AN INTERVENTION PROGRAMME TO IMPROVE THE SELF-CONCEPT AND ATTITUDES OF PROSPECTIVE MATHEMATICS TEACHERS

by

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DECLARATION

I declare that AN INTERVENTION PROGRAMME TO IMPROVE THE SELF-CONCEPT AND ATTITUDES OF PROSPECTIVE TEACHERS is my own work and that all the sources I have used or quoted have been indicated and acknowledged by means of complete reference.

SIGNATURE (HJ Moyana) 08 - 09 - 2000
DATE
DEDICATION

This study is dedicated to my daughter (Vutivi) and my two sons (Nhlahla and Masungulo) who form part of the young generation to take South Africa into the economic challenges of the 21st century.
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KEY TERMS

Mathematics self-concept, Mathematics attitudes, Prospective teachers, Intervention programme, Mathematics anxiety, Cooperative learning, Real life experiences, Mastery learning, Manipulatives, Hands-on activities, Gender stereotypes, Workshops, Word problems, Teaching methods, Relevant curriculum, Classroom atmosphere, Focus group interview.
SUMMARY

This study attempted to design and implement an intervention programme to improve the self-concepts and attitudes of prospective primary school teachers. The possible effects of the programme were researched by means of a combined quantitative and qualitative approach. A questionnaire to determine the effectiveness of the programme was also designed. Important findings of this study are that:

(a) the Cronbach Alpha Coefficient indicated a 0.9 reliability of the designed questionnaire;
(b) the average self-concepts of prospective teachers improved after the intervention programme was implemented, though not significantly and
(c) the self-concepts of prospective teachers not majoring in Mathematics also improved after the intervention, though not significantly.

A focus group interview was conducted to improve the intervention programme. On the basis of the responses of the participants in the focus group interview as well as of the quantitative study and of the literature reviewed, an improved version of the intervention programme was designed. According to the research, the programme should include: cooperative learning; everyday life contexts; manipulatives; hands-on activities, encouraging the asking of questions; a positive relationship between lecturer and student; writing assignments before doing a new topic; content relevance; a positive communication of assessment; games; various approaches to solving problems; understandable language; gender sensitivity and positive role modeling.
The intervention programme implemented in this study was tested over a period of three months; hence the recommendation in this research for the replication thereof over a longer period. The study further recommends that since the study was conducted in one college of education only, there is a need for it to be conducted in a number of colleges, in order to elicit a broader and more representative picture of the impact of the intervention programme.

The findings of this study advocate the need to combine both quantitative and qualitative research in studies: the results of the quantitative research did not conclusively indicate a positive impact of the intervention programme. However, the qualitative research saw respondents expressing improved confidence and attitudes.
CHAPTER 1

THE RESEARCH PROBLEM: STATEMENT AND DEFINITION OF CONCEPTS

1.1 Introduction

Meeting society's needs for a mathematically literate workforce clearly requires more students to choose careers in Mathematics and Science (Hungerfold 1994:16). From the South African Government's support of studies like the one conducted by EduSource (1997), it is clear that the Government is trying its best to build and sustain a political climate sympathetic to mathematical research. For so long, Government concentrated its effort on programmes for in-service teachers. These programmes are, of course, absolutely essential and will continue to be so for some time, but they have no direct effect on future teachers – those now enrolled in Mathematics teacher education programmes (Hungerfold 1994:16). This investment in the present generation of teachers will not have any significant effect if we continue to ignore the generation that is going to dilute the effect and will ultimately replace the present generation.

Accordingly, House (1988:638) points out that education is a partnership in which we cannot develop successful students without also developing successful teachers. Yet the Norms and Standards for Teacher Education, Training and Development (Discussion Document) (1997:13) identifies as one of the weaknesses of teacher education in South Africa the realisation that there is an inadequate, or neglect of, training of teachers in Mathematics and Science, amongst others. Furthermore, Sherman (1992:33) contends that a thorough understanding of and skillfulness with Mathematics is essential to the well-being of our country’s future. However, preparation for success in Mathematics can
only begin in preservice education programmes. Also, Merseth (1993:551) asserts that the major cause of the disappointing performance of students in Mathematics has to do with the preparation of the teaching force. He further reports that if teachers prepare students poorly, it is due in large part to deficiencies in their own training (Merseth 1993:551).

For South Africa to reduce poverty and unemployment, and all their negative side-effects, it must become competitive in the global economy. This can only be attained by an education system that develops a highly skilled labour force for the future economy. In order to inject a competitive edge while at the same time redressing the inequities of the past and improving the general standards of living, a well-educated pool of human resources with knowledge and skills at all levels in Mathematics, Science, Technology, Economics and Communication (in the sense of language skills) is needed. It is a well-documented fact that there is a severe shortage of people in these respects in South Africa at present. Hence the reference made to these areas, particularly to Mathematics and Science as scarce subjects (EduSource 1997:8; The Reconstruction and Development Programme (RDP): A Policy Framework 1994:60). In his message to the International Donor Conference on Human Resource Development in RDP; the previous president, Mr Nelson Mandela pointed out that none of our aspirations to attain and sustain economic growth, global competitiveness and equity as well as RDP ideals can be realised without a skilled workforce (Human Resource Development in the RDP, 1995:v; Galbraith, Richard, Lovie & Merle 1992:569).

We successfully secured a new constitutional dispensation. But Mr Roelf Meyer, the then Minister of Provincial Affairs and Constitutional Development said “A new constitutional dispensation cannot itself guarantee, amongst others, progress towards gender equity, racial equity and economic development. It can, at best, provide the soil where these can take root” (Human Resource Development in the RDP, 1995:67). It is only a generation that is relevantly educated, particularly as regards Mathematics, which can ensure the realisation
of the aspirations enshrined in our constitution, the RDP policy document as well as our macro-economic policy – GEAR. That is why Bishop (1990:359) contends that mathematical illiteracy is both a personal loss and a national debt.

The reconstruction of education and training, however, requires a body of teachers, educators and trainers committed to RDP goals and competent in carrying them out. Black education, in particular, suffered severe shortcomings in the areas of Science and Mathematics, amongst others. This resulted in the development of negative self-concepts and attitudes towards Mathematics. Curriculum development must, therefore, pay special attention to these areas (The Reconstruction and Development Programme: A Policy Framework 1994:65-67).

For South Africans to safeguard our democracy, we need to promote mastery of Mathematics as referred to as “a science, the mother, the queen, the core, a tool of other sciences” (Mura 1993:381 and Georgewill 1990:380). Hungerfold (1994:16) further points out that meeting society's increasing need for a mathematically literate workforce clearly requires more students to choose careers in Mathematics and Science. Economic development in an increasingly technological country like South Africa needs a thorough grounding in Mathematics (Smith & Gessler 1989:33; Bishop 1990:1 and Meece, Wigfield & Eccles 1990:60).

Mathematics has come to be identified as a critical filter to a wide range of trades, occupations and tertiary courses and hence to long term career and occupational opportunities (Strauss 1988:533; Ethington 1990:105; Bosker & Dekkers 1994:179). However, Mathematics should be made a pump rather than a filter in the pipeline of South African education (Bishop 1990:359). Isenberg and Altizer-Tuning (Rech, Hartzell & Stephens 1993:141) further stress the need of a mathematically literate generation when they say technology will play an increasingly important role in society as the twenty-first century approaches. As a
matter of fact, South Africa is not immune to this scenario. Therefore, to be prepared for potential success in the world of today and in the future, knowledge of Mathematics and Science is important. Mr Roelf Meyer advances a sound warning (Human Resource Development in the RDP 1995:67) when he asserts that:

... Development is possible without democracy, but a democracy without development has a limited lifespan.

Forewarned, forearmed! In order for us to provide a comfortable environment for a full-scale development and an eternal lifespan of our democracy, we have to follow in the footsteps of countries like Japan and Korea by strengthening the mathematical background of our society. These countries outperformed the 41 countries that took part in the Third International Mathematics and Science Study (EduSource 1997:1). Bishop (1990:359) also asserts that mathematical literacy is essential as a foundation for democracy in a technological age.

Speaking to Sowetan during an interview, MRC group executive, Dr Anthony Mbewu, said that the main effective method of wealth creation in the modern world is through Science and Technology (Sowetan, Tuesday 29 July 1997). Furthermore, “Mathematics, Science and Technology have a distinct bearing on overall economic growth. In every country, Science, Technology and Engineering are the fields that make the population innovative and the country competitive. It is the technological fluency of its human resource that gives a country the strength to develop the economy” (Sunday Times, July 20 1997). This further supports Bishop’s (1990:359) prior contention that quality Mathematics education for all students is essential for a healthy economy. Mathematics is no longer only meant for aspiring doctors, but for any one who wants to improve his/her competitive edge and prepare himself/herself for a career in Science and Technology-driven fields (Sunday Times, July 20 1997). To stress the importance of Mathematics, Sunday Times further asserts that even boilermakers and bricklayers need Mathematics (Sunday Times, July 20 1997).
Despite the importance of Mathematics, a profession in Mathematics or the Science-based sectors is commonly viewed as an area, not for the masses, but for an intellectually gifted elite (House 1988:634; Merseth 1993:349). Affective factors as well as lack of achievement (performance) of both educators and learners in Mathematics militate against the realisation of the envisaged technology-driven, mathematical society in South Africa.

The blame for the inadequacies lies with our schooling – there is a lack of good Mathematics and Science teaching in South Africa. Dr Sylvia Weir attributes this poor teaching to poorly qualified teachers whose students do badly in matric. Subsequently, these students become poorly qualified teachers (Sunday Times, July 20 1997). This results in a vicious cycle of mediocrity (Sunday Times, July 20 1997). The cycle yields a generally mediocre workforce in all sectors in the country, which further results in mediocre output, including goods and services.

The quality of Mathematics and Science teaching at colleges of education vary considerably across institutions. EduSource (1997:70) found that Mathematics and Science receive a 'stepchild' treatment in the curriculum as a result of "Bantu Education" which diminished their relative importance in the understanding of pupils and teachers alike and also helped to mystify these subjects.

More girls than boys wrote matric in each province in 1996, but proportionately fewer girls than boys passed (Sunday Times, June 29 1997). It is further reported in this newspaper that "... matric results for 1993 divided into gender and race, show that white girls and boys had more or less the same pass rate of close to 100 percent". More white girls than boys passed with exemption, but only 26 in 100 black girls passed. This alarming scenario is a self-fulfilling prophecy of the famous statement underlying Bantu Education by Dr H.F. Verwoerd when he said:
The school must equip the Bantu to meet the demands which the economic life of South Africa will impose on him. There is no place for him in the European community above the level of certain forms of labour. Within his own community, however, all doors are open. Until now he has been subject to a school system which drew him away from his own community land and misled him by showing him the green pastures of European society in which he is not allowed to graze. What is the use of subjecting a Native child to a curriculum which in the first instance is traditionally European? What is the use of teaching the Bantu child Mathematics when he cannot use it in practice? That is absurd. Education must train and teach people in accordance with their opportunities in life. It is, therefore, necessary that native education should be controlled in such a way that it should be in accordance with the policy of the state (Liebenberg & Spies 1993:326).

True enough in the statement is the idea that "... education must train and teach people in accordance with their opportunities in life. It is, therefore, necessary that native education should be controlled in such a way that it should be in accordance with the policy of the state." The Reconstruction and Development Programme: A Policy Framework (1994:61) identified, *inter alia* the following as the underlying principles of education and training:

(a) We must develop an integrated system of education and training that provides equal opportunities to all irrespective of race, colour, sex, class, language, age, religion, geographical location, political or other opinion. It must address the development of knowledge and skills that can be used to produce high-quality goods and services in such a way as to enable us to develop our cultures, our society and our economy.

