's schools for the 21st century. *The education digest*, 57:5-6.

AHMED, M., CHENG, KAI MING & RAMACHANDRAN, K. 1991. *Basic education and development: Lessons from China and India*. New York: UNICEF.

ALLEN, G. 1987. *Community education — An agenda for educational reform*. Milton Keynes: Open University.

ANTONOURIS, G. & WILSON, J. 1989 *Equal opportunities in schools - New dimensions in topic work*. London: Cassell.

ATKIN, J., BASTIANI, J. & GOODE, J. 1988. *Listening to parents: An approach to the improvement of home-school relations.* London: Croom Helm.

AVENANT, P.J. 1980. *Riglyne vir suksesvolle onderwys*. Durban: Butterworths.

BEATTIE, N. 1985. *Professional parents - Parent participation in four Western European countries*. London: The Falmer Press.

BELL, A. 1987. *The small rural primary school — A matter of quality*. London: The Falmer Press.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

BERGER, E.H. 1987. *Parents as partners in education, the school and home working together*. Columbus: Mervill Publishing Company.

BERRY, G.L. & ASAMEN, J.K. 1989. *Black students: Psychosocial issues and academic achievement*. Newbury Park, Cardiff: Sage Publications.

BISHOP, A.J. 1988. *Mathematical enculteration: A cultural perspective on mathematics education*. Dordrecth: Kluwer.

BLISS, J., ASKEW, M. & MACRAE, S. 1996. Effective teaching and learning: Scaffolding revisited. *Oxford review of education*, 22(1):37-61.

BLOOM, B.S. (Ed.) 1956. *Taxonomy of educational objectives. The classification of educational goals. Handbook 1: Cognitive domain.* New York: David McKay Co.

BOHAN, H. & BOHAN, S. Extending the regular curriculum through creative problem solving. *Arithmetic teacher*, 41(2)83-87.

BORG, W.R. & GALL, M.D. 1979. *Educational research*, (3rd Ed.). New York: Longman.

BRANCA, N.A. 1980. *Problem solving as a goal, process and basic skill: Problem-solving in school mathematics.* National Council of Teachers of Mathematics.

BULLOCK, K.M. & SCOTT, A.H. 1992. Teacher shortages in mathematics, physics and technology. *Educational review*, 44(1):167-179.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

BURGESS, R.G. 1993. *Educational research and evaluation for policy and practice*. Basingstoke: Falmer Press.

CARLSON, R.V. & AWKERMAN, G. 1991. *Educational planning-concepts*. New York: Longman.

CHAPMAN, E.N. 1992. *Life is an attitude: Staying positive when the world seems against you*. Menlo Park: Crisp Publication.

CHARLES, R. & LESTER, F. 1984. *Teaching problem solving*. London: Arnold.

CHEVIGNY, B.G. 1996a. Mississippi learning: Algebra as political curriculum. *The nation*, pp.16-21.

CHRISTIANSEN, B., HOWSON, A.G. & OTTE, M. 1984. *Perspectives on mathematics education*. Dordrecht: D. Reidel.

COCKROFT COMMITTEE. 1981. *Mathematics counts*. London: HMSO.

COSIN, B. & HALES, M. 1983. *Education, policy and society: Theoretical perspectives*. London: Routledge and Kegan Paul.

COSTELLO, J. 1991. *Teaching and learning mathematics 11-16.* London: Routledge.

COTEP, 1996. *Norms and standards for teacher education.*

CRONBACH, L.J. 1977. *Educational psychology*. Fort Worth: Harcourt Bruce Jovanovich.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

CURZON, L.B. 1985. *Onderrig in verdere onderwys: 'n Oorsig van beginsels en praktyke*. Pretoria: J.L. Van Schaik.

D'AMBROSIO, U. 1985. Ethnomathematics and its place in the history and pedagogy of mathematics. *For the learning of mathematics*, 5(1):44-48.

DANIELS, H. & ANGHILERI, J. 1995. *Secondary mathematics and special educational needs.* London: Cassell.

DEAN, P.G. 1982. *Teaching and learning mathematics*. London: Waburn.

DECKER, L.E., DECKER, V.A., DEMMON-BERGER, D., MARTIN, A. & HILL, T.S. 1988. *Home, school, community involvement.* Arlington, Vancouver: American Association of School Administrators.

DE CORTE, E. 1995. *introducing schools to new perspectives on learning and teaching*. A paper read in the B.F. Nel-gedenklesing at the University of Pretoria. Belgium: University of Leuven.

DEGENAAR, J.P. & McFARLANE, L.R. 1982. *Opleiding in vakdidaktiek*. Pretoria: Universiteit van Suid-Afrika.

DEPARTMENT OF EDUCATION AND CULTURE, 1992. *Teacher contributions to curriculum development: Educational newsflashes.* Administration: House of Assembly, May, no.92.

DOWLING, P. & NOSS, P. 1990. *Mathematics versus the National curriculum*. Basingstoke: Falmer Press.

DUMINY, P.A. 1980. *Didactics: Theory and practice*. Cape Town: Maskew Miller Longman.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

EISER, L. 1993. A math for a reason: Technology and learning. *Technology review,*

ERNEST, P. 1991. *The philosophy of mathematics education*. London: The Falmer Press.

ESSEN, J. & WEDGE, P. 1982. *Continuities in childhood disadvantage*. London: Crown.

FLEMING, M.L & LEVIE, W.H. 1993. *Instructional message design principles from the behavioural and cognitive sciences* Engelwood Cliffs: Educational Technology Publisher.

FLETCHER, C. & THOMPSON, N. 1980. *Issues in community education*. Hong Kong: The Falmer Press.

FRAENKEL, J.R. & WALLEN, N.E. 1993. *How to design and evaluate research in education*. New York: McGraw-Hill.

FRASER, W.J., LOUBSER, C.P. & VAN ROOY, M.P. 1993. *Didactics for the undergraduate student*. Durban: Butterworths.

FULLAN, M.B. & STIEGELBANER 1996. *The new meaning of educational change*. New York: Teachers College Press.

GAGNé, C.W. 1978. *Principle of instructional design*. Fort Worth: Harcourt-Brace Jovanovich.

GAGNé, R.M., BRIGGS, L.J. & WAGER, W.W. 1992. *Principles of instructional design.* Fort Worth: Harcourt Brace Jovanovich.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

GALL, M.D. & GALL, J.P. 1976. The discussion method. In: Gage, N.L. (Ed.). *The philosophy of teaching methods*. Chicago, Illinois: National society for the study of education.

GAMMAGE, P. 1982. *Children and schooling - Issues in childhood socialisation*. London: Allen & Unwin.

GILLBORN, D. 1990. *Race, ethnicity and education: Teaching and learning in multi-ethnic schools*. Boston: Unwin Hyman.

GLENCROS, M.J. & FRIDJHON, P. 1990. Planning tomorrow's mathematics curriculum: Curriculum decision-making for high school teachers. *Suid-Afrikaanse Tydskrif vir Opvoedkunde*, 10(4):307-309.

GOODMAN, J. 1995. Change without difference: School restructuring in historical perspective. *Harvard Educational Review*, 65(1):1-29.

GORDON, A. 1989. *The maths centre for primary teachers. Its impact on Soweto teachers and their pupils*. Pretoria: Human Sciences Research Council.

GOULD, W.T.S. 1993. *People and education in the Third World.* Harlow: Longman Scientific & Technical.

GRIFFITHS, H. & HOWSON, A.G. 1974. *Mathematics, society and curricula*. Cambridge: University Press.

HALLAK, J. 1990. *Investing in the future: Setting educational priorities in the developing world*. Unesco, IIEP. Paris: Pergamon Press.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

HARBER, C. 1989. *Politics in African Education*. London: MacMillan Publishers.

HILGARD, E.R. 1948. *Theories of learning*. New York: Appleton Century Crofts.

HOLT, M. 1980. *Schools and curriculum change*. London: McGraw-Hill.

HOWSON, A.G. & MELLIN-OLSEN, S. 1986. Social norms and external evaluation. In: Christiansen, *et al*. *Perspectives on mathematics education.* Dordrecht: Reidel.

HUDSON, B.L. 1986. *Behavioral social work: An introduction*. Basingstok: Macmillan Press.

HUNTER, M. 1967. *Motivation theory for teachers*. El Segundo: Corwin Press.

HUNTER, M.L. 1996. *Motivation theory for teachers*. Thousand Oaks: Corwin Press.

JEEVANANTHAN, L.S. 1993. Does the motion of compensatory education make philosophical sense? *South African Journal of Education*, 13(3):125-128.

JOHNSON, M.C. 1977. *A review of research methods in education*. Chicago: Rand McNally College Publishing Company.

KGORANE, P.M. 1983. *Pedagogic situatedness with special reference to the educator and the educand as persons-in-education*. Unpublished DEd thesis. Pretoria: University of South Africa.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

KINDRED, L.W., BAGIN, D. & GALLAGER, D.R. 1984. *The school and community relations*. New Jersey: Prentice-Hall.

KLEIN, S.B. 1991. *Learning: Principles and applications*. New York: McGraw-Hill.

KRAMER, J.R. 1978. *Siekepastoraat en die sielkunde van siek*. Ongepubliseerde BD-skripsie. Pretoria: Universiteit van Pretoria.

KRIEK, C.G. 1996. *Wiskundekurrikulumontwikkeling vir die senior sekondêre fase*. Unpublished PhD thesis. Pretoria: University of Pretoria.

LAGERWERF, L. 1985. *Witchcraft, sorcery and spirit possession. Pastoral responses in Africa*. Gweru: Mambo Press.

LETSHUFI, J.T. 1988. *The attitude of the secondary school pupils towards teachers*. Unpublished MEd dissertation. Pretoria: Vista University.

LEWIN, K.M. & STUART, J.S. 1991. *Educational innovations in developing countries: Case studies of changemakers*. Basingstoke: Macmillan.

LONDON, N.A. 1994. Community engagement in the implementation of educational policy in Trinidad and Tobago. *Interchange*, 25(4):335-348.

LONDON, M. 1988. *Change agents. New roles and innovation strategies for human rsources profesionals.* San Francisco: Jossey-Bassy.

LOUW, W.J. 1992. *Relationship in didactics*. Pretoria: Academica.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

LYNCH, J. 1987. *Prejudice reduction and the schools.* London: Cassell Company.

MAHLANGU, D.M.D. 1987. *Educational research methodology*. Pretoria: De Jager-Haum.

MAIRER, H.V. 1978. *Three theories of child development*. (3rd Ed.). New York: Harper & Row.

MAREE, J.G. 1995. Kritieke toestand van wiskunde-onderwys in swart skole in die Republiek van Suid-Afrika. *South African Journal of Psychology*, 25(1):47-52.

MAREE, J.G. 1994. *Kry wiskunde klein*. Pretoria: J.L. van Schaik.

MAREE, J.G. 1992. *Die ontwerp van 'n model vir die identifisering en hantering van ontoereikende prestasies in wiskunde*. Unpublished PhD thesis. Pretoria: University of Pretoria.

MASHABELA, H. 1987. *A people on the boil: Reflections on Soweto*. Johannesburg: Skotaville.

MASSACHUSSETTS INSTITUTE OF TECHNOLOGY, 1993. *Technology review*. Cambridge, Massachussetts: Massachussetts Institute of Technology.

MATTHAI, R.J. 1985. *The rural university: The Jawaja experiment in educational innovation*. London: Sangam Books.

MAY, L. 1995c. Motivating activities. *Teaching Practice*, 26(1):26.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

MEHRENS, W.A. & LEHMANN, I.J. 1984. *Measurement and evaluation in education and psychology*. Fort Worth: Harcourt Brace Jovanovich.

MNCWABE, M.P. 1990. *Separate and equal education - South Africa's education at the crossroads*. Durban: Butterworths.

MOKGALABONE, M.D. 1992. *The teaching of history in black secondary schools with special reference to concept teaching.* Unpublished DEd thesis. Pretoria: Vista University.

MOKHABA, M.B. 1993. *The application of the activity principle in mathematics teaching - A strategy for teacher training*. Unpublished PhD thesis. Pretoria: University of South Africa.

MOLEPO, J.M. 1985. *Identification of introductions in mathematics lessons — Rationale and usage*. Unpublished MEd dissertation. United Kingdom: University of Bath.

MONIUSZKO, L.K. 1991. Reality math. *Arithmetic Teacher*, 39(1):10-16.

MOULY, G.J. 1978. *Educational research - The art and science of investigation*. Boston: Allyn & Bacon.

MUNN, P. 1993. *Parents and schools: Customers, managers or partners?* London: Routledge.

MURSELL, J.L. 1954. *Successful teaching*. (2nd Ed.). Tokyo: McGraw-Hill.

NASH, R. 1980. *Schooling in rural societies* New York: Methuen.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

NELISSEN, J. & TOMIC, W. 1993. Learning and thought processes in realistic instruction: Curriculum and Teaching. *International Review of Curriculum and Teaching*, 8(1):19-38.

NICKSON, M. & LEHRMAN, S. 1992. *The social context of mathematics education: Theory and Practice. Proceedings of the group for research into social perspective of mathematics education.* London: Southbank Press.

NIKANDROV, N. 1993. Curriculum reform in Russian schools: Curriculum and teaching. *International review of curriculum and teaching*, 8(2):21-30.

NKOMO, M. 1990. *Pedagogy of domination*. Trenton: Africa World Press.

ODENDAL, F.F., SCHOONES, P.C., SWANEPOEL, C.J., DU TOIT, S.J. & BOOYSEN, C.M. 1988. *Verklarende Woordeboek van die Afrikaanse taal.* Johannesburg: Perskor.

OOSTHUIZEN, W.L., SWART, J. & GILDENHUYS, D.G. 1988. *Didactics: Mathematics for the secondary phase*. Pretoria: De Jager-Haum.

ORTON, A. 1987. *Learning mathematics: Issues, theory and classroom practice*. London: Cassell.

ORTON, A. & WAIN, G. 1994. *Issues in teaching mathematics*. London: Cassell.

ORMAN, S.A. (1993a). Mathematics backpacks: Making the home-school connection. *Arithmetic teacher*, 40(6):306-308.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

PEIRCE, B. 1881. Linear associative algebra. *American journal of mathematics*, 4:47.

PIAGET, J. 1973. *Main trends in inter-disciplinary research.* London: Allen & Unwin.

PIEK, G.C. 1984. *General didactics*. Pretoria: De Jager-Haum.

PIEK, G.C. 1986. *Teaching science organisation and practice.* Pretoria: De Jager-Haum.

PIEK, G.C. & MAHLANGU, D.M.D. 1990. *Educational perspectives and teaching practice*. Pretoria: De Jager-Haum.

PIMM, D. 1988. *Mathematics, teachers and children*. London: Hodder and Stoughton.

POMPEU, G.J. 1992. *Bringing ethnomathematics into the mathematics curriculum*. Unpublished doctoral thesis. United Kingdom: University of Cambridge.

POSAMENTIER, A. & SCHULZ, W. 1996. *The art of problem-solving: A resource for the mathematics teacher*. Thousand Oaks: Corwin Press.

POST, T.R. (Ed.) 1992. *Teaching mathematics in grades 1-8 - Research-based methods*. Boston: Allyn & Bacon.

POSTLETHWAITE, T.N. (Ed.) 1986. *International educational research: Papers in honour of Torsten Husen*. Oxford: Pergamon Press.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

PRATT, D. 1980. *Curriculum: Design and development*. New York: Harcourt Brace Jovanovich.

PRAWAT, R. 1996. Learning community, commitment and school reform. *Journal for curriculum studies*, 12(1):91-110.

PRESSEISEN, B.Z. 1988. *At-risk students and thinking: Perspective from research*. Washington: NEA.

PRINSLOO, E., VERSTER, P.J. & SIBAYA, P.T. 1996. *Teaching with confidence*. Pretoria: Kagiso Tertiary.

RALUSHAI, N.V. 1996. *Report of the Commission of Inquiry into witchcraft violence and ritual murders in the Northern Province of the Republic of South Africa*, (Unpublished). Pietersburg.

RAMBARAN, A. 1987. *The relationship between environmental factors and performance in mathematics of Indian pupils in the junior secondary phase.* Unpublished PhD thesis. Pretoria: University of South Africa.

READERS DIGEST OXFORD WORDFINDER, 1993.

REAVES, C. & GRIFFITH, H. 1992. *Restructuring schools: Theory and practice*. Lancaster: Technomic Publishing Company.

REIGELUTH, C.M. 1983. *Instructional design theories and models: An overview of their current status*. Hillsdale: Lawrence Erlbaum Association.

REY, R.E. & POST, T.R. 1973. *The mathematics laboratory: Theory to practice.* Boston: Prindle, Weber & Schmidt.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

REYES, L.A. & STANIC, G.M.A. 1988. Race, sex, socio-economic status and mathematics. *Journal for research in mathematics education*, 19(1):26-43.

REYNOLDS, D., CREEMERS, B.P.M., NESSELDRODT, P.S., SCHAFFER, E.C., STRINGFIELD, S. & TEDDLIE, C. 1994. *Advances in school effectiveness, research and practice*. Great Yarmouth: Pergamon Press.