(b) Education must be directed to the full development of the individual and community, and to strengthening respect for human rights and fundamental freedoms. It must promote understanding, tolerance and friendship among all South Africans and must advance the principles contained in the Bill of Rights.
(c) A new national human resources development strategy must be based on the principles of democracy, non-racism, non-sexism, equity and redress the pitfalls of the past.

(d) Girls and women in education and training: Girls and women are frequently denied education and training opportunities because they are female.

Furthermore, girls and women are educated and trained to fulfil traditional roles, which perpetuate their oppression. Within all education and training programmes, special attention must be given to the special interests of girls and women ... Girls and women should be encouraged to pursue non-traditional subjects such as Mathematics and Science, for example.

Documented by research is the point that, unlike other African countries, South African girls and boys have equal access to schooling (EduSource 1997:19; Sunday Times, June 29 1997). EduSource (1997:19) further indicates that contrary to the trend in the developing world, there tends to be fewer boys than girls enrolled at the secondary school level, which applies to all provinces. On average, 54% of the enrolment is female. This does not necessarily imply that girls aspire to close the existing gender gap in education, particularly in traditionally male-dominated areas like Mathematics and Science. Some researchers like Dr Hofmeyr, a policy advisor on education and training to the NBI (National Business Initiative) suggested that this is merely attributed to the link between lobola value and education whereby higher educated girls are worth more in the "marriage market" in rural black areas (EduSource 1997:19; Sunday Times, June 29 1997). From this assertion, it becomes clear that girls may not be driven by a yearning to leave a mark in the dawning technology-driven 21st century, but to enhance their marketability in the 'marriage market'.
All the above are consequences of the social engineering designed to socialise the black sector of our society in line with Bantu Education policies. Realising that the key socialising state apparatus is the school and the teacher, the state between 1954 and 1965, made a typical black school environment unworkable. "While the number of African children at school doubled between 1954 and 1965, there was no corresponding increase in government spending. During the same period the expenditure in real terms on each African pupil dropped from R8.70 to R4.90. Significantly, the per capita expenditure on white pupils rose from approximately R50 to R75 during the same period" (Liebenberg & Spies 1993:327).

This resulted in poorly resourced black schools. This led to poorly equipped students who proceeded to follow poorly designed teacher education programmes and to come back to schools and offer poor lessons themselves. From here the cycle simply replicated itself viciously. This is so, because many studies found that school experiences dictate the teaching behaviour of those who end up pursuing teaching as a profession. It is further documented that teacher beliefs, like their self-concepts and attitudes in relation to Mathematics, direct their behaviour in teaching Mathematics (Mura 1993:375; Plucker 1996:739; Relich 1996:186; Nicol 1997:86; Ulia 1997:161). It is also reported that these affective factors do not merely determine the teachers' course of action in Mathematics classes, but they are also modeled and transferred to students (Herrington, Pence & Cockcroft 1992:7). Wiest (1999:265) further contends that intended or not, teachers' actions exemplify to learners ways of doing things. The students further undergo teacher education programmes and return to schools to perpetuate a continuum in this vicious cycle of mediocre, affectively underprepared teachers.

As Hungerfold (1994:15) put it:

We have met the enemy and he is us
- Pogo Possum
The enemy is us teachers.

To break this vicious cycle, we have to produce a new generation of teachers. Teachers whose training/education not only focuses on content and methodology. By concentrating on content and methodology, teacher education programmes seem to have been magnifying the wrong enemy. We seem to have put to the background the development of positive affective feelings and self-concepts in teachers. It is the researcher's view that teachers who are well-grounded in content and methodology who also have positive self-concepts and attitudes towards Mathematics, are those teachers who received a well-balanced education diet.

This study is, therefore, intended to establish the effect of an intervention programme to improve some of the affective and other factors of prospective Mathematics teachers, namely their attitudes towards Mathematics, as well as their Mathematics self-concepts. In a previous study (Moyana 1996:106) these factors were identified as most important.

1.2 Analysis of the problem

1.2.1 Awareness of the problem

Weaknesses in teacher education identified by the Technical Committee on the Revision of Norms and Standards for Teacher Education are amongst others:

(a) inadequate, or the neglect of training of teachers in Mathematics, Science and Technology, and in specialised education;
(b) the curriculum in most colleges is dominated by old-fashioned concepts, inappropriate philosophies, methodologies and modes of assessment, negative institutional cultures, lack of professionalism, limited subject knowledge and ..., disjunction between theory and practice, and

(c) no clear links between pre-service teacher education (PRESET) and in-service teacher education (INSET) (CEPD, 1995:83) (Norms and Standards for Teacher Education, Training and Development (Discussion Document), 1997:13).

The Mathematics programmes in both schools and colleges of education are still guided by traditional philosophical underpinnings where the ‘talk and chalk’ method of teaching in Mathematics (Boling 1991:384), rote learning and memorisation of mathematical procedures and algorithms still fall far short of attaining the outcomes purported by Outcome-Based-Education (OBE) such as affective outcomes. Furthermore, Spungin (1996:73) cites the overemphasis on rote memorisation of facts and procedures rather than on underlying understanding as one reason for the past failure of many students in Mathematics. Yet we are in the midst of multiple calls for educational change. Reformers demand that teaching focuses on understanding ideas, not on memorising facts (Government Notice No 82, Department of Education, 4 February 2000, National Education Policy Act; Norms and Standards for Educators 1996:22). Students should master skills so that their self-concepts and attitudes towards Mathematics will improve (Wilson, Peterson, Ball & Cohen 1996:468). Most importantly, reformers want these experiences for all students, not only for the intellectual elite, as reported by Merseth (1993:549) to be the prevailing belief.

Part of the success of reform in Mathematics education rests on the effectiveness of pre-service teacher education programmes to improve the self-concepts and attitudes of beginner teachers, and to create lasting belief
structures that will guide teaching practices (Frykholm 1996:666). Frykholm (1996:666) further indicates that belief structures influence thinking, which then influences actions in the classroom.

Thus, if Mathematics teachers are the principal actors in the drama of Mathematics education, (Ernest (b) 1989:22), there is a need to give them proper affective mathematical grounding. Moyana (1996:106) established in his study that one variable contributed significantly towards the variance in achievement in Mathematics, namely student variables, which included students' self-concept and students' attitudes in relation to Mathematics. Fifty-seven percent of the variance in Mathematics achievement was found to be caused by this variable (Moyana 1996:106). Stepwise Regression Analysis for Correlation with achievement in Mathematics indicated that, of all student variables, students' self-concepts contributed most towards achievement in Mathematics.

Some studies (Maqsud 1991:377) put on record that in general, students have negative attitudes towards Mathematics and they are of the opinion that Mathematics is a subject to be avoided. This is supported by the researcher's observation as a lecturer, where a pre-service teacher wrote on one of the pages of his Mathematics prescribed book:

As for me and my children we shall hate Mathematics forever and ever.

Furthermore, of the first-year student teachers admitted each year at the college to which the researcher is attached, only a few opt for Mathematics as a major subject, as illustrated in table 1.
TABLE 1

Total number of students enrolled at Shingwedzi College of Education and the number of Mathematics students for the years 1995, 1997, and 1998

<table>
<thead>
<tr>
<th></th>
<th>1995</th>
<th></th>
<th>1997</th>
<th></th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>186</td>
<td>Total</td>
<td>266</td>
<td>Total</td>
<td>232</td>
</tr>
<tr>
<td>enrol-</td>
<td>Number of Mathematics students</td>
<td>enrol-</td>
<td>Number of Mathematics students</td>
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<td>Number of Mathematics students</td>
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<tr>
<td>48</td>
<td>61</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As depicted in table 1, the vast majority of students entering the teacher education institution in question avoids Mathematics and pursue the general stream. This leaves a negligible number who pursue Mathematics, namely, 48 out of 186 (25.8%) in 1995, 61 out of 266 (23.9%) in 1997 and 29 out of 232 students (12.5%) in 1998.

Rearranging the data on the basis of gender yields a disturbing picture indicating a further underrepresentation of females.
TABLE 2

Number of male and female students enrolled for Mathematics at Shingwedzi College of Education for the years 1995, 1997 and 1998

<table>
<thead>
<tr>
<th></th>
<th>1995</th>
<th></th>
<th>1997</th>
<th></th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of males</td>
<td>32</td>
<td>Number of males</td>
<td>31</td>
<td>Number of males</td>
<td>30</td>
</tr>
<tr>
<td>Number of females</td>
<td>16</td>
<td>Number of females</td>
<td>30</td>
<td>Number of females</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

This results in a majority of males in Mathematics education. This is despite the fact that teaching is a female-dominated profession. EduSource (1997:8) attributes this to poor teaching in the schools which could lead to negative self-concepts in and attitudes towards Mathematics. This tends to limit the number of students who study Mathematics and Science at matric level, so that the number of students who might wish to undergo teacher training is drawn from a small pool. This again results in the relaxation of admission requirements where the quality of the knowledge and skills that these students bring to colleges of education are sacrificed.

These poor Mathematics enrolments as depicted in tables 1 and 2 do not come as a surprise since they have their foundation on the matric pass rates illustrated in part by table 3.
TABLE 3

Overall standard 10 Mathematics results for the years 1994, 1995 and 1997 in Malamulele West, East and Central, Northern Province

<table>
<thead>
<tr>
<th>Year</th>
<th>Number wrote</th>
<th>Number Pass</th>
<th>Number Fail</th>
<th>% Pass</th>
<th>% Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>572</td>
<td>121</td>
<td>451</td>
<td>21.2</td>
<td>78.8</td>
</tr>
<tr>
<td>1995</td>
<td>763</td>
<td>208</td>
<td>555</td>
<td>27.3</td>
<td>72.2</td>
</tr>
<tr>
<td>1997</td>
<td>1351</td>
<td>268</td>
<td>1083</td>
<td>19.8</td>
<td>80.2</td>
</tr>
</tbody>
</table>

The consequences of the high failure rate manifest themselves in the provision of a limited pool from which teacher education institutions derive their students. The number of students who wrote standard 10 Mathematics confirm EduSource's (1997:12) finding in their research that there is a very high pupil attrition rate at the standard 10 level in Mathematics and Science higher than in most other subjects. The picture drawn by table 3 is reported to be even worse at national level. EduSource (1997:18) asserts this when they indicate that despite the historically low enrolments in Mathematics and Science, the proportion of standard 10 learners (students) taking these subjects is decreasing.

With the teacher being a key player in improving education in general, and Mathematics education in particular, rather than either methods or curriculum (Mullis 1991:212; Austin, Wadlington & Bitner 1992:391), a microscopic look at self-defeating Mathematics beliefs associated with them is warranted. Many studies document a strong relation between affective variables such as attitudes towards Mathematics and/or Mathematics self-concepts with performance in Mathematics (Rzoska & Ward 1991:17). Many studies report Mathematics self-

As principal actors in the drama of Mathematics education (Ernest (b) 1989:22), teachers are found to be the sources of either favourable or unfavourable affective feelings. They communicate their emotional feelings through the way they teach as well as their interaction with learners as Nicol (1997:86), Van Voorhis and Anglin (1994:408) as well as Carter and Norwood (1997:62) report. According to them one's view of what Mathematics is affects one's presentation of it. This is in line with Emenaker's (1996:75) literature study where he established that teaching actions are directly influenced by teachers' beliefs, and in turn those teacher actions have a tremendous impact on students' belief systems.