ROWAN, J. 1993. *Discover your subpersonalities: Our inner world and people in it*. London: Routledge.

RUGGIERO, V.R. 1988. *Teaching thinking across the curriculum*. New York: Harper and Row Publishers.

RUSSELL, B. 1903. *The principles of mathematics*. (1st Ed.). London: Allen and Unwin.

SCHMINKE, C.W., MAERTENS, N. & ARNOLD, W. 1978. *Teaching the child mathematics*, (Second edition). New York: Holt, Rinehart and Winston.

SEAL, K.R. & HARMON, H.L. 1995d. Realities of rural school reform. *Phi Delta Kappan*, pp.119-124.

SEDIBE, E.M. 1994. *The black adolescent in the single parent family - A guidance perspective*. Unpublished PhD thesis. Pretoria: University of Pretoria.

SHER, J.P. 1981. *Rural education in urbanized nations - Issues and innovations.* Boulder: Westview.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

SHERMAN, R.R. & WEBB, R.B. (Eds.) 1988. *Qualitative research in education: Focus and methods*. London: Falmer Press.

SINGLEMANN, J. 1996. Will rural areas still matter in the 21st century? OR Rural Sociology Remain Relevant?. *Rural sociology*, 61(1):143-158.

SKILBECK, M. 1984. *School-based curriculum development*. London: Harper & Row.

SMITH, D.E. 1951. *History of mathematics*. London: Dover Publishers.

SMITH, D.J. 1984. *The state of graduate education*. Papers presented at conference at Brookings Institution, Washington.

SMITH, D.J. & TOMLINSON, S. 1989. *the school effect - A study of multicultural comprehensives*. London: Policy Studies Institute.

SOUTH AFRICAN NEW LANGUAGE POLICY. 1994, South African Community Services.

SOWETAN EDUCATION. 02/08/1996. *Report of the Joint Education Trust.*

STEYN, P.J.N., YULE, R.M. & BADENHORST, D.C. 1983. *Teaching method*. Johannesburg: McGraw-Hill.

STOKER, J. 1992. *Teachers as learners - problem solving and cultural psychology.* Proceedings of the Eleventh National Congress on Mathematics Education (MASA).

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

SWAP, S.M. 1993. *Developing home-school partnership: From concepts to practice*. New York: Teachers College Press.

SWENSON, L.C. 1980. *Theories of learning: Traditional perspectives/ contemporary developments*. Belmont: Wadsworth.

TECHNOLOGY REVIEW, 1993.

TEMPLE, G. 1981. *100 Years of mathematics*. London: Duckworth.

TERWEL, J., HERFS, P.G.P., MERTENS, E.H.M. & PERRENET, J.C. 1994. Cooperative learning and adaptive instruction in a mathematics curriculum. *Journal of curriculum studies*, 26(2):217-232.

THACKER, J., PRING, R. & EVANS, D. 1987. *Personal, social and moral education in a changing world*. Windsor: NFER-Nelson.

THEOBALD, P. & NACHTIGAL, P. 1995D. Culture, community and the promise of rural education. *Phi Delta Kappa*, pp.132-135.

THE SOWETAN. *Sowetan education*, 2-8-1996:2.

THOMAS, A.M. 1991. *Beyond education: A new perspective on society's management of learning*. San Francisco: Jossey-Bass.

TRAVERS, R.M.W. 1978. *An introduction to educational research* (4th Ed.). New York: McMillan Publishing Co.

TUCKMAN, B.W. 1988. *Conducting educational research* (Third edition). San Diego: Hartcourt-Brace Jovanovich.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

TURNER, G. & CLIFT, P. 1988. *Studies in teacher appraisal*. Trowbridge: Falmer Press.

TURNER, A.W. 1991. Constructing a curriculum for equality. *Forum for promoting 3-19 comprehensive education*, 34(1):24-25.

UHL, S. 1994. School education in a 'multicultural society: Opportunities and limits. *South African journal of education*, 14(1):77-86.

VAN TIL, W. 1978., *Secondary evaluation: School and community*. Boston: Houghton Mifflin Company.

VAN DER STOEP, F. & LOUW, W.J. 1984. *Didactics*. Pretoria: Academica.

VITHAL, R. 1993. *Ethnomathematics: Research directions and some implications for curriculum*. Paper read at first annual meeting of the South African Association for Research in Science and Mathematics Education (SAARMSE).

VOCKEL, E.L. 1983. *Educational research*. New York: Macmillan.

VREY, J.D. 1979. *The self-actualising educand.* Pretoria: UNISA (Mannualia).

WALBERG, H.J. 1982. *Improving educational standards and productivity: The research basis for policy*. Berkley: McCutchan Publishing Corporation.

WALKER, R. 1985. *Doing research: A handbook for teachers*. London: Routledge.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

WARWICK, D. (Ed.) 1989. *Linking schools and industry*. Oxford: Blackwell Education.

WHEELER, D.K. 1967. *Curriculum process*. London: Hodder Stoughton.

WHITBREAD, N. 1992. Teachers and parents as management partners. *Forum for promoting 3-19 comprehensive education*, 34(2):36-37.

WIEGAND, P. & RAYNER, M. 1989. *Curriculum progress 5-16: School subjects and the national curriculum debate*. New York: Falmer Press.

WIERSMA, W. 1980. *Research methods in education: An introduction*. Itasca: Peacock.

WILSON, J.A.R. 1969. *Psychological foundations of learning and Teaching*. New York: McGraw-Hill.

ZAIS, R.S. 1976. *Curriculum: Principles and foundations*. New York: Harper & Row.

ZAJDA, J. 1993. School curriculum reforms for the new values post-communist Russia: Curriculum and teaching. *International review of curriculum and teaching*, 8(1):3-9.

Digitised by the Department of Library Services in support of open access to information, University of Pretoria, 2021

APPENDIX A

LETTER OF PERMISSION TO CONDUCT RESEARCH IN THE DEPARTMENT OF EDUCATION (FORMER LEBOWA)

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MMUSO WA LEBOWA/LEBOWA-REGERINGSDIENS/GOVERNMENT SERVICE

No. ya Tshupetso / Verw. Nr./Ref. No. 11/1

DINYAKISISO / NAVRAE/ENQUIRIES: C.M. Kekana

No. ya Thelefomo / Tel. Nr./No. 0156-37130/5/6

Telex. Nr. No.

OFISI YA/KANTOOR VAN DIE/OFFICE OF THE

Department of Education
Private Bag X03
CHUENESPOORT
0745
1994 8. 0 1.

REGIONAL CHIEF INSPECTORS
CIRCUIT INSPECTORS
INSPECTORS OF EDUCATION
PRINCIPALS OF SELECTED SECONDARY SCHOOLS
MATHS TEACHERS (SELECTED SCHOOLS) STD 10

PERMISSION TO CONDUCT RESEARCH IN THE DEPARTMENT

Name of Researcher : Jacob Maisha Molepo

Research Topic : The Role of Mathematics in developing rural and tribal communities in South Africa

University : UP

Degree : PhD.

1. This is to inform you that the Department has approved of the above researcher's application to conduct research in selected secondary schools in our region.

2. Kindly, when contacted by this researcher, give the necessary assistance and co-operation.

3. The nature of assistance required from you is as follows:-

   3.1 Grant him interviews and allow him to distribute questionnaires.

   3.2 Give him access to relevant records d statistics.

DIRECTOR-GENERAL : EDUCATION

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RESEARCH

SCHOOLS TO BE VISTED
BY MR J.M. MOLEPO

CIRCUIT	:	SCHOOL
MANKWENG	:	TWATSHO
		SETLAKALANA
	:	RANTI
RAMOKGOPA	:	TIDIMA
	:	TABUDI
	:	KGARAHARA
	:	
MOGODUMO	:	TSHEHLO
	:	RADIKGOMO
POLOKWANE	:	MAGADANGELE
	:	NARE

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APPENDIX B

QUESTIONNAIRE 1
1994 STANDARD 10 STUDENTS

QUESTIONNAIRE 2
FORMER STANDARD 10 STUDENTS

QUESTIONNAIRE 3
STANDARD 10 MATHEMATICS TEACHER

QUESTIONNAIRE 4
PARENTS OR GUARDIANS OF THE PRESENT STANDARD 10 STUDENTS (ENGLISH AND NORTH SOTHO VERSIONS)

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UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
DEPARTMENT OF DIDACTICS

THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

(QUESTIONNAIRE 1 : 1994 STANDARD 10 STUDENTS)

Introduction.

The purpose of this questionnaire is to determine the role of Mathematics in developing rural Communities in South Africa. Your co-operation in answering the questions or statements contained here would be appreciated.

Please do not write your name or identify yourself in any way. The questionnaire is to be answered completely anonymously and as such you cannot be identified. Your honest opinions are sought.

You are requested to answer all questions or statements by indicating your answer choice by drawing a circle (O) around the number associated with the answer or opinion which best suits you. In some cases you are asked to write an answer directly on the questionnaire in the place provided.

An example of a question involving a single choice could be, for example:

40. Do you enjoy soccer?

ATTITUDE TO SOCCER	Code
I hate it	1
I like it	2
It depends on who is playing	3
I have difficulty in understanding it	4

V 70	3	79

Should you consider that option '3' (i.e. 'It depends on who is playing') best fits your opinion, you should draw a circle (O) around the '3' in the box above as indicated.

PLEASE DO NOT FILL IN THE BLOCKS ON THE RIGHT HAND SIDE OF THE QUESTIONNAIRE THEY ARE TO BE USED FOR "OFFICE USE".

NB ***Please submit the completed questionnaire to the Principal of your School within two (2) weeks from the time of receiving it***

Thank you for your co-operation and assistance with my research

Mr JM Molepo

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A.	RESPONDENT NUMBER	
B.	SCHOOL NUMBER	
C.	CARD NUMBER	

V 1			1-2
V 2			3-4
V 3	1	5	

1. Please supply the name of your home village

V 4			6-7

2. What is your father's occupation? (If your father has died, then enter **deceased**)

V 5			8-9

3. What is your mother's occupation? (If your mother has died, then enter **deceased**)

V 6			10-11

4. How many people are living with you at home? (Please include your parents and guardians in this total)

V 7			12-13

5. How many pupils are there in your Mathematics class?

V 8			14-15

6. My attitude to Mathematics is....

ATTITUDE TO MATHEMATICS	Code
I hate it	1
I like it	2
I have difficulty understanding it	3

V 9		16

7. Do you intend studying Mathematics after Matric?

MATHEMATICS AFTER MATRIC	Code
Yes	1
No	2
Not sure	3

V 10		17

8. The **MAIN** reason for your choice in 7 above is ..

REASON	Code
Because Mathematics is important	1
Because Mathematics is useless	2
Because I need it for other subjects	3
Because I am weak in Mathematics	4
Because it may not be applied in my life	5

V 11		18

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9. Does Mathematics play an active and important role where you live?

MATHEMATICS ROLE	Code
Yes	1
No	2
Don't know	3

V 12		19

10. Should all students in your village study Mathematics?

MATHEMATICS STUDY	Code
Yes	1
No	2
It is up to them to decide	3

V 13		20

11. Can Mathematics help to develop your community?

MATHEMATICS and COMMUNITY DEVELOPMENT	Code
Yes	1
No	2
Don't know	3

V 14		21

12. If your answer to **11** is '**YES**', how can Mathematics develop the Community you stay in?

MODE OF DEVELOPMENT	Yes	No
By forcing all students to study Mathematics	1	2
By encouraging all students to study Mathematics	1	2
By developing a closer relationship between the home and the school	1	2
By appointing qualified Mathematics teachers to the school	1	2

V 15		22
V 16		23
V 17		24
V 18		25

13. Do you ever discuss Mathematics with your parents/guardians?

MATHEMATICS DISCUSSIONS	Code
Yes	1
No	2
Can't remember	3

V 19		26

14. Do you always start the discussions referred to in **13**?

MATHEMATICS DISCUSSIONS	Code
Yes	1
No	2
Can't remember	3

V 20		27

15. Which remarks do they always make after discussing your Mathematics work with you?

REMARKS	Yes	No
Boring!	1	2
Good!	1	2
Don't disturb me!	1	2
Relevant to our life	1	2
Irrelevant to our life but continue with it	1	2
No remarks at all	1	2
No remarks as I don't have discussions	1	2

V 21		28
V 22		29
V 23		30
V 24		31
V 25		32
V 26		33
V 27		34

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16. There is a lot of Mathematics in your home environment

MATHEMATICS IN ENVIRONMENT	Code
Agree	1
Don't agree	2
Don't know	3

V 28		35

17. Our teacher uses Mathematics examples from our village to explain concepts

MATHEMATICS EXAMPLES	Code
Yes, in every lesson	1
Very rarely	2
Can't remember	3
Not at all	4

V 29		36

18. More examples from our environment will make Mathematics more interesting in our lessons

MATHEMATICS INTERESTS	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4
Not sure	5

V 30		37

19. Adults from the village may be invited to school to demonstrate some Mathematical concepts from our rural culture

MATHEMATICAL CONCEPTS	Code
Strongly agree	1
Agree	2
Not necessary	3

V 31		38

20. Parents should be encouraged to know more about the performance of their children in Mathematics

MATHEMATICAL CONCEPTS	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4

V 32		39

21. Our Mathematics teachers should discuss our mathematical problems with our parents/guardians

MATHEMATICAL PROBLEMS	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4

V 33		40

22. Mathematics can develop our Community by...

COMMUNITY DEVELOPMENT	Yes	No
Making us find work quickly	1	2
Changing our way of thinking	1	2
Making us think more scientifically	1	2
Making us think more productively	1	2
Making us earn money quickly	1	2

V 34		41
V 35		42
V 36		43
V 37		44
V 38		45

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23. If you have an opinion (one only please) which has not been mentioned in **22.** above, please state it now?

V 39			46-47

24. What is your opinion concerning Mathematics and the training of your mind?

OPINION	Yes	No
It could retard our mental development	1	2
It will enable us to be socio-economically productive	1	2
It will retard our socio-economic development	1	2
It will make us 'tsotsies' or thieves	1	2
I have no opinion regarding this matter	1	2

V 40		48
V 41		49
V 42		50
V 43		51
V 44		52

25. Mathematics will help us in changing some of our Community's uncivilised practices

COMMUNITY PRACTICES	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4

V 45		53

26. Rural Mathematics should be developed as a subject for rural pupils

RURAL MATHEMATICS	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4

V 46		54

27. The present school Mathematics is biased towards urban communities

URBAN MATHEMATICS	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4

V 47		55

28. The Standard 10 Mathematics syllabus should be changed to suit rural pupils

STANDARD 10 SYLLABUS	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4

V 48		56

29. Rural Communities and pupils should be consulted when a relevant Mathematics syllabus is compiled

SYLLABUS COMPILATION	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4

V 49		57

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30. Rural Community structures should be represented in any Mathematics subject committee

MATHEMATICS SUBJECT COMMITTEE	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4

V 50		58

31. When a new Mathematics syllabus has been compiled, it should not be implemented before the rural communities have been consulted

COMMUNITY CONSULTATION	Code
Strongly agree	1
Agree	2
Disagree	3
Don't know	4

V 51		59

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UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
DEPARTMENT OF DIDACTICS

THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

(QUESTIONNAIRE 2 : FORMER STANDARD 10 STUDENTS)

Introduction.

The purpose of this questionnaire is to determine the role of Mathematics in developing rural Communities in South Africa. Your co-operation in answering the questions or statements contained here would be appreciated.

Please do not write your name or identify yourself in any way. The questionnaire is to be answered completely anonymously and as such you cannot be identified. Your honest opinions are sought.

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An example of a question involving a single choice could be, for example:

40. Do you enjoy soccer?

ATTITUDE TO SOCCER	Code
I hate it	1
I like it	2
It depends on who is playing	3
I have difficulty in understanding it	4

V 70	3	79

Should you consider that option '3' (i.e. 'It depends on who is playing') best fits your opinion, you should draw a circle (O) around the '3' in the box above as indicated.

PLEASE DO NOT FILL IN THE BLOCKS ON THE RIGHT HAND SIDE OF THE QUESTIONNAIRE THEY ARE TO BE USED FOR "OFFICE USE".

NB ***Please return the completed questionnaire to P O Box 2568, Pietersburg, 0700 in the self addressed envelope supplied within two (2) weeks from the time of receiving it***

Thank you for your co-operation and assistance with my research

Mr JM Molepo

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A.	RESPONDENT NUMBER		V 1			1-2
B.	SCHOOL NUMBER		V 2			3-4
C.	CARD NUMBER		V 3	2	5	

1. Please supply the name of your home village

	V 4			6-7

2. What is your father's occupation? (If your father has died, then enter **deceased**)

	V 5			8-9

3. What is your mother's occupation? (If your mother has died, then enter **deceased**)

	V 6			10-11

4. What is your present occupation?

	V 7			12-13

5. When did you pass Standard 10?
(Please supply only the year e.g. 92)

	V 8			14-15

6. What symbol did you obtain for Mathematics in Standard 10?

	V 9		16

7. My attitude to Mathematics is....

ATTITUDE TO MATHEMATICS	Code
I hate it	1
I like it	2
I have difficulty understanding it	3

V 10		17

8. Do you intend studying Mathematics at sometime in the future?

MATHEMATICS AFTER MATRIC	Code
Yes	1
No	2
Not sure	3

V 11		18

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9. The **MAIN** reason for your choice in **8** above is ..