Some of the emotional feelings that students bring to the system are portrayed by some of the students' essays in Cherkas' (1992:84) study:

Nothing seems to make sense when it comes to Math. I don't know if it is because that no matter how much I struggle I barely make it. That's the reason why I hate hate and hate so much. Why I am then in it? I was compelled by my major to take it! .... I am not much of a Mathematics fan. I don't know why it was ever discovered but if I were to see the person who did invent this type of mechanical theory, I'd choke them. Mathematics is one of my worst classes, not only because it seems too mechanical or non-sensible, but because I feel it deals with too much memorizing....I have always felt insecure about learning it .... (sic)
It is the researcher's view that these feelings are shared by our student teachers in General Mathematics and Mathematics Didactics as well.

EduSource (1997:3) projected that for the seven provinces that were considered for the years 1998, 1999 and 2000, there will be an annual deficit of approximately 3000 Mathematics teachers. This demand is further aggravated by the 15% attrition rate of Mathematics teachers reported by EduSource (1997:3).

Given the background above, there will be a need for the teachers who left Mathematics at about Standard 8 (Grade 10) only to be forced by the requirements of their teachers' courses to teach Mathematics. These student teachers already hold negative attitudes and self-concepts that can be communicated to learners by the time they start teaching. This will in turn influence learners' own self-concepts and attitudes, which will perpetuate the cycle, because these learners will also take their negative affective feelings to teacher education institutions and bring them to the schools where they will ultimately teach.

This study is, therefore, intended to contribute in postively influencing Mathematics self-concepts and attitudes as suggested by Hofmeyr and Hall (1996). The study will attempt to explore the impact an intervention programme may have on improving the self-concepts and attitudes of preservice teachers. On the basis of sampled participants' recommendations, the study will also try to provide an improved version of the intervention programme, if necessary.

1.2.2 Examination of the problem

The problem under consideration in this study comes to light in many forms, amongst others:

(a) the poor Mathematics self-concepts of Mathematics teachers and learners;
(b) the negative mathematical attitudes of Mathematics teachers and learners;
(c) the poor general performance in Mathematics;
(d) the underrepresentation of female teachers in Mathematics education and Mathematics-related fields;
(e) the general avoidance of Mathematics by both teachers and learners; and
(f) Mathematics anxiety, which is an irrational fear of Mathematics (Nimer Fayez 1990:319).

However, the main focus of this study will be on the improvement of the self-concept and the attitudes of prospective Mathematics teachers.

To show how unfavourable attitudes towards Mathematics can adversely impact on the liking and enjoyment of other subjects, Young and Kellog (1993:288) quote some math phobic student saying:

The more you like something, the easier it is to learn about it ...My biggest weakness in science is with numbers and equations. I am not a very mathematical person, and I really have a struggle when it comes to numbers.

Wong (1992:33) reports a consistent, negative relationship between Mathematics anxiety and performance. He further contends that of many variables: self-concept, attitudes towards Mathematics and Mathematics achievement were significantly but negatively related to Mathematics anxiety (Wong 1992:36-37).

EduSource (1997:20) demonstrates the South African picture when it reports that Mathematics teaching is a male-dominated preserve in a predominantly female profession. Dickens and Cornell (1993:53) attribute this underrepresentation to the assertion that many adolescent girls with high academic ability have poor Mathematics self-concepts. Academically capable girls who do well in Mathematics but nevertheless often lack self-confidence in their abilities, tend to attribute their success to effort rather than ability, and have negative expectations...
for their future success. This might be one of the reasons for the underrepresentation of females in teacher education Mathematics major classes (EduSource 1997:19). Holden (1987:661) suggests that sex differences in Mathematics performance stem from affective differences rather than from cognitive deficiency.

Garofalo (1989:502) also points out that the emotions (e.g. anxiety, frustration, enjoyment) one feels while working on a mathematical task, and the beliefs one holds towards performance on mathematical tasks, influence the direction and outcome of one's performance. Thus, if preservice teachers enter teacher education institutions with negative attitudes towards Mathematics, they are likely to perform poorly or even avoid Mathematics classes. Not only that, eventually, these feelings can be transferred to their learners (Herrington, Pence & Cockcroft 1992:7, Van Voorhis & Anglin 1994:408; Ulla 1997:161).

Education is always a key to social change (Curriculum 2005 1997:2). This is shown by South Africa's shift to an Outcomes-Based-Education system. The values and attitudes of most South Africans, like these for Mathematics, were formed in the old, divided South Africa. Education, mathematical in this context of study, is the key to changing many of the commonly held values and beliefs (Curriculum 2005 1997:16). For instance, Maqsud (1991:377), in a study conducted in Bophuthatswana (which is part of the North-West Province, RSA) established that Mathematics phobia (anxiety) is strengthened by teachers who stress their own difficulties in doing mathematical tasks. This provides support for the notion that teachers' affective feelings need to be developed to promote a Mathematics learning atmosphere, which do not communicate negative affection for Mathematics. If this is not done, students' anxiety, lack of confidence in learning Mathematics, negative self-concepts and attitudes towards Mathematics may cause cognitive blockages while students attempt to solve mathematical problems (Maqsud 1991:379).
Fennema, Peterson, Carpenter and Lybinski (1990:56) indicate that these affective feelings are transmitted through teachers' instructional decisions. Frykholm (1996:666) quotes Thompson who states that teachers' views, beliefs, and preferences about Mathematics do influence their instructional practice. He further reports Grant's findings that teachers' beliefs are generally congruent with classroom practices (Herrington, et al 1992:7; McDevitt, Heikkinen & Alcorn 1993:594; Frykholm 1996:666; Kleinsasser & Foss 1996:430; Ludlow & Bell 1996:864; Ulla 1997:161). There is consequently a need for teacher educators to model (not just preach) instructional strategies and behaviours that will create a favourable climate for Mathematics teaching and learning. As Ernest (1991:64) stresses the Lakatos paraphrasing Kant thus:

... theory without practice is empty, but practice without theory is blind.

Thus, if we really need quality in Mathematics teaching and teacher education, as we do, then we must ensure that our theory on these areas is neither empty nor blind.

Ernest (1991:62) continues to assert that teachers' beliefs are as much a function of the incidental and hidden curriculum of teacher education as they are of the planned curriculum. This implies that deliberate actions need to be inculcated in preservice teachers to have their hidden curriculum enhance favourable emotional feelings that they in turn can transfer to their learners.

Sayers (1994:389) indicates that attitudes play a much more significant role in the outcomes of student learning. He reports that attitudes are found to become less positive with age, more markedly for girls than for boys. He also asserts that girls do better in the topics that are perceived by the teacher as important, and suggests the possibility that girls may disadvantage themselves by trying to please the teacher.
Carter and Norwood (1997:62) imply the role of teachers in shaping pupils’ affective feelings when they point out that teachers’ beliefs shape the way in which they teach Mathematics. Hence the need to inculcate positive Mathematics teachers’ attitudes and self-concepts as well as beliefs to ensure that the influence work for instead of against Mathematics education. Schuck (1996:119) stresses the need for teacher education programmes that enhance positive affective feelings when he states:

Prospective primary school teachers enter their Mathematics education subject sequences in their teacher education programs with a number of chains fettering them to the past …. Some of these beliefs act as chains, which could impede reform in the teaching of Mathematics.

Roulet (1996:88) supports Schuck’s (1996:119) notion indicating that teachers’ beliefs and values, the body of ideas which they hold about education, teaching, schooling in particular and life in general influence their teaching styles. These beliefs and values are obtained from past schooling experiences such as in Mathematics.

According to Smith (1991:52), the dawning Outcomes Based-Education (OBE) in South Africa needs attitudes and climates favourable to students. Thus, reforming teacher education to instil these favourable attitudes and climates in prospective teachers is important. According to Hofmeyr and Hall (1996:1):

Quality teacher education is not only important for economic progress, it is a basic teacher and learner entitlement. Teachers-in-training have the right to an education which increases their understanding of the subject they are to teach and gives them the competence to teach. Learners are entitled to an education which empowers, which allows them to pass a school-leaving examination, and which prepares them adequately for life and work.
This study attempts to test the impact of an intervention programme on improving student teachers' Mathematics self-concepts and their attitudes towards Mathematics. An improved version of the intervention programme will be developed if necessary, on the basis of students' recommendations elicited through a focus group interview. In line with the principles above, this will provide a fair chance to all student teachers to improve their confidence in and attitudes towards Mathematics. It is intended to reduce, if not eliminate, barriers (i.e. unfavourable affective feelings) which either stop or impede certain groups of student teachers from participating in formal education, particularly in Mathematics education (Hofmeyr & Hall 1996:2).

1.3 Problem statement

This study will develop and test an intervention programme from literature review studies to improve teachers' attitudes and self-concepts towards Mathematics. An instrument (questionnaire) to test the effectiveness of the programme will also be developed. If necessary, the intervention programme will be improved. Thus, the general research problem is as follows:

*How can an intervention programme be designed to improve the self-concepts and attitudes of prospective Mathematics teachers?*
1.4 Aims of the study

1.4.1 Specific aims

This study attempts to:

(a) design an intervention programme (which will be identified by means of a literature study and adapted to local needs) for the improvement of self-concepts and attitudes of prospective primary school teachers;

(b) design an instrument to test the programme (in the form of a questionnaire);

(c) implement the programme referred to in (a) for a period of 3 months and to make observations on its effects;

(d) test the effect of the programme statistically and

(e) conduct a focus group interview to evaluate and possibly improve the programme.

Thus, a combined quantitative, qualitative approach will be followed. The research will, by doing so, attempt to reply to the research problem as stated in 1.3.

1.4.2 General aims

To the researcher’s knowledge, hardly any study has been conducted in the South African context in general, and in the Northern Province in particular, on intervention programmes to improve the self-concepts and attitudes of prospective Mathematics teachers. Generally, this study intends to shed light on the improvement of Mathematics teacher education in our country.
The findings will form the basis on which Mathematics teacher education and Mathematics education in general can be improved. Also, according to Stevens and Wenner (1996:2), the development of teacher education programmes to improve the education of elementary school teachers, require an empirical base on which to anchor meaningful change. This research makes such an effort. Most importantly, this study will contribute towards the realisation of the vision aspired to by our education policies, the RDP as well as the GEAR, i.e. a numerate workforce to lead our country into the economic battles of the 21st century.

It is hoped that the specific and general aims will be achieved by means of two methods: A literature survey and an empirical investigation, which includes implementing an intervention programme and evaluating it by means of a questionnaire and a focus group interview. Thus, a quantitative as well as a qualitative approach will be followed.

1.5 Demarcation of the field of study

The following will be studied as part of the research:

(a) Mathematics self-concepts and how they are developed and may be improved; and

(b) attitudes towards Mathematics and how these may be improved.
1.6 Definition of concepts

1.6.1 Intervention programme

The word *intervention* is formed from the verb *intervene* which means to become involved in a situation, especially so as to prevent something happening or being done (Oxford Advanced Learners' Dictionary of Current English: Fifth Edition (1994). The Oxford Advanced Learners' Dictionary of Current English defines the word *programme* as a plan of future events, activities, etc. Therefore, *intervention programme* in the context of this study means a plan of activities for use in teacher education so as to alleviate negative affective feelings such as negative self-concepts and attitudes of preservice Mathematics teachers.

1.6.2 Self-concept

According to Shavelson, Hubner and Stanton, general self-concept may be divided into two components: academic self-concept and non-academic self-concept. Academic self-concept has further been divided into subject matter areas. Non-academic self-concept is divided into social and physical self-concepts (Wong 1992:33). Wong (1992:33) further indicates that academic self-concept refers to how one indicates to oneself your ability to achieve in academic tasks as compared with others engaged in the same task. Naude and Bodibe (1990:26) point out that the individual's attitudes towards the self determine the way in which he/she will evaluate him- or herself. This self-evaluation is called self-esteem and is defined as the evaluative sector of the self-concept. Multifaceted as the self-concept is, the construct is composed of many different dimensions, the most important of which are:

- the body image,
- the social image, and
- the cognitive self (Naude & Bodibe 1990:26).
In line with Bester (1988:165) Gerdes, Moore, Ochse and van Ede (1989:77) assert that when a Mathematics student evaluates himself or herself, there are three factors that influence his or her self-concept, namely:

(a) whether he/she views himself or herself as a success or a failure;

(b) the ideal self that he/she holds of him/herself, and

(c) how others evaluate him/her and how his/her own evaluation agrees with the evaluation of the important others.

Townsend, Moore, Tuck and Wilton (1998:2) define Mathematics self-concept as a person’s perception of his/her ability to learn new topics in Mathematics and to perform well in Mathematics classes and tests.

Thus, the self-concept in this study refers to a subject specific self-concept, which is a dimension of cognitive, intellectual or academic self-concept. It is the person’s perception of self in relation to Mathematics formed through experiences with the environment and influenced by environmental reinforcements and the reinforcements of “significant others” like teachers and teacher educators (Relich 1996:180).

1.6.3 Attitudes

Ernest (a) (1989:24) identifies attitudes to Mathematics, and attitudes to teaching Mathematics as key attitude components. Ernest (a) (1989:24) further indicates that the teacher’s attitudes to Mathematics include liking, enjoyment and interest in Mathematics, or their opposites, which in the extreme can include mathphobia (or Mathematics anxiety). There is also the teacher’s confidence in his or her own mathematical abilities and the teacher’s valuing of Mathematics (Ernest (a) 1989:24). Furthermore, Ernest (a) (1989:24) thus describes the teacher’s
attitudes to the teaching of Mathematics to include *liking*, *enjoyment* and *enthusiasm* for the teaching of Mathematics and confidence in the teacher's own Mathematics teaching ability (or their opposites) (Ernest (a) 1989:25).

Norwich and Rovoli (1993:309) define attitude as "... the outcome of a person's beliefs about the outcomes of the behaviour and his or her evaluations of those outcomes...". Quinn (1998:2) defines attitude towards Mathematics as the level of like or dislike felt by an individual towards Mathematics. In accordance, Allport states (Van den Aardweg & Van den Aardweg 1988:26; Maqsud & Khalique 1991:386), "An attitude is a mental or neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related". Moyana (1996:34) also contends that an attitude prepares people for action, is acquired from experience and exerts a motivating force on behaviour.

Tocci and Engelhard (1991:280) report that the attitudes of the students are developed by direct experiences with the attitude object and by interaction with relevant others like teachers. They also indicate that interactions with other persons provide individuals with information in the form of attitudes, beliefs, and behaviour of important others, that become a guide for the development of their own attitude. This further stresses how significant others like teachers can help to shape pupils' attitudes (Moyana 1996:34-35).

Finally, this study adopts Ernest's (a) (1989:24) definition that teachers' attitudes have two components, i.e. attitude to Mathematics in general and attitude to teaching Mathematics.

1.6.4 Prospective Mathematics teachers

The Northern Province Department of Education Provincial Policy on Teacher Supply, Utilisation and Development: A Stakeholder Response (1996:7) and
Hofmeyr and Hall (1996:92) describe preservice teacher (prospective teacher) education (PRESET) as the initial education (training) given to student educators before they practise as educators. Hofmeyr and Hall (1996:1) also refers to prospective (preservice) teachers as teachers-in-training. Thus, this study defines prospective Mathematics teachers as preservice primary (student) educators or (teachers-in-training) undergoing the initial education (training) given to learners aspiring to teach Mathematics once they have completed the course requirements.

In this study, the focus will be on teachers who are being prepared to teach learners who are in the range 6 to 11 years of age. This is the age at which the child is at stage 4 of childhood, according to Erikson (Naudé & Bodibe 1990:24). The crises peculiar to this age group mainly arise from the conflict of industry versus inferiority. The lesson that children learn during this stage is "the pleasure of work completion by steady attention and persevering diligence" (Naudé & Bodibe 1990:24), from which develops a sense of industry. If the child successfully develops competencies and skills (mathematical, in this case), he is praised and feels good. If he fails and is criticised for it, he feels inferior and inadequate. At this stage the significant others, like teachers, are very important for the successful resolution of this crisis. If the child's sense of industry outweighs his sense of inferiority, he will leave this stage with the virtue of competence and a high self-esteem (which is a facet of positive self-concept) (Naudé & Bodibe 1990:24).

Unfortunately, it is not easy for many practising teachers to recognise and reward mathematical success. Many also do not know how to react to failure, without intensifying a feeling of inferiority in the child. This points to the need to prepare a new generation of Mathematics teachers who are sensitive to the learner's self-concept and attitude in Mathematics.
1.7 Programme of study

This thesis is presented as follows:

In chapter two, the literature review on the Mathematics self-concept and the improvement thereof will be provided.

Chapter three gives a review of the literature on attitude towards Mathematics and the improvement thereof.

Chapter four presents aspects needed to be included in a programme to improve self-concepts and attitudes towards Mathematics. In the summary, one programme to be used in the empirical investigation is developed.

In chapter five, the research design is described.

In chapter six, results and a discussion of the results are presented.

Conclusions and recommendations are made in chapter seven.
CHAPTER 2

MATHEMATICS SELF-CONCEPT AND THE IMPROVEMENT THEREOF

2.1 Introduction

Some of the factors that have commanded a plethora of relational research findings include a cognitive factor like Mathematics self-concept, amongst others. Despite the innumerable research documented on this variable, not much has been done on studies testing intervention strategies to improve learners' Mathematics self-concept. Hence the need for such a study.

Consequently, Mathematics self-concept and the improvement thereof are discussed in this chapter.

Though many studies have been conducted on Mathematics self-concept, only a few researchers looked into the improvement of this aspect of the self-concept. The vast majority of literature reviewed by the researcher was on the effect of self-concept on Mathematics achievement. Relich (1996:180) reports that there aren't any studies which specifically target the self-concept of teachers, particularly the Mathematics self-concept of the teachers. Therefore, findings of studies conducted on elementary and secondary school learners will be seen as applicable, and hence as a basis for a study to explore and improve the Mathematics self-concepts of teachers.

Hackett and Betz (1989:261) found a moderate correlation between Mathematics performance and Mathematics self-concept. This may imply that the teaching profession may lose many able would-be Mathematics teachers, who, due to
poor Mathematics self-concepts, opt for other majors in standard 10, as well as at teacher education institutions. Thus, the success of the planned intervention programme may form a basis on which the misplaced prospective teachers could be redirected to where they are needed, i.e. into the understaffed Mathematics education sector.

2.2 The relationship between the Mathematics self-concept of teachers and the Mathematics self-concept of students

The need for a study of this nature is indisputable given Midgley, Feldlaufer and Eccles' (1989:256) as well as Chen, Clark and Schaffers' (1988:116) assertions that teachers who do not feel confident about their knowledge of Mathematics content are likely to communicate low expectations to their learners. They further maintain that teachers who have confidence in themselves as Mathematics teachers are effective. It is only teachers with positive Mathematics self-concepts regarding their knowledge of the subject and their ability to use appropriate teaching methods who have confidence in teaching Mathematics.

Midgley et al (1993:251) and Hopf and Hatzichristou (1999:2) assert that students whose teachers feel less efficient, lower their expectancies and perceptions of their performance and raise their perceptions of the difficulty of Mathematics, in comparison with students whose teachers feel more efficient. They proceed to report that a high teacher sense of efficacy is significantly related to the maintenance of a warm, accepting classroom climate (Midgley et al 1993:255). They further suggest that teachers who do not feel efficient may especially be likely to communicate low expectations to low-achieving students. It may also be the case that teachers who feel efficient are especially likely to communicate high expectations to low-achieving students (Midgley et al
1993:256). This may enhance achievement as a self-fulfilling prophecy and consequently develop positive Mathematics self-concepts.

Midgley et al (1993:256) also say:

... changes in the classroom environment in this case changes in teacher efficacy beliefs, from elementary to junior high school are related to changes in student beliefs about their performance and potential and about the difficulty of the subject matter, at least in the Mathematics domain. Students who move into classrooms taught by teachers with a low sense of efficacy do show the commonly reported developmental decline in self and task beliefs after the transition to junior high school. In contrast, students who move into classrooms taught by teachers with a high sense of efficacy show either less negative change or some positive change.

It is only a teacher education system that caters for the development of positive self-concepts which can provide a climate for the development of confident, numerate citizens as purported by Curriculum 2005 (1997:21) and OBE (Outcomes Based Education). Considering Bracey's (1991:86) attribution of Japan's leading Mathematics achievement to better-educated teachers, we also need to improve our Mathematics teacher education for the better. Raising the self-concepts of teachers, particularly novice teachers, would therefore seem a desirable goal. After all, if they are going to impart knowledge it would seem advantageous to regard their knowledge highly (Relich 1996:181). A possible reason for poor performance at school, the high Mathematics attrition rate at high school, students' Mathematics anxiety, negative attitudes towards Mathematics and poor self-concept may be the fact that we are producing teachers who lack confidence in their own abilities as problem solvers and as mathematicians. This is communicated to learners of Mathematics through teacher behaviour, which ends up in a vicious cycle, since some of these learners end up as teachers who lack confidence themselves. Also, Relich
(1996:187) reports that without exception the low self-concept teachers describe themselves as traditional in their approach. 'Chalk-talk' was mentioned on several occasions as well as a strict adherence to the textbook (Ethington 1990:106). If this is allowed to carry on for long, co-operative learning, deviating from what is in the textbook, and the use of context-based real life problems in Mathematics teaching as suggested by Curriculum 2005, will remain a myth.

2.3 The relationship between achievement in Mathematics and Mathematics self-concept

Valas and Søvik (1993:284) established no reciprocal effect between school achievement and self-concept of ability for the third and fourth grade, but they found that achievement significantly affected self-concept. Accordingly, Marsh (1988:100) reports that academic achievement is mostly highly and positively correlated with academic self-concept. Thus, this study will also regard intervention strategies intended to enhance achievement in Mathematics to be indirectly enhancing self-concept and attitudes as well.

In support of Valas and Søvik's (1993:284) finding of a reciprocal effect between school achievement and self-concept of ability, many studies established findings that implied reciprocity of effect. Bester (1988:168) reports a significant positive correlation between Mathematics self-concept and performance (r=0.55). He also found that 30.25% of the variation in Mathematics performance was a function of self-concept. Wong (1992:33) reports Wong and Cheng's findings of a study with 894 Hong Kong secondary school students, the fact that the most important variable influencing Mathematics achievement was self-expectation – which is a function of self-concept.
Valas and Søvik (1993:284) found that in accordance with cognitive evaluation theory and related research, students' feelings of being competent (implying a positive self-concept) in Mathematics affect their interest, curiosity, preference for challenge, and independent achievement in Mathematics. This further stresses that enhancing a favourable Mathematics self-concept is indispensable if we are really determined to take South Africa into the 21st century with confidence. This can only be achieved by producing a generation of teachers who can model these feelings of being competent (having positive self-concepts).