REASON	Code
Because Mathematics is important	1
Because Mathematics is useless	2
Because I need it for my job	3
Because it may not be applied in my life	4
I an not sure	5

V 12		**19**

10. Is Mathematics important in your home village?

MATHEMATICS IMPORTANCE	Code
Yes	1
No	2
Not sure	3

V 13		**20**

11. Can your community develop because of the influence of Mathematics?

MATHEMATICS INFLUENCE	Code
Yes	1
No	2
Not sure	3

V 14		**21**

12. How can Mathematics help to develop your community?

MATHEMATICS INFLUENCE	Yes	No
By adults going back to school	1	2
By students teaching Mathematics in the village	1	2
By teachers applying rural concepts in Mathematics	1	2
By retarding community development	1	2
By turning everyone into a thief or mugger	1	2
By making people unnecessarily clever	1	2
By making people socio-economically active	1	2

V 15		**22**
V 16		**23**
V 17		**24**
V 18		**25**
V 19		**26**
V 20		**27**
V 21		**28**

13. Did you enjoy Mathematics lessons in class?

MATHEMATICS ENJOYMENT	Code
Yes	1
No	2
Can't remember	3

V 22		**29**

14. Is Mathematics important in you present job?

PRESENT JOB	Code
Yes	1
No	2
Not sure	3

V 23		**30**

15. Do you apply Mathematics in you present job?

MATHEMATICS APPLICATION	Code
Yes	1
No	2
Not sure	3

V 24		**31**

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16. I was employed because I passed Mathematics in Matric.

PASS - EMPLOYMENT	Code
Yes	1
No	2
Not sure	3

V 25		32

17. My knowledge of Mathematics is important to my community.

MATHEMATICS KNOWLEDGE	Code
Yes	1
No	2
Not sure	3

V 26		33

18. Which remarks do people make after discussing your Mathematics work with you?

MATHEMATICS DISCUSSION	Code
You are boring me!	1
That's good!	2
Don't disturb me!	3
What? Come again!	4
This is relevant to our lives!	5
It's irrelevant to me, but carry on!	6
No comment!	7
No remarks are made	8

V 27		34

19. I discuss Mathematics with all sections of non-schooling members of the community in my home village

NON-SCHOOLERS DISCUSSIONS	Code
Always	1
Often	2
Rarely	3
I have no chance	4
I want to, but have no time	5
I want to, but they have no interest	6
It is not my business	7
Not at all	8

V 28		35

20. Which remarks are mostly made by people in **19** above after discussing Mathematics with them?

MATHEMATICS DISCUSSION	Code
You are boring!	1
That's good!	2
Don't disturb me!	3
What? Come again!	4
It's relevant to our lives!	5
It's irrelevant to me, but carry on!	6
No comment!	7
No remarks are made	8
No discussion takes place at all	9

V 29		36

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21. How would you rate your former Standard 10 Mathematics teacher, with regard to his/her Mathematics expertise?

TEACHER RATING	Code
Boring!	1
Knowledgeable	2
Of high esteem	3
Good, but poor in language	4
Poor, but good in language	5
Poorly trained	6
Poor in all respects	7
Good in all respects	8
None of the above	9

V 30		37

22. There is a lot of Mathematics in your home environment

MATHEMATICS IN ENVIRONMENT	Code
Agree	1
Disagree	2
Not sure	3

V 31		38

23. Rural Mathematics teachers should use a lot of examples from the rural environment in their Mathematics lessons

RURAL CONCEPTS & EXAMPLES	Code
Agree	1
Disagree	2
Don't know	3

V 32		39

24. Examples from the rural environment will make Mathematics more interesting to rural students

INTERESTING EXAMPLES	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Don't know	5

V 33		40

25. Adults from the rural villages should sometimes be invited to offer lessons in schools on their rural Mathematical experiences

ADULT EXPERIENCES	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Not sure	5

V 34		41

26. The suggestion made in 25 above will ....

LESSON SUGGESTION	Code
Distort Mathematics learning	1
Confuse the students	2
Make Mathematics biased to rural life	3
Make students understand Mathematics better	4
Improve the link between the home and the school	5
Make parents more interested in the children's education	6
None of the above	7

V 35		42

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UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
DEPARTMENT OF DIDACTICS

THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

(QUESTIONNAIRE 3 : STANDARD 10 MATHEMATICS TEACHERS)

Introduction.

The purpose of this questionnaire is to determine the role of Mathematics in developing rural Communities in South Africa. Your co-operation in answering the questions or statements contained here would be appreciated.

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An example of a question involving a single choice could be, for example:

40. Do you enjoy soccer?

ATTITUDE TO SOCCER	Code
I hate it	1
I like it	2
It depends on who is playing	3
I have difficulty in understanding it	4

V 90	3	79

Should you consider that option '3' (i.e. 'It depends on who is playing') best fits your opinion, you should draw a circle (O) around the '3' in the box above as indicated.

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Thank you for your co-operation and assistance with my research

Mr JM Molepo

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A.	RESPONDENT NUMBER
B.	SCHOOL NUMBER
C.	CARD NUMBER

V 1			1-2
V 2			3-4
V 3	3	5	

1. Please supply the name of the village where your school is situated

V 4			6-7

2. Please supply your highest **Mathematics** qualification e.g. B.Sc. (Mathematics III)

V 5			8-9

3. Please supply your highest **professional** qualification e.g. Senior Primary Teacher's Diploma (Mathematics as Major)

V 6			10-11

4. For how many completed years have you taught standard 10 Mathematics?

years

V 7			12-13

5. How many standard 10 Mathematics students are you teaching at present?

V 8			14-15

6. Why do you have the number of students referred to in **5.** above studying Mathematics this year?

NUMBER OF STUDENTS	Code
They love the subject	1
They hate the subject	2
Roll of the school is small	3
I don't know	4

V 9		16

7. What is the general attitude of your Mathematics students towards the Mathematics that is taught to them?

STUDENT ATTITUDE	Code
Positive	1
Negative	2
Average	3
Not sure	4
Don't know	5

V 10		17

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8. The Mathematics that I teach is difficult for my class to understand

MATHEMATICAL DIFFICULTY	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Don't know	5

V 11		18

9. The reason for my choice in **8.** above is ...

REASON FOR DIFFICULTY	Code
Mathematics is relevant to the rural life of pupils	1
Mathematics is not relevant to the rural life of pupils	2
Pupils do not see any importance in it	3
Pupils regard Mathematics as being important	4
My methods are good	5
My methods are poor	6
I don't know	7

V 12		19

10. The present standard 10 Mathematics syllabus is urban biased

URBAN BIAS	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 13		20

11. There are a lot of Mathematical concepts in the rural environment

RURAL CONCEPTS	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 14		21

12. If you indicated 'Strongly agree' or 'Agree' in **11.** above, please name **five (5)** such concepts **in order of priority** in the space below

MATHEMATICAL CONCEPTS
Concept 1
Concept 2
Concept 3
Concept 4
Concept 5

V 15			22-23
V 16			24-25
V 17			26-27
V 18			28-29
V 19			30-31

13. Should Mathematical concepts associated with the rural environment be incorporated into the school Mathematics curriculum

RURAL CONCEPTS	Code
Yes	1
No	2

V 20		32

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14. If your answer to **13.** above is **'Yes'**, please name the rural concepts you feel should be included in the Mathematics curriculum.

CONCEPTS FOR INCLUSION IN CURRICULUM
Concept 1
Concept 2
Concept 3
Concept 4
Concept 5

V 21			**33-34**
V 22			**35-36**
V 23			**37-38**
V 24			**39-40**
V 25			**41-42**

15. Adults from the village near the school should sometimes be invited to address students on their Mathematical cultural experience.