2.4 Gender differences in Mathematics self-concept

Valas and Søvik (1993:293) indicate that despite better achievement in Mathematics, girls in grade 9 had lower self-concepts in Mathematics than boys. These lower self-concepts could be the main cause of the avoidance of Mathematics by female learners both at secondary school and at tertiary institutions. For us to redress the prevailing gender inequities and female underrepresentation in Mathematics-oriented careers, it is thus necessary to improve their self-concepts. Since previous studies found teachers to be transmitting their poor self-concepts, there is a need to start by improving the Mathematics self-concepts of pre-service teachers.

2.5 The relationship between the image of Mathematics and self-concept

Meece, et al (1990:60) reviewed literature and established that self-concept of Mathematics ability, amongst others, was predictive of junior and senior high school students' course enrolment plans and performance in Mathematics. This is further worsened by the image both at school and in society that students
easily fail Mathematics and that it should be avoided (Maqsud 1991:377; Braithwaite 1993:4). Braithwaite (1993:4) reports that Mathematics often evokes feelings of frustration and panic in people, with admissions of failure at school and of 'not being good' at Mathematics.

2.6 The relationship between Mathematics self-concept and feelings of anxiety

Austin et al (1992:390) define Mathematics anxiety as a fear of Mathematics or an intense, negative emotional reaction to anything remotely mathematical. Cherkas (1992:84) indicates that lack of confidence, i.e. poor self-concept in Mathematics manifest in such feelings as Mathematics anxiety or Mathematics phobia (Maqsud 1991:379), lack of confidence, and negative mathematical attitudes. Richardson and Suinn (Maqsud & Khalique 1991:387; Bush 1991:33) refer to Mathematics anxiety as "... feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations."

Individuals suffering from Mathematics anxiety may become nervous and unable to concentrate when confronted with mathematical situations. They often have negative Mathematics self-concepts as well (Austin et al. 1992:390). Maqsud (1991:379) further reports that Mathematics phobia or Mathematics anxiety, i.e. an irrational fear of Mathematics (Nimer Fayez 1990:319) is strengthened by significant others like teachers by emphasising their own difficulties in learning mathematical tasks. Rech, Hartzell and Stephens (1993:141) report that most math-anxious teachers plan significantly less instructional time for Mathematics.

The effects of Mathematics anxiety on self-concept are portrayed by Cherkas (1992:84) quoting one of his male respondents as saying:
Some days my mind is like a motor that can't start when it comes to maths. I could look at a math equation and only see the design that the numbers and function symbols make on the paper or black-board. Other days my mind is feeling more confident or clear when it comes to numbers and I enjoy giving my brain a mathematical workout. Generally, I think I enjoy math, but there is a part of me that feels slow & stupid when it comes to numbers. I remember the frustration in the 5th grade (or whenever??) when I had to learn the "time tables" it was so hard for me to remember them. I remember crying, it was so hard for me to attach meaning to the numbers to help me remember them. Back in H.S. I remember being very bored with math.

Maqsud (1991:379) further indicates that students' Mathematics anxiety and lack of confidence in learning may cause cognitive blockage while they solve mathematical problems. Wong (1992:36-27) found that four variables (general self-concept, academic self-concept, attitudes towards Mathematics and Mathematics anxiety or phobia) were significantly but negatively correlated with Mathematics anxiety. However, Cheung (1988:217) indicated that individual help and supervision would assist students to restore confidence in learning Mathematics and eventually to increase achievement in Mathematics. Hence their Mathematics self-concepts would improve.

2.7 Improving the Mathematics self-concept of prospective teachers

2.7.1 Everyday life contexts

Newman and Schwager (1993:9) established that developing the students' self-expectations is likely to be a more effective way of improving students' Mathematics learning. This can be communicated to learners by teacher's behaviour as Hafner (1993:72) established a significant relationship between
teacher behaviour and student achievement. Apart from this, relating content to everyday life contexts is important as will now be indicated.

Some of the intervention programmes that can be used to improve the self-concept of prospective teachers are those implied by Relich (1996:187) when he reports that:

In general, the low self-concept teachers ... emphasised that, for them, learning Mathematics lacked relevance to real world and felt that teachers needed to be more concrete in their presentations to make Mathematics meaningful for their students.

Thus, there is a need for making students aware of the real life applications of Mathematics principles. Relich (1996:188) reports that teachers with a high self-concept expressed a need to relate Mathematics to real world activities and to offer a variety of concrete based activities at primary level (4/4) and interestingly, at the secondary level (2/4) as well. Referring to word problems as another form of real life applications of mathematical principles, Toom (1999:36) says that at school level, many non-word problems tend to be technical exercises, which are necessary, but not so exciting. He (1999:36) further indicates that a word problem provides an application of Mathematics to situations which occur in everyday life. He further reports that many interesting and non-standard problems are in the form of word problems (Toom 1999:36).

Toom (1999:36) as well as Parmar and Crawley (1997:189) report that the purpose of word problems is to convey a mathematical meaning that is the use of suitable concrete objects to represent abstract mathematical concepts. Sherman (1992:28) found that students who were taught pedagogy with manipulatives could explain instructional approaches with more understanding than those who learned Mathematics methods by reviewing fraction rules. He further asserts that studying appropriate models serves two purposes for student
teachers: reviewing the content for themselves and gaining experience with modeling the concepts through hands-on experiences (Sherman 1992:28).

Sherman further asserts that some primary school pupils think that Mathematics teachers create Mathematics content which has really very little to do with their own everyday experiences (Sherman 1992:29). He gave an example of when a learner/student was asked if parallel lines occur anywhere in space, he answered, “No, they’re only in the math book.” After noticing an example of the ceiling and the floor as a real world context of parallel lines, the student seemed surprised that the geometric concept had any relation to real life. This further stresses the need for real life contexts in teaching Mathematics. Furthermore, it is only interesting content which will encourage learners to study and hence improve their achievement. Hence, as Marsh (1989:192) as well as Valas and Søvik (1993:284) assert, self-concept will improve in proportion with improvement in achievement.

2.7.2 Co-operative learning

The approach used by effective teachers, referred to by Relich (1996:188), to teaching was reported to be less traditional, more group as well as individually oriented, far less dependent on texts and always monitored in order to determine how students progress. One of the teachers was quoted saying:

They sit in groups because they explain things (to each other) in their own language, if they don’t get it (understand) from me they get it from each other.
(Female, primary, high self-concept teacher) (Relich 1996:188)

Furthermore, according to Slavin (Bush 1991:41; Wilcox, Schram, Lappan & Lanier 1991:31; Ulla 1997:167; Putnam 1998:24) for some students small-group work improved academic achievement, interpersonal relationships, self-esteem
(evaluative aspect of self-concept), and attitudes towards school. This is also
reported to result in a decrease in Mathematics anxiety. Mulryan (1994:284)
reports that cooperative small groups could help to build confidence in those
students who are hesitant and unsure in their approach to Mathematics. Lee,
Maureen and Jacobs (1998:59) established that where cooperative learning has
not clearly produced superior performance, it has contributed to other gains in
the affective domain like self-concept. Townsend et al (1998:1) established that
in a cooperative learning environment, the self-concept improved significantly
over time, as did confidence in dealing with statistical problems. They further
report that cooperative learning is effective in increasing self-esteem and
feelings of competence (Townsend et al 1998:3).

Spungin (1996:73) claims that by working in groups, sharing ideas, and making
and testing conjectures, prospective teachers gain confidence in their own ability
to do Mathematics and to develop a variety of useful problem-solving strategies.
Other studies also assert that the relaxed atmosphere in a cooperative learning
environment as well as the pooling of ideas created by the environment makes
the environment conducive to learning (Nichols & Miller 1994; Webb & Farivar
1993:712). Russel and Corwin (1993:555) also report that since a cooperative
learning environment requires students to share their thinking, mistakes become
fuel for discussion, rather that an evil to be avoided.

Relich (1996:190) also points out that the majority of teacher respondents he
worked with referred to methodology, in other words, lack of information on how
to introduce and teach in the different topic areas as the major deficiency in their
initial training. This is supported by EduSource's (1997:2) finding that each
college of education in South Africa (in the 7 provinces considered in their
studies) makes its students aware of various teaching methodologies, but the
lecturers rarely employ these methods such as co-operative learning,
themselves and are therefore not the role models they ought to be. However, Sherman (1992:28) found that modeling is a powerful influence on the development of a teacher. This is what this study also intends to research.

EduSource (1997:2) further asserts that because of this theory/practice divide Didactics courses generally do not prepare student teachers for the realities they will have to face. This results in lack of confidence in teachers to use cooperative learning strategies. However, Outcomes Based Education in South Africa: Background Information for Educators (1997:24) gives, amongst others, the following critical outcomes: That learners should be able to:

1. work effectively with others as members of a team, group, organisation, community;

2. communicate effectively using visual, mathematical and/or language skills in models of oral and/or written presentation.

It is further asserted that the only instructional consideration to create optimal learning environments is that teachers need knowledge in, inter alia, cooperative learning. For the new generation of teachers to be able to do this, there is a need for teacher educators to model these, not merely preach about them.

Thus, in the Mathematics teacher education programme, cooperative learning will be used to develop mathematical power in student teachers. Mathematical power involves the development of personal self-confidence, amongst others (Professional Standards for Teaching Mathematics: National Council of Teachers of Mathematics 1991:1). The document, The Professional Standards for Teaching Mathematics identifies a direction towards which we need to shift in transforming Mathematics teaching and learning environments for the
development of mathematical power. Mathematical power is said to involve the development of a positive Mathematics self-concept as well. The researcher feels this is exactly what Curriculum 2005 and Outcomes Based Education (OBE) intend to achieve. The document The Professional Standards for Teaching Mathematics, just like Curriculum 2005, points out that we need to shift:

- toward classrooms as mathematical communities,
- away from classrooms as simply a collection of individuals,
- toward logic and mathematical evidence as verification,
- away from the teacher as the sole authority for right answers,
- toward conjecturing, inventing, and problem solving,
- away from an emphasis on mechanistic answer-finding,
- toward connecting Mathematics, its ideas, and its applications and

Some of the aforementioned are achieved by means of cooperative learning.

A shift in this direction is topical, given Relich's (1996:182) finding that primary female teachers have lower self-concepts, compared to their secondary counterparts. By shifting to an educational environment like this one, we may be moving some way towards meeting the objectives of Comenius, stated some 340 years ago: to seek a method by which teachers teach less and the learners learn more (Burn & Wood 1995:32). This is necessary because Elliot (1990:160) reports that many students enter college (particularly non-traditional students i.e.
those students who return to college after they have got married or after they have had a break of schooling) with certain beliefs that play a role in their learning experiences. For instance, many adults (many from the college where this study was conducted) returned to school with low self-esteeems (self-concepts) and lack of confidence, and they are extremely self-critical.

Strategies like co-operative learning have consistently shown beneficial effects on affective variables such as a liking for school subjects. They have also been found to be more effective than traditional whole class methods in improving self-concepts (Rzoska & Ward 1991:18; Newman & Schwager 1993:3; Mulryan 1994:284; Toom 1999:36). Thus it seems warranted to further investigate the effects of co-operative strategies on the Mathematics self-concept of prospective primary school teachers.

Sherman (1992:28), McDevitt et al's (1993:596), Parmar and Crawley (1997:189) and Toom (1999:36) suggest that investigative "hands-on" activities and instructional strategies like cooperative learning groups are particularly appropriate for groups presently underrepresented in scientific and technological fields. These are some of the characteristics of the respondents at Shingwedzi College of Education where this study was conducted. This college is a historically black institution in the Northern Province of the RSA.

There is a dire need to prepare a new generation of teachers who see Mathematics learning in a positive light, because in so far as it is realised in practice, it is a vital factor in the child's experience in learning Mathematics. Ernest (a) (1989:24) indicates that the teacher's model of learning Mathematics influences the cognitive and affective outcomes of learning experiences. He further asserts that in the long term, these learning experiences can vary in results from a student who is an interested, confident, skilled and autonomous
problem-solver, at best, to one who is a disenchanted, non-numerate mathephobe, at worst.

Placing research reports on affective factors in the library and stressing the need to read them is another way to inform PRESET teachers about the learners they are going to work with. This will also prepare them to guard against some practices in classrooms that can enhance the unfavourable feelings that students already hold.

2.7.3 Research reports

Towers (1992:92) established that mastery learning results in students' improvement in self-concept, self-confidence and feelings about instruction.

2.7.4 Mastery learning

Towers (1992:90) further quotes Guskey defining mastery learning as an instructional process. It involves organising instruction, providing students with regular feedback on their learning progress, giving guidance and direction to help students correct their individual learning difficulties, and providing extra challenges for students who have mastered the material. Grading in mastery learning is not competitive. When students demonstrate mastery of the section or unit, they proceed to the next unit of study for mastery. As a result, students compete with themselves, not with their classmates (Towers 1992:90). Thus, this study will also incorporate this strategy as part of the intervention programme.
2.8 Summary

This chapter gave a literature review on the Mathematics self-concepts of prospective teachers.

As suggested by literature, the intervention programme to improve the Mathematics self-concepts of prospective primary school teachers will include:

(a) the use of everyday life contexts so that learning is seen as relevant. Both exercises and assignment projects will be context-based and sometimes involve the use of "hands-on" activities;

(b) the use of cooperative learning strategies;

(c) research articles and dissertations on self-concept will be placed in the reserve section of the library for constant reference;

(d) the mastery learning strategy will be used where both individual and group problems will be attended to until mastery of a unit has been attained by group or an individual before moving on to the next unit.

In the next chapter, a literature review on the Mathematics attitudes of prospective teachers and the improvement thereof will be discussed.
CHAPTER 3

ATTITUDES TOWARDS MATHEMATICS AND THE IMPROVEMENT THEREOF

3.1 Introduction

In the previous chapter, Mathematics self-concept and ways to enhance it were discussed. Other factors also militate against the success of Mathematics education. These may be affective factors like the attitudes of teachers towards Mathematics. The only way in which these unfavourable attitudes can be improved is through transforming our teacher education programmes to produce a generation of teachers who are mindful of the effect their attitudes may have on those of the learners. In line with this reasoning, Klebanov and Brooks-Gunn (1992:97) identify important others like teachers as important influences on the attitudes of learners. Thus, teacher training should be refocused to consider the impact of affective variables like attitudes towards Mathematics.

Consequently, this chapter will discuss attitudes towards Mathematics. However, the main focus of the chapter will be on the improvement thereof which is the ultimate aim.

3.2 The influence of the teacher's attitude towards Mathematics on Mathematics students

Many studies report the teacher to be a pivotal figure in the Mathematics classroom. Cherkas (1992:85) quotes one of his respondents saying:
When I got to high school, I had problems with algebra, but thanks to a concerned instructor, I eventually learned to enjoy it.

Cherkas (1992:85) continues to indicate that the communication of a teacher's belief in students' abilities has a powerful influence to raise (or lower) the sense of expectations and performance. He proceeds to report that many of the non-specialists who end up teaching Mathematics in lower grades convey inferior attitudes about the nature and role of thinking in Mathematics. This notion is supported by Merseth (1993:551) when she says that this problem results from a fairly common practice of assigning teachers to teach classes in fields outside their areas of competence or certification. Quinn (1998:1) contends that teachers who have inadequate meaningful mathematical content knowledge and/or poor attitudes towards the subject often exacerbate the problem that students experience in learning Mathematics. McDevitt, Heikkinen and Alcorn (1993:594) also established that teachers' attitudes to Science and Mathematics represent a critical influence on their instruction in these subjects. Swetman, Munday and Windham (1993:421) and Schuck (1997:535) point out that teachers may pass on positive or negative attitudes which may affect students' motivation to learn.

Expressions of negative attitudes to Mathematics are more strongly presented by primary school teachers. Secondary school teachers report a recovery of positive attitudes to the subject at tertiary level. This recovery is ascribed to improved performance associated with a master teacher who ameliorated an increase in confidence through patience and through what was perceived as personal attention to them as individuals (Relich 1996:186). This is typical role modeling that prospective teachers need, unlike merely informing them about successful teaching procedures, as reported by EduSource (1997:2) to be happening at colleges of education in South Africa.

Tocci and Engelhard (1991:280) point out that the attitudes of the students are developed by direct experiences with the attitude object and by interactions with
relevant others like teachers and teacher educators. Tocci and Engelhard (1991:280) further indicate that interactions with other persons provide individuals with information in the form of attitudes, beliefs and behaviour of important others that become guides for the development of their own attitudes (Moyana 1996:34).

Schuck (1996:128) also reports that student attitude is another significant chain which shackles the students apart from their limited subject-matter knowledge. Because of their belief that Mathematics is purely the learning of algorithms, many students focus only on their current knowledge of primary school procedures. They look to the Mathematics education subjects to improve their ability both in the basic skills, and at teaching these skills. They are, as a result, nervous about teaching Mathematics with their present knowledge, and their vision of Mathematics as a rule-bound, procedural subject leads to their desire to be taught how to explain these rules and procedures (Schuck 1996:128).

Ernest (1989:25) (a) points out that attitudes to Mathematics and its teaching are important contributors to a teacher's make-up and approach, because of the effect they may have on a child's attitude to Mathematics and its learning. Ernest (1989:24) (a) goes on to indicate that the teacher's attitude to Mathematics includes liking, enjoyment and interest in Mathematics, or the opposite, which in the extreme can include mathephobia. This is apart from the teacher's confidence in his or her own mathematical abilities: the teacher's Mathematics self-concept, and his valuing of Mathematics.

Ernest (a) also indicates that the teacher's attitude to the teaching of Mathematics includes liking, enjoyment and enthusiasm for the teaching of Mathematics, and confidence in the teacher's own Mathematics teaching ability (or the opposites) (Ernest 1989:25) (a). He goes on to indicate that the teacher's knowledge, especially of Mathematics and its teaching, could be expected to influence the teacher's Mathematics attitudes. It seems likely that knowledge,
both with regard to Mathematics and its teaching, will positively influence the teachers' attitude towards the teaching of Mathematics.

Towers (1992:92) says that in terms of attitudes, mastery-taught students appeared more interested in the subject matter being learned and showed greater improvement in self-concept, self-confidence and feelings about instruction.

It is thus necessary to prepare primary school Mathematics teachers to consider the affective development of children. Rech et al (1993:141) support this when they point out that the acquisition of mathematical skills and knowledge begins in elementary school. And the teaching of Mathematics at this point is a critical factor in the future success of the students. Swetman (1994:173) also reports that attitudes towards arithmetic are formed in the primary grades. Rech et al (1993:141) further quotes Schoefield indicating that elementary teachers must possess sound mathematical competency, as well as positive attitudes towards the subject, in order to be effective teachers. They further report that evidence indicates that the early educational experiences of many students may lead to the avoidance of Mathematics and a set of negative attitudes (Rech et al 1993:144). Despite the primary school teacher's importance in the early development of a mathematical environment for students, primary school Mathematics teachers seem to regard Mathematics as a necessary evil. On the other hand, the Sunday Times (July 20 1997) reports that in England, Australia, Canada, China, Japan and Portugal the main reason young people choose careers in Science and Technology is because of an inspiring school teacher. It is only a teacher who holds positive attitudes towards Mathematics, who can inspire young people to pursue the quantitative disciplines.

Karp (1991:266) found that teachers with negative attitudes towards Mathematics employed methods that fostered dependency, whereas teachers with positive attitudes were found to encourage student initiative and independence. Student
dependency, which is reported to be fostered by teachers with negative attitudes, may encourage learned helplessness among students. Students who have developed a learned helplessness syndrome have been found to attribute their problems to factors they see as either uncontrollable or unchangeable, such as ability, task difficulty or the attitudes of other people (Karp 1991:267). Trying to help people with this type of mindset is a futile exercise because they do not think there is anybody to free them from these mental shackles. Therefore, prevention of the development of detrimental attitudes like these is better than an attempt to cure them. The only form of prevention that teacher educators and the Government may have at hand is to provide teachers who hold positive attitudes towards Mathematics.

This may be achieved by a teacher education programme which is considerate of the affective preparation of teachers. This is what this study attempts to achieve.

3.3 The relationship between achievement and attitude towards Mathematics

Emenaker (1996:75) found that what goes on in the Mathematics classroom is directly related to the attitudes teachers hold towards Mathematics. Meredith (1993:337) reports that attitudes towards pedagogical content knowledge may be attributable to prior learning and experience. He further reports that elementary school teachers have a significant role to play in students' achievement, as well as the formation of beliefs and attitudes towards Mathematics (Meredith 1993:337). Hence, Stevens and Wenner (1996:8) suggest that affective issues need to be taken into account in preparing Science and Mathematics instruction for preservice teachers.

Relich (1996:180) established that teacher attitude affects student achievement. He further points out that teachers' attitudes in Mathematics may have an
influence on how students perceive their own abilities to deal with Mathematics (Relich 1996:180). He indicates that the attitudes of low self-concept subjects (teachers) in his study tended towards the negative and they expressed low expectations of their students (Relich 1996:187). For instance, he reports about three teacher respondents in his study who reported traumatic school experiences (i.e. failure, teacher over-reaction, poor test performance, teacher disapproval, etc.) which soured their taste for any activity that was mathematical in nature. In two of Relich's cases, traumas resulted in loss of confidence and liking of Mathematics that had initially existed (Relich 1996:186). Schuck (1998:711) confirms that past experiences often close students' minds to the possibilities that exist in primary school Mathematics, and also encourage prospective teachers to place ceilings on the sort of activities that might be done in a primary school classroom.

Other studies also confirm the relationship between achievement and attitude. For example, Taylor established a significant relationship between teacher attitude towards Mathematics problem solving and pupil achievement (Tooke 1993:274). Mudeliar (1987:4) associates teachers’ attitudes towards Mathematics with students’ attitudes and achievement in Mathematics. Dungan and Thurlow (1989:10) also found that students’ attitudes to Mathematics are derived from teachers’ attitudes to this subject area. Moyana (1996:35) claims that this in turn, impinges on students’ achievement in Mathematics.

3.4 The influence of teaching methods on attitude towards Mathematics

EduSource (1997:2) points out that although each college of education makes its students aware of various teaching methodologies, the lecturers rarely seem to employ these methods themselves and are therefore not the role models they are expected to be. Lecturers have to bring to a halt the theory/practice divide in Didactics courses. When they talk of a teacher expected to be patient, to give
individual attention to learners, use cooperative learning strategies, use real life problem situations, etc, they have to model these activities ourselves, not just preach them. They therefore have to practice what they preach as teacher educators.

Karp (1991:267) established that teachers with negative attitudes were observed completing tasks for some students while requiring others to do the same tasks themselves. This differential behaviour was most apparent in the teachers' practice of writing equations or writing algorithmic procedures for the students. They were observed taking away the student's pencil or using their own pencils to strike off the student's work, rewrite an equation, or perform a mathematical process. Again, this may suggest to the students that they are not capable of accomplishing the task themselves, and that the teacher is the mainstay for both verbal and written instruction. Such messages foster learned helplessness and negative attitudes towards Mathematics by encouraging the view that Mathematics problems cannot be solved independently (Karp 1991:268).