ADULT PARTICIPATION	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 26		**43**

16. The reason for my choice in **15.** above is that I think that participation by adults from the village will ...

PARTICIPATION REASON	Yes	No
Distort Mathematics learning	1	2
Confuse the students	1	2
Make Mathematics biased to rural life	1	2
Make students understand Mathematics better	1	2
Improve the link between the home and the school	1	2
Make parents more interested in the children's education	1	2
Accomplish none of the above	1	2

V 27		**44**
V 28		**45**
V 29		**46**
V 30		**47**
V 31		**48**
V 32		**49**
V 33		**50**

17. Rural communities should have a say in the Mathematics curriculum design

CURRICULUM DESIGN	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 34		**51**

18. Rural communities should be represented in all Mathematics Committees

COMMUNITY REPRESENTATION	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 35		**52**

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19. Most students who studied Mathematics in Matric and passed the subject do not struggle to get employment

EMPLOYMENT OPPORTUNITIES	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 36		53

20. To my knowledge the students to whom I taught Mathematics in Matric and passed the subject have the following employment situations:

EMPLOYMENT OF PREVIOUS STUDENTS	Code
All are presently employed	1
At least 50% are employed	2
At least 25% or less are employed	3
It is difficult to assess how many are employed	4
It is none of my business	5

V 37		54

21. Do you believe that Mathematics can develop the rural community you are working in?

COMMUNITY DEVELOPMENT	Code
Yes	1
No	2
Not sure	3

V 38		55

22. In which way can Mathematics develop the community you are working in?

MATHEMATICS INFLUENCE	Yes	No
By adults going back to school	1	2
By students teaching Mathematics in the village	1	2
By teachers applying rural concepts in Mathematics	1	2
By retarding community development	1	2
By turning everyone into a thief or mugger	1	2
By making people unnecessarily clever	1	2
By making people socio-economically active	1	2

V 39		56
V 40		57
V 41		58
V 42		59
V 43		60
V 44		61
V 45		62

23. If the present Mathematics syllabus were to be changed to suit rural communities ......

SYLLABUS CHANGE	Yes	No
I will resist it	1	2
I will quit teaching	1	2
I will accept retraining	1	2
I will support it at all costs	1	2
I will just accept it without questioning	1	2
I will just wait for the instruction	1	2
I will discourage this to occur	1	2

V 46		63
V 47		64
V 48		65
V 49		66
V 50		67
V 51		68
V 52		69

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24. Parents and Guardians should always feel free to enquire about the progress of those of their children who are at school

PROGRESS ENQUIRY	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 53		70

25. Students should be encouraged to discuss their success or failures in Mathematics with their parents or guardians

PROGRESS DISCUSSION	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 54		71

26. In my opinion the discussions referred to in **25.** above should be held as follows:

DISCUSSION TIMES	Code
On a daily basis	1
On a weekly basis	2
On a monthly basis	3
On a yearly basis	4
I have no fixed opinion	5

V 55		72

27. If you were unable to make a choice in **26.** above, please supply an opinion in the space provided below. (Supply only **one (1)** opinion)

OPINION

V 56			73-74

28. Discussions between the parent or guardian and the child will ...

DISCUSSION RESULTS	Yes	No
Motivate the child	1	2
Demotivate the child	1	2
Make the child parent dependant	1	2
Improve the link between home and school	1	2
Destroy the future of the child	1	2

V 57		75
V 58		76
V 59		77
V 60		78
V 61		79

D.	RESPONDENT NUMBER
E.	SCHOOL NUMBER
F.	CARD NUMBER

V 62			1-2
V 63			3-4
V 64	4	5	

29. Mathematics teachers should regard parents and guardians .....

TEACHER/PARENT RELATIONSHIP	Yes	No
With suspicion	1	2
As co-educators	1	2
As intruders in the educational process	1	2
As being useless in the teaching-learning situation	1	2
As facilitators of meaningful education	1	2

V 65		6
V 66		7
V 67		8
V 68		9
V 69		10

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30. Mathematics teachers should accept invitations after hours to participate in the discussions between parents and students on their students' Mathematical progress or failure.

TEACHER PARTICIPATION	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 70		**11**

31. Such invitations as alluded to in **30.** above should follow on agreement reached between the child and parent or guardian because it ....

INVITATION AGREEMENT	Yes	No
Will be successful	1	2
Will be rejected by either party	1	2
Will be full of suspicion	1	2
Will lead to motivation of the child	1	2
Will lead to demotivation of the child	1	2

V 71		**12**
V 72		**13**
V 73		**14**
V 74		**15**
V 75		**16**

32. Mathematics teachers should also take part in other community development programmes apart from their Mathematics teaching responsibilities

TEACHER PARTICIPATION	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 76		**17**

33. Problem solving is an essential part of Mathematics

PROBLEM SOLVING IMPORTANCE	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 77		**18**

34. The problem solving approach used in Mathematics will help students to solve everyday problems

EVERY DAY PROBLEM SOLVING	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 78		**19**

35. The rural Mathematics syllabus should include problem solving activities

PROBLEM SOLVING ACTIVITIES	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
I don't know	5

V 79		**20**

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36. To what extent should problem solving be taught in the rural high school Mathematics syllabus?

EVERY DAY PROBLEM SOLVING	Code
To a very large extent	1
To an average extent	2
To little extent	3
To very little extent	4
Not at all	5
I don't know	

V 80		21

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UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
DEPARTMENT OF DIDACTICS

THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

(QUESTIONNAIRE 4 : PARENTS OR GUARDIANS OF PRESENT STANDARD 10 MATHEMATICS STUDENTS)

Introduction.

The purpose of this questionnaire is to determine the role of Mathematics in developing rural Communities in South Africa. Your co-operation in answering the questions or statements contained here would be appreciated.

Please do not write your name or identify yourself in any way. The questionnaire is to be answered completely anonymously and as such you cannot be identified. Your honest opinions are sought.

You are requested to answer all questions or statements by indicating your answer choice by drawing a circle (O) around the number associated with the answer or opinion which best suits you. In some cases you are asked to write an answer directly on the questionnaire in the place provided.

An example of a question involving a single choice could be, for example:

40. Do you enjoy soccer?

ATTITUDE TO SOCCER	Code
I hate it	1
I like it	2
It depends on who is playing	3
I have difficulty in understanding it	4

V 70	3	79

Should you consider that option '3' (i.e. 'It depends on who is playing') best fits your opinion, you should draw a circle (O) around the '3' in the box above as indicated.

PLEASE DO NOT FILL IN THE BLOCKS ON THE RIGHT HAND SIDE OF THE QUESTIONNAIRE THEY ARE TO BE USED FOR "OFFICE USE".

NB ***Please return the completed questionnaire to P O Box 2568, Pietersburg, 0700 in the self addressed envelope supplied within two (2) weeks from the time of receiving it***

Thank you for your co-operation and assistance with my research

Mr JM Molepo

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A.	RESPONDENT NUMBER
B.	CARD NUMBER

V 1			1-2
V 2	5	3	

1. Please supply the name of your home village

V 3			4-5

2. What is your occupation?

V 4			6-7

3. What is your relationship to the Standard 10 student who is studying Mathematics?

RELATIONSHIP TO STUDENT	Code
Father	1
Mother	2
Guardian	3

V 5		8

4. Are any of your children presently studying Standard 10 Mathematics?

STUDENTS STUDYING MATHEMATICS	Code
Yes	1
No	2
Not sure	3

V 6		9

5. How many of your children are presently studying standard 10 Mathematics?

V 7			10-11

6. If your answer to **4.** above is '**Yes**' or '**No**', how did you get to know about this?

INFORMATION	Code
Informed by the Teacher/Principal	1
Informed by my spouse	2
Informed by my child	3
Discovered it by myself	4
None of the above	5

V 8		12

7. Do you like Mathematics yourself?

LIKING MATHEMATICS	Code
Yes	1
No	2
Not sure	3

V 9		13

8. Do you feel proud that your child is studying Mathematics in Standard 10?

PROUD OF CHILD	Code
Yes	1
No	2
Not sure	3

V 10		14

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9. Will you encourage all your children to study Mathematics in Standard 10 and possibly beyond Standard 10 in the future?

PARENTAL ENCOURAGEMENT	Code
Yes	1
No	2
Not sure	3

V 11		**15**

10. Which of the following reasons best describe your answer to **9.** above?

ENCOURAGEMENT REASON	Yes	No
It will destroy their lives	1	2
They will cheat me easily	1	2
They will become useful citizens	1	2
They will uplift our community	1	2
They won't have respect	1	2
They won't get jobs quickly	1	2
They will get jobs quickly	1	2
They will excel in future	1	2
I am not sure	1	2

V 12		**16**
V 13		**17**
V 14		**18**
V 15		**19**
V 16		**20**
V 17		**21**
V 18		**22**
V 19		**23**
V 20		**24**

11. Will you encourage all children other than yours to study Mathematics in Standard 10 and possibly beyond Standard 10 in the future?