In contrast to the aforementioned, teachers with positive attitudes towards Mathematics use instructional methods that encourage independence. They are more inclined to deal with skills development by giving instruction which focuses on why an algorithm works, demonstrating how certain Mathematics skills are interrelated, discussing what properties are characteristic of a given skill, identifying the common problems encountered, and providing appropriate means for proving correct answers (Karp 1991:268). This promotes positive attitudes in students.

Another method that promotes an independent attitude is requesting that the students prove their answers; this process of self-correction leads to the ability to independently cope with mathematical tasks because it gives students a better understanding of how to solve problems (Karp 1991:268). Fennema and Peterson describe teacher actions such as encouraging independence and
responsibility, building problem solving strategies and acting as problem solving role models that lead to the development of autonomous learning behaviour (Karp 1991:268-269).

Williams (1987:97) found a significant improvement in learners' attitude-towards-the-course/instructor after the use of the intentional teacher errors intervention strategy. He further reports that the Errant-Lecture Treatment had several positive effects (Williams 1987:97). On a daily basis the majority of students interacted with the instructor. More than 25% of the students questioned what the instructor said or wrote in class each day whereas some of these students had been passive learners in the previous course. Very few students seemed to be bored at the end of the 110-minute class period.

Many studies attribute positive attitudes towards learning, high achievement and interpersonal skills to cooperative learning strategies. Rzoska and Ward's (1991:18) assertion is comforting as they report that negative attitudes may be changed. They report that cooperative learning strategies have consistently shown beneficial effects on affective variables such as a liking for school subjects and attitudes towards the subject (Rzoska & Ward 1991:18). Bush (1991:41) also concludes that small-groupwork improves academic achievement and attitudes towards school.

According to Orsak (1990:345), cooperative learning augurs well with the motto "One for all, and all for one". McDevitt et al (1993:607) found that students' participation in a project which incorporates cooperative strategies enhance students' attitudes towards the teaching of Science and Mathematics. Orion and Davidson (1992:257) mention benefits enumerated by cooperative learning activities to include greater student enjoyment and improved individualisation by enabling the teacher to pay attention to the needs of a few groups rather than those of many separate students.
Hart (1993:170) asserts that collaborative efforts (cooperative learning activities) allow problem solving to go on when an individual member might have encountered an impasse. Moyana (1996:44) also points out that cooperative learning provides a less restrictive social environment in which students are more able to pursue various strategies and ideas. Stacy (1992:261) also adds to this by reporting that groupwork in problem solving includes the opportunity for pooling ideas, the natural need that arises to explain and express ideas clearly and the reduction of anxiety for tackling something difficult.


3.5 Gender differences in attitude towards Mathematics

Cheung (1988:214), Hensel (1989:650), Marsh (1989:203), Randal (1990:619), Mullis (1991:379), Kaiser-Messmer (1993:214) and Plucker (1996:738-739) identify numerous possible causes for female underachievement and underrepresentation in quantitative disciplines, the attitudinal of which include gender role stereotyping, differential expectations, and differential treatment within the classroom. Plucker (1996:739) further asserts that psychologists and educators assume that attitude and behaviour are involved in a cause-and-effect relationship, owing to “… the belief that people make evaluative judgments about a wide variety of targets. It is further believed that they rely on these judgments, or attitudes, in deciding among several possible courses of action in the future”. If teacher behaviour is linked to differential outcomes in the classroom based on gender, and teacher attitude is related to teacher behaviour, then the
investigation of the impact of an intervention programme on attitude towards Mathematics is justified.

Hackett and Betz (1989:261) stress gender stereotypes in their findings by reporting that both Mathematics performance and Mathematics self-efficacy were significantly and positively correlated with attitudes towards Mathematics and masculine sex-role orientation. They further indicate that sex differences in Mathematics avoidance have, in turn, been thought to result from socialised negative attitudes and affective reactions to Mathematics, such as Mathematics anxiety (Hackett & Betz 1989:261). Hackett and Betz (1989:262) report that from the social learning theory perspective, self-efficacy expectations of the genders are proposed to be an important factor influencing attitudes towards Mathematics and Mathematics performance as well as Mathematics-related educational and career choices.

However, Swetman et al (1993:421) report that female students' attitudes towards Mathematics are significantly more positive than male students' attitudes at the third-, fourth-, fifth- and sixth-grade levels. Attitudes of students towards Mathematics and their Mathematics achievement were found to be significantly related (Swetman et al 1993:421). An implication of this, which studies reviewed before, is that a positive attitude towards Mathematics culminates in higher Mathematics achievement, hence the need for a study of this nature.

Knowledge of strategies that enhance favourable teacher attitudes towards gender equity and knowledge of behaviours that encourage or discourage young women in Science and Mathematics will help educators design further educational experiences and interventions that effectively reduce the gender gap in participation and performance in quantitative disciplines.

3.6 The relationship between attitude towards Mathematics and anxiety

Negative attitudes towards Mathematics may manifest in Mathematics anxiety. Austin et al (1992:390) report that reasons for Mathematics anxiety in elementary school teachers might include negative Mathematics attitudes by their own teachers, inadequate Mathematics backgrounds and lack of mathematical understanding. They further assert that Mathematics anxiety may inhibit teachers from acquiring the required Mathematics skills and processes needed to teach children. Conversely, failure to acquire appropriate Mathematics competencies may make teachers math-anxious. Austin et al (1992:391) also point out that there is evidence that math-anxious elementary school teachers may affect their pupils adversely. Swetman et al (1993:421) conclude that there is a relationship between math-anxious teachers and the development of negative attitudes of their students towards Mathematics. Some teachers may transmit their
undesirable attitudes towards Mathematics to their students, therefore perpetuating a cycle of Mathematics anxiety and negative attitudes. They go on to report that a child’s attitude towards Mathematics is a learned attitude that develops through Mathematics experiences, many of which take place in the elementary school classroom. This highlights the need to instil favourable attitudes in prospective elementary school teachers.

Austin et al (1992:391) as well as Bush (1991:34) assert that Mathematics anxiety arises from an affective climate in which negative attitudes and anxiety are transmitted from adults to students. Bush (1991:34) further indicates that teachers’ attitudes and enthusiasm towards a subject have a greater impact on student attitudes than instructional variables. More specifically, he attests that teachers with Mathematics anxiety transmit their anxiety to their students.

Swetman et al (1993:423) conclude that math-anxious teachers convey a negative attitude towards Mathematics to students, who in turn take fewer Mathematics courses, and are then ill-prepared math-anxious teachers with more students who are math-anxious and have a negative attitude towards Mathematics. Schuck (1996:127) points out that another chain binding the students is their attitude towards Mathematics. Most of the students participating in his study felt negative about Mathematics. Schuck (1996:127) further asserts that this chain created a particular mindset in the learners on entering the Mathematics education classroom at university; students were anxious about their ability to “do Mathematics” and to teach Mathematics.

3.7 Improving the attitudes of prospective teachers towards Mathematics

The findings and recommendations of studies reviewed here suggest the need for teacher education institutions and school district administrators to develop programmes to help prospective teachers to recognise and overcome the
problems of negative attitudes towards Mathematics and the effect of these attitudes on students. Furthermore, a number of strategies are suggested to improve attitudes towards Mathematics. This study will test the effect of an intervention programme to improve the attitudes of prospective primary school teachers.

Hungerfold (1994:16) asserts that elementary school teachers who don't know much Mathematics, who have little interest in what it means to do Mathematics and who are afraid of Mathematics, are not likely to engender positive attitudes towards Mathematics in their students. Quinn (1998:1) reports that teachers who have inadequate meaningful mathematical content knowledge and/or poor attitudes towards the subject often exacerbate the problems that students experience in learning Mathematics. Yet, this may be the kind of teachers that South Africa produces and is still geared to produce. This being the case, the inescapable corollary is that continued neglect of the Mathematics education of prospective elementary school teachers courts disaster, both for the profession and for the larger society (Hungerfold 1994:16). In order to address the situation, Mathematics departments in teacher education institutions must:

- offer prospective Mathematics teachers courses that are adequate in terms of both breadth and depth, and expect them to achieve at a reasonable level; and
- must encourage Mathematics teacher educators to adopt teaching styles other than the conventional lecture, e.g. cooperative learning strategies.

There are a number of strategies that aim at improving the attitudes of prospective teachers towards Mathematics. Some of the most important strategies are discussed below.
3.7.1 Relevant curriculum

Plucker (1996:744) suggests that the curriculum should be changed to enhance positive attitudes towards Mathematics. Curricula should be relevant for everyday life and this relevancy should be pointed out to students.

McDiarmid (1990:14) reports that most prospective elementary school teachers dislike Mathematics. Most students he interviewed reported that they had avoided Mathematics “like the plague” in high school and college. Most of them could not see any value in learning Mathematics. One of them wrote:

In my eyes, Mathematics was useless. I could never understand where in my lifetime I would ever use math formulas again. In a checkbook? On a resume? What was the purpose of learning it? From the beginning, my understanding of math was to memorize the laws and formulas to get the answer. I didn’t have to know the concepts of math. I didn’t even know mathematics had concepts! (McDiarmid 1990:14).

What is implied by this quotation is a need for Mathematics to be taught in the context of real life situations and to stress the transferability of Mathematics content. Furthermore, Lumpkin and Powell (1995:48) define Mathematics as the use of numbers, patterns and shapes to describe and explain the world. Thus, all Mathematics concepts need to be introduced in the context of the learners’ real life experiences. In another study conducted by Maher (1988:4), pupils did work relating to money and finance and as such were offered the opportunity to study the Mathematics they need or are interested in. Remillard (1992:185) also supports this when he quotes the California State Department of Education when they indicate that:

To isolate the acquisition of mathematical knowledge from its uses and its relationships is to limit the depth of understanding achieved.
Remillard (1992:186) goes on to quote one fifth-grade teacher he interviewed:

To Jim, teaching for understanding means making Mathematics applicable to daily life. He stressed, "It's very important that they learn the mathematical rules and formulas, but the bottom line is where, when, how to use it ... I think just doing all of that in isolation and not dragging in part of your lifestyle or things that you are doing in everyday life would be ridiculous. ... You have to always apply it to something". Jim worried that students see math as only applicable to school. ... Jim commented on this in one conversation: Nobody wants to learn anything if they're never going to use it. Just like the answers I got out of them. ... "So you can go to the sixth grade?" "So you can graduate from high school?" All the answers had nothing to do with life. ... It was all school (Remillard 1992:186).

Jim's comments above still stress the need for a daily-life-based approach to teaching Mathematics. EduSource (1997:48) found that none of the colleges in South Africa considered in their study gave attention to the relevance of Mathematics to local communities. In other words, Mathematics is taught out of context, which emphasises its remoteness from everyday life. Moyana (1996:65) reports that if pupils view Mathematics as a useful subject in their lives, they are bound to work hard to strengthen their mathematical background. However, if they are made to view it as irrelevant, they will develop negative attitudes towards Mathematics. EduSource (1997:48) attribute this to the rigid nature of most of the syllabi and the externally imposed curriculum of the past in certain colleges of education.

Vatter (1992:292) also suggests that learners' attitudes can be improved by making the content tied to the real world and their daily life experiences. Curriculum 2005 (1997:20) asserts that learning involves a learner's mind, body and emotions and normally culminates in establishing attitudes. Toom (1999:38) supports this assertion when he argues against the 'no-transfer' theory and says according to this theory, children cannot transfer their skills to life outside the school. Because the purpose of schooling is simply better preparation for life, the
curriculum should be filled with those problems that people solve in everyday life. Curriculum 2005 (1997:9) further points out that by exposing the learner to learning experiences which are real to his/her life, the teacher will not only assist in achieving learning area outcomes (like in Mathematics), but will help the learner to develop as a whole person.

Moyana (1996:38) states that only a teacher who is well educated and knows and understands pupils' thought processes can effectively carry out this suggestion, and not teachers with negative attitudes towards Mathematics who slavishly follow the textbook. Ethington (1990:109) indicates that the textbook should not be followed slavishly, but should be adapted to suit the needs of both the learner and the teacher or teacher educator. What is in the textbook can be made to accommodate the real life experiences of learners. This makes the content relevant and easy to follow for the learner. It enhances enjoyment, interest and a view of Mathematics as a subject area transferable to real life non-routine problem situations. This is in line with Schmalz (1990:16) when she points out that the textbook must not be “the sole determiner of our daily Mathematics instruction. Let us be bold enough to restructure the order and development of the topics without apology. In this way, the textbook becomes a servant and not a dictator”. This may facilitate the development of positive attitudes towards Mathematics.

Now that central Government has freed teacher educators from the shackles of these externally imposed curricula, teacher education institutions are charged with a responsibility to develop their own curricula. It is the duty of teacher educators to transform Mathematics syllabi without apology, and make Mathematics content applicable to learners' everyday lives. This type of content that is transferable to life outside the four walls of the classroom will enhance positive attitudes in learners.
As part of the intervention programme, this study will stress the applicability of content/use of "real-life" examples, i.e. the use of real life problems to teach new concepts in Mathematics as well as in most assignments and test questions. This will enable students to see the usefulness of Mathematics in dealing with problems of life on a daily basis. It is the view of this study that mathematical concepts were invented as a consequence of problems faced then. They must therefore be taught in problem solving contexts.

3.7.2 Positive classroom atmosphere

Classroom environments in which comparisons between and the ranking of students are never evident, have to be created. Test results are only to be discussed with individual students, and then with the view to improve. They are thus used for diagnosis only (Maher 1988:4).

3.7.3 The encouragement of women

In an attempt to help provide role models for females, Plucker (1996:744) and Moyana (1996:152) suggest that women should be encouraged to attend workshops and conferences on Mathematics. In particular, they should be encouraged to attend those workshops and conferences in which female Mathematics specialists play a prominent role, for instance by reading research papers.

It is against this background that Moyana (1996:153) and Plucker (1996:744) further suggest that young women should be encouraged to do Mathematics and Science as well as traditionally male-dominated Mathematics- and Science-driven careers. Moyana (1996:152-153) further suggests that more female students could be encouraged to pursue a career in teacher education to add to the negligible number of female role models in the teaching profession.
Plucker (1996:744) and Moyana (1996:153) also recommend the use of gender-neutral pronouns in examples, assignments, exercises and test questions. The traditionally gender-driven chores should be assigned gender-blindly. Hensel (1989:651-652) quotes Cain's warning to guard against assigning domestic and clerical chores to females while reserving the muscle tasks and leadership roles for males.

3.7.4 Methods

The following are some of the methods that encourage the development of positive attitudes of prospective teachers towards Mathematics:

- **Use of concrete materials**


- **Use of cooperative learning strategies**

strategies as part of the intervention programme. Both peer tutoring and group investigation, as types of cooperative learning (Kroll, Masingila & Mau 1992:620) will be employed for the purpose of this study.

- Use of hands-on activities

Vatter (1992:292) also suggests that we can help at-risk students, like those enrolled for General Mathematics at colleges of education, find some success by (a) making them work hands-on, and (b) ensuring that students' feelings of worth and accomplishment are nurtured by the work itself.

3.8 Summary

In this chapter, the attitudes of prospective teachers towards Mathematics were discussed on the basis of a literature review. Strategies that could improve these attitudes were also identified and discussed.

The following should be incorporated into an intervention programme to improve prospective teachers' attitudes towards Mathematics:

(i) the use of co-operative learning strategies,
(ii) the use of real life problems to teach new concepts in Mathematics as well as in most assignments and test questions. Concepts previously treated will be redesigned using this strategy as well;
(iii) stress of applicability of content/use of "real life" examples;
(iv) the use of manipulatives and "hands-on" activities;
(v) the encouragement of student teachers to attend workshops on women in quantitative disciplines; and
(vi) the use of gender-neutral pronouns in mathematical problem scenarios.
The next chapter outlines the intervention programme to be used in an attempt to improve the Mathematics self-concept and attitudes of prospective teachers towards Mathematics.
CHAPTER 4

A PROGRAMME TO IMPROVE MATHEMATICS SELF-CONCEPT AND ATTITUDE TOWARDS MATHEMATICS

4.1 Introduction

The previous two chapters, namely chapters 2 (two) and 3 (three) were devoted to a literature review on self-concept and attitude towards Mathematics. This review of the literature culminated in aspects to be included in a programme to improve self-concept and attitudes towards Mathematics. This chapter discusses this programme, which will be implemented and tested in a classroom.

4.2 The improvement of Mathematics self-concepts

A number of activities were suggested in the review of the literature for intervention strategies to improve the Mathematics self-concepts of prospective primary school teachers. These strategies are outlined in this section.

The following is the programme and an explanation of how it will be implemented:

4.2.1 The use of cooperative learning strategies

As suggested in the literature review, students will be divided into groups of three to five members (Chambers & Abrami 1991:141; Urion & Davidson 1992:263; Sutton 1992:64). For the purpose of this study, each group will be composed of five members, which will reduce the number of groups to a manageable number.
Stratified random sampling will be used. There are 33 student teachers majoring in Mathematics who are also doing General Mathematics 2. The 33 students will be randomly allocated to each group until each group has at least one of them. The other four members will be randomly chosen from the list of those registered for General Mathematics. Student representatives will compile the list of names. Four members of each group will be randomly sampled from the list. The researcher believes that if each group has at least one member majoring in Mathematics, he or she will be able to explain difficult mathematical concepts to the other group members.

The groups will be made aware of the fact that the success of each group depends on the effort of each team member.

Just as in Sutton's (1992:64) study in this study, cooperative learning will be used for homework, assignments, reviewing, and studying for tests, as well as the search for meaning in the introduction of new concepts. Ongoing assessment by the researcher will take two forms: (a) listening to group discussions and (b) randomly picking any group member to report to the whole class on their group's answers and how they reached the answers. This should ensure thorough understanding of each unit (concept) by each member in a group. Furthermore, this ought to result in the individual mastery of the learning of material. The researcher will also go from group to group, answering only those questions that the students have been unable to answer. However, most of the researcher's time will be spent listening to explanations and discussions (Sutton 1992:65).

This exercise does not, however, move individual accountability to the background. It is maintained through testing. Group members will work together in preparing for tests. They will help each other in their preparation, but each student will take her or his own test without assistance.
4.2.2 The use of everyday life contexts

Verschaffel, De Corte and Borghart (1997:358) report that in many current reform documents relating to Mathematics education, a strong plea is made for making problem solving in school Mathematics more closely related to the experiential worlds of children by using real life problems. Sherman (1992:130) suggests that problems could be drawn from real world situations in the newspaper, from maps, menus, the financial world, and so on. He further maintains that finding a relationship between content and its application to actual useful situations and/or patterns serves to deepen and further explain Mathematics knowledge to the learner at many levels of sophistication (Sherman 1992:130). Thus, almost all new concepts will be preceded by a real life mathematical scenario or problem context on which targeted content will be based. All examples, exercises, test questions and assignments will be based on students' everyday experiences, for instance, farming, shopping, cooking, building, etc.

4.2.3 Mastery learning strategy

In line with Guskey's (Towers 1992:92) definition of the mastery learning strategy, students will regularly be provided with feedback on their learning progress and they will be helped on how to correct their (both group and individual) learning difficulties. Groups are expected to reach mastery level of material treated before proceeding to new learning material. Groups that are identified to have mastered the material will be provided with extra challenges. When groups and individuals demonstrate mastery of a section or unit, they will proceed to the next unit of study. As a result, students (groups and individuals) will compete with themselves, not with their classmates (Towers 1992:90).
4.2.4 Placing research articles and dissertations on self-concepts in the reserve section of the library

Research articles and dissertations will be placed in the reserve section of the library for constant reference by student teachers. To ensure that the articles are studied, group research projects and assignments based on these articles will be given to the group members. Groups will be expected to give presentations of their findings to the entire class.

4.3 The improvement of attitude towards Mathematics

The previous section outlined an intervention programme to improve the self-concepts of prospective Mathematics teachers. This section explains intervention strategies that have been identified to improve the attitudes of student teachers towards Mathematics.

The following are the strategies included in the intervention programmes:

4.3.1 The use of cooperative learning strategies

The same procedure as that already outlined in section 4.2.1 will be followed (see section 4.2.1).

4.3.2 Stressing the applicability of content/use of contexts in learners' everyday lives

As in section 4.2.2, real life problems will be used to teach new concepts, also in most assignments and test questions. This is intended to help students to realise how relevant and useful Mathematics is in their everyday lives. It is the researcher's view that Mathematics concepts were invented as a consequence of
quantitative problems faced at the time. Thus, these concepts have to be taught in real life contexts. Amongst other things, Sigurdson and Olson (1992:44) suggest two ways to promote teaching with meaning, namely (1) familiar applications of Mathematics; and (2) Mathematics interpretation. This is the philosophy that underpins the strategy in this study. The interpretation of Mathematics will be achieved through relevant word problems and the use of variables.

4.3.3 The use of manipulatives and 'hands-on' activities

A number of authorities advocate the use of manipulatives and 'hands-on' activities in teaching Mathematics (Boling 1991:18; Georgewill 1990:380; Mullis 1991:300). Sherman (1992:28) found that the group using manipulatives achieved significantly higher performance scores than the groups taught by the traditional 'talk and chalk' methods. Concrete things like counters, chairs, fruit, cattle, etc would be used in the introduction of new mathematical concepts and in assignments.

Sigurdson and Olson (1992:38) refer to the use of concrete materials that requires active manipulation as the 'high road' route to learning. Amongst others, they (1992:44) suggest two categories of this approach, namely (a) representations with physical objects and (b) pictorial representations. These are the approaches this study intends to follow.

4.3.4 Encouraging student teachers to attend workshops and to read biographies

Prospective teachers will be encouraged to attend workshops where women mathematicians play a prominent role. Visits from female mathematicians and scientists will be arranged. Biographies of women mathematicians will be placed in the reserve section of the college library. This will provide learners with role
models of females who have excelled in Mathematics and Science (Hensel 1989:651-652). This should correct the view by most students that Mathematics is a male domain. This should make them realise that there are women who are Mathematics masters and that this is not a domain for males only, but for both sexes. Mathematical gender stereotypes should thus be avoided. This should curb the sex-related expectations by teachers, as asserted by Hensel (1989:650). If not alleviated, these differential teacher expectations would result in self-fulfilling prophecies where female learners do poorly, as was expected by their teachers.

4.3.5 The use of gender-neutral pronouns/emphasis on non-stereotyped roles in creating and using Mathematics word problems

All Mathematics problems used for the purpose of this study will as far as possible be free of gender-biased pronouns. The instances of the dominance of male pronouns in Mathematics problems will be avoided. In concurrence with Hensel (1989:650), the researcher is of the opinion that the constant use of male pronouns communicates a negative message to their female counterparts, namely that Mathematics is an elite subject area for males only. This notion would ultimately result in learned helplessness on the part of females, which would result in underrepresentation on their part. This negative opinion regarding Mathematics militates against the government’s aspiration to produce a workforce representative of both genders.

Hence the need to use gender-neutral