ENCOURAGEMENT OF OTHER CHILDREN	Code
Yes	1
No	2
Not sure	3

V 21		**25**

12. Which of the following reasons best describe your answer to **11.** above?

OTHER REASONS	Yes	No
They will beat off my children	1	2
They will not respect adults	1	2
They will be useful to our community	1	2
They will uplift our standard of life	1	2
They will get jobs quickly	1	2
They will struggle to get jobs	1	2
Because I am not sure	1	2

V 22		**26**
V 23		**27**
V 24		**28**
V 25		**29**
V 26		**30**
V 27		**31**
V 28		**32**

13. Can Mathematics develop your community?

COMMUNITY DEVELOPMENT	Code
Yes	1
No	2
Not sure	3

V 29		**33**

14. If your answer to **13.** above is '**Yes**', in which way can Mathematics develop the community you are working in?

MODE OF DEVELOPMENT	Yes	No
By ensuring that all children study Mathematics	1	2
All adults should study Adult Mathematics Education courses	1	2
Children should share their knowledge of Mathematics with adults	1	2
Mathematical ideas should be practically applied in the village	1	2
Mathematical ideas at school should be linked with those occurring at home	1	2

V 30		**34**
V 31		**35**
V 32		**36**
V 33		**37**
V 34		**38**

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15. If there are any other ways in which Mathematics can develop the community you are working in, which are not mentioned in **14.** above, please indicate these in the spaces provided below

	V 35			**39-40**
	V 36			**41-42**
	V 37			**43-44**

16. Should adults share their traditional and practical Mathematics experience with their children?

MATHEMATICS EXPERIENCE	Code
Yes	1
No	2
Not sure	3

V 38		**45**

17. Do you discuss Mathematics with your child(ren)?

MATHEMATICS DISCUSSION	Code
Always	1
Sometimes	2
Rarely	3
Not at all	4
I would like to, but have no time	5
I would like to, but my children are disinterested	6
I don't want to interfere	7
It is my duty to do it	8

V 39		**46**

18. Who starts the discussion?

DISCUSSION STARTING	Code
My child(ren)	1
Myself	2
Someone else (Please specify)	3
No discussion at all	4

V 40		**47**
V 41		**48**

19. How do you regard the Mathematics discussions?

FEELING ABOUT DISCUSSION	Code
Boring	1
Useless	2
Useful	3
Interesting	4
Motivate my child(ren)	5
Waste my time	6
No discussions take place	7

V 42		**49**

20. Adults from the village can play a role in the teaching of Mathematics

ROLE OF ADULTS	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Not sure	5

V 43		**50**

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21. Adults from the village should sometimes be invited to share their cultural and practical Mathematical knowledge with students and teachers during school Mathematics lessons

ADULTS AND LESSONS	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Not sure	5

V 44		51

22. The reason for your choice made in **21.** above is that this practice will ....

PARTICIPATION REASON	Yes	No
Distort Mathematics learning	1	2
Confuse the students	1	2
Make Mathematics biased to rural life	1	2
Make students understand Mathematics better	1	2
Improve the link between the home and the school	1	2
Make parents more interested in the children's education	1	2
Accomplish none of the above	1	2

V 45		52
V 46		53
V 47		54
V 48		55
V 49		56
V 50		57
V 51		58

23. Mathematics will help in changing some of our community's practices

CHANGING COMMUNITY PRACTICES	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Not sure	5

V 52		59

24. Rural Mathematics should be developed as a subject for rural pupils

RURAL MATHEMATICS	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Don't know	5

V 53		60

25. The present school Mathematics syllabus does not represent the rural culture of our communities

RURAL CULTURE	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Don't know	5

V 54		61

26. The Standard 10 Mathematics syllabus should be changed to suit rural pupils

MATHEMATICS SYLLABUS	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Don't know	5

V 55		62

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27. Rural communities should be consulted when a relevant Mathematics syllabus is compiled

COMMUNITY CONSULTATION	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Don't know	5

V 56		63

28. Rural people should be represented on all committees dealing with Mathematics curricula

ADULTS AND LESSONS	Code
Strongly agree	1
Agree	2
Disagree	3
Strongly disagree	4
Don't know	5

V 57		64

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UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
DEPARTMENT OF DIDACTICS

THE ROLE OF MATHEMATICS IN DEVELOPING RURAL AND TRIBAL COMMUNITIES IN SOUTH AFRICA

(QUESTIONNAIRE 4 : PARENTS OR GUADIANS OF PRESENT STANDARD 10 MATHEMATICS PUPILS)

Introduction

Maikemišetšo a pampiri ye ya dipotšišo ke go kwa mohola woo dithuto tša Mathematics di nago le wona mabapi le go hlabolla ditšhaba tša dinaga-legae.

O kgopelwa go fa bowena bja gago ka botshephegi ka ntle le go boledi-šana le yo mongwe mabapi le maikutlo a gago.

O kgopelwa go araba ditšišo ka go dira sekele (circle - O) mo go nomoro yeo o kwago e le maleba. Mohlala ke wo:

40. O iphsina ka kgole ya maoto?

BOIPHISINO BJA KGOLE YA MAOTO	CODE
Ke e hloile	1
Ke a e rata	2
Go ya le gore e bapalwa ke mang	③
Ga ke e kwišiši gabotse	4

V 70	3	79

Ge karabo e le '**3**' "(Go ya le gore e bapalwa ke mang)" gona dira sekele (O) go '**3**' ka mo lepokisaneng.

O SEKE WA NGWALA MO DIKAMORANENG, TŠA KA LETSOGONG LA GOJA.
DI ŠOMIŠWA KE "balaodi ba MOŠOMO WO"

Pampiri ye e tla kolekwa ke mongwadi go ba ngwana wa gago wa Standard 10.

Ke leboga tšhomišano le thušo ya gago dinyakišišong tše. Le ka moso.

Wa lena

Mr J.M. Molepo

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A.	RESPONDENT NUMBER
B.	CARD NUMBER

V 1			1-2
V 2	5	3	

1. Ngwala leina la mo o dulago (motse)

V 3			4-5

2. Mošomo wa gago ke ofe?

V 4			6-7

3. O tswalana bjang le morutwanayo a dirang Mathematics ka go Mphato wa Lesome?

TSWALANO GO MORUTWANA	CODE
PAPA	1
MMA	2
MOHLOKOMEDI FELA	3

V 5		8

4. O na le ngwana yo a ithutelago Mathematics mphatong wa Lesome?

BARUTWANA BA MATHEMATICS	CODE
EE	1
AOWA	2
GA KE NA NNETE	3

V 6		9

5. O na le bana ba bakae ba go ithuta Mathematics mo Mphatong wa Lesome?

V 7			10-11

6. Ge karabo ya gago e le "**Ee**" goba "**Aowa**" mo go potšišo ya bone (**4.**) ka mo godimo gona o tsebile bjang ka taba ye?

TSHEDIMOŠO	CODE
KE TSEBIŠITŠWE KE MORUTIŠI/PRINCIPAL	1
KE TSEBIŠIŠWE KE MOLEKANI WAKA	2
KE TSEBIŠITŠWE KE NGWANAKA	3
KE LEMOGILE KA NOŠI	4
GA GO YA MALEBA KA MO GODIMO	5

V 8		12

7. A o rata Mathematics?

HATO YA MATHEMATICS	CODE
EE	1
AOWA	2
GA KE NA NNETE	3

V9		13

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8. A o a itumela ge ngwana wa gago a ithutela Mathematics mo Mphatong wa Lesome?

BOITUMELO KA NGWANA	CODE
EE	1
AOWA	2
GA KE NA NNETE	3

V10		14

9. A o tla hlohleletša bana ba gago ka moka go ithutela Mathematics mo Mphatong wa Lesome le dithuto tša ka godimo?

TLHOTLHELETŠO YA BOTSWADI	CODE
EE	1
AOWA	2
GA KE NA NNETE	3

V11		15

10. Ke lefe la mabaka ao a latelago leo le hlalosago karabo ya gogo mo go nomoro ya **9.**?

LEBAKA LA TLHOTLHELETŠO	EE	AOWA
E TLA SENYA BOPHELO BJA BONA	1	2
BA KA TLA BA NHLAKIŠA GA BONOLO	1	2
BA KA TLA BA BA SETŠHABA SA MOHOLA	1	2
BA TLA HLABOLLA MOTSE WA GEŠO	1	2
BA KA TLA BA HLOKA TLHOMPHO	1	2
BA KA SE HWETŠE MOŠOMO KA PELA	1	2
BA TLA HWETŠA MOŠOMO KA PELA	1	2
BA TLA BA LE BOKAMOSO BJO BO PHADIMAGO	1	2
GA KE NA NNETE	1	2

V 12		16
V 13		17
V 14		18
V 15		19
V 16		20
V 17		21
V 18		22
V 19		23
V 20		24

11. A o tla hlohleletša le bana ba bangwe, le ge e se ba gago, go ithuta Mathemati Mphatong wa lesome le go feta fao ?

HOHLELETŠO GO BANA BA BANGWE	CODE
EE	1
AOWA	2
GA KE NA NNETE	3

V21		25

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12. Ke lefe la mabaka ao a. latelago leo le hlalosago karabo ya gago mo go **11.** ka godimo?

MABAKA A MANGWE	EE	AOWA
BA KA PHALA BANA BAKA	1	2
BA KA HLOKA HLOMPHO BATHONG BA BAGOLO	1	2
BA KA BA LE MOHOLA SETŠHABENG	1	2
BA KA GODIŠA SEEMO SA RENA SA BOPHELO	1	2
BA KA HUMANA MOŠOMO KA PELA	1	2
BA KA BA LE BOTHATA BJA GO HWETŠA MOŠOMO	1	2
KA GOBANE GA KE NA NNETE	1	2

V 22		**26**
V 23		**27**
V 24		**28**
V 25		**29**
V 26		**30**
V 27		**31**
V 28		**32**

13. A naa Mathematics o ka hlabolla setšhaba sa geno?

TLHABOLLO YA SETŠHABA	CODE
EE	1
AOWA	2
GA KE NA NNETE	3

V29		**33**

14. Ge karabo ya gagomo go **13.** ka. godimo e le '**Ee**', Mathematics o ka hlabolla bjang setšhaba se o dulago go sona?

MOKGWA WA GO HLABOLLA	EE	AOWA
KA GO BA LE BONNETE BJA GORE BANA KA MOKA BA ITHUTA MATHEMATICS	1	2
BATHO BA BAGOLO KA MOKA BA ITHUTE THUTO YA MATHEMATICS	1	2
BANA BA THUŠANE LE BATHO BA BAGOLO MO TSEBONG YA BONA YA MATHEMATICS	1	2
TSEBO YA MATHEMATICS E DIRIŠWE MO MOTSENG	1	2
TSEBO YA MATHEMATICS YA SEKOLONG E SEPELELANE GOBA E NYALANE LE YEO E LEGO GONA MO GAE	1	2

V 30		**34**
V 31		**35**
V 32		**36**
V 33		**37**
V 34		**38**

15. Ge gona le ditsela tšeo Mathematics o ka hlabollago setšhaba sa geno, tšeo di sa rotogego go **14.** ka godimo, leka go di ngwala sekgobeng seo se lego ka fase.

1.
2.
3.

V 35			**39-40**
V 36			**41-42**
V 37			**43-44**

16. A batho ba bagolo, ba ka thuša ka tsebo ya bona ya setšo le tiragatšo ya Mathematics mo baneng ba bona?

TSEBO YA MATHEMATICS	CODE
EE	1
AOWA	2
GA KE NA NNETE	3

V 38		**45**

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17. A o ke o sware poledišano le bana ba gago ka Mathematics?

POLEDIŠANO YA MATHEMATICS	CODE
KA MEHLA	1
NAKO YE NNGWE	2
KA GO NNYANE	3
LE GA TEE	4
KE A RATA, EUPŠA GA KE NA NAKO	5
KE A RATA, EUPŠA BANA BAKA GA BA NA KGAHLEGO	6
GA KE NYAKE GO TSENATSENA DILONG TŠA BATHO	7
KE MOŠOMO WAKA GO DIRA SEO	8

V 39		46

18. Ke mang a thomago poledišano?

MATHOMO A POLEDIŠANO	CODE
BANA BAKA	1
NNA KA NOŠI	2
O MONGWE FELA (HLALOSA)	3
GA GONA POLEDIŠANO	4

V 40		47

19. 0 tšea/bona bjang poledišano ye ya Mathematics?

MAIKUTLO MABAPI LE POLEDIŠANO	CODE
E NOLA MOOKO	1
GA E NA MOHOLA	2
E NA LE MOHOLA	3
E A THABIŠA	4
E FA BANA BAKA MAFOLOGOLO	5
E NTSHENYETŠA NAKO	6
GA NKE GO E BA LE POLEDIŠANO	7

V 41		48

20. Batho ba bagolo mo motseng ba ka tšea karolo ya go ruta Mathematics.

MOŠOMO WA BATHO BA BAGOLO	CODE
E DUMELELWA KA MAATLA/KUDU	1
E A DUMELELWA	2
GA E DUMELELWE	3
E TLOGA E SA DUMELELW LE GATEE	4
GA KE NA NNETE	5

V 42		49

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21. Batho ba bagolo go tšwa mo motseng ka nako ye nngwe ba swanetše go mengwa mo dithutong tša Mathematics gore ba tšweletše tsebo ya bona ya setšo le tiragatšo yo bana le barutiši.

BATHO BA BAGOLO LE DITHUTO	CODE
E DUMELELWA KA MAATLA/KUDU	1
E A DUMELELWA	2
GA E DUMELELWE	3
E TLOGA E SA DUMELELWE	4
GA KE NA NNETE	5

V 43		50

22. Lebaka la kgetho ye e dirilwego mo go **21.** ka godimo ke gore tiragatšo ye e tla....

LEBAKA LA GOTŠEA KAROLO	EE	AOWA
DIRA THUTO YA MATHEMATICS YEO E HLAKAHLAKANEGO	1	2
GAKANTŠHA BARUTWANA	1	2
DIRA MATHEMATIC GORE O BE LE BOMENETŠA MO DINAGA MAGAENG	1	2
DIRA GORE BARUTWANA BA KWEŠIŠE MATHEMATICS BOKAO NE	1	2
KAONAFATŠA TSWALANO YA SEKOLO LE LEGAE	1	2
DIRA GORE BATSWADI BA BE LE KGAHLEGO THUTONG	1	2
DIRA GORE GO SE BE LE YE E AMOGELWAGO GO TŠEO DI LEGO KA GODIMO	1	2

V 44		51
V 45		52
V 46		53
V 47		54
V 48		55
V 49		56
V 50		57

23. Mathematics o tla fetola tše dingwe tša ditlwaelo tša rena mo setšhabeng.

PHETOŠO YA DITLWAELO TŠA SETŠHABA	CODE
E DUMELELWA KA MAATLA/KUDU	1
E A DUMELELWA	2
GA E DUMELELWE	3
E TLOGA DI SA DUMELELWA	4
GA KE NA NNETE	5

V 51		58

24. Mathematics wa go ama naga-legae o swanetše gotšwelela bjalo ka thuto ya barutwana ba naga-legae.

MATHEMATICS WA NAGA-LEGAE	CODE
E DUMELELWA KA MAATLA/KUDU (E TLOGA E DUMELELWA)	1
E A DUMELELWA	2
GA E DUMELELWE	3
E TLOGA E SA DUMELELWE	4
GA KE NA NNETE	5

V 52		59

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25. Lenaneo thuto la bjale la Mathematics ga le tšweletše/akaretše setšo sa naga-legae mo metseng ya rena.

SETŠO SA NAGA-LEGAE	CODE
E DUMELELWA KA MAATLA/KUDU	1
E A DUMELELWA	2
GA E DUMELELWE	3
E TLOGA E SA DUMELELWE	4
GA KE NA NNETE	5

V 53		60

26. Lenaneo thuto la Mathematics mo mphatong wa **10.** le swanetše go fetolwa gore le lokele barutwana ba naga-legaeng.

LENANEO-THUTO LA MATHEMATICS	CODE
E DUMELETŠWE KUDU	1
E DUMELETŠWE	2
GA E DUMELELWE	3
E TLOGA E SA DUMELWE	4
GA KE NA NNETE	5

V 54		61

27. Badudi ba naga-legaeng ba swanetše go ba le seabe go lenaneothuto la Mathematics ge le hlophiwa.

POLEDIŠANO LE SETŠHABA	CODE
E DUMELELWA KA MAATLA	1
E A DUMELEWA	2
GA E DUMELELWE	3
E TLOGA E SA DUMELELWE	4
GA KE NA NNETE	5

V 55		62

28. Badudi ba naga-legaeng ba swa.netše go ba le baemedi go dikomiti ka moka tsa go beakanya dithuto tša Mathematics.

DITHUTO LE BATHO BA BAGOLO	CODE
E DUMELELWA KA MAATLA	1
E A DUMELELWA	2
GA E DUMELELWE	3
E TLOGA E SA DUMELELWE	4
GA KE NA NNETE	5

V 56		63

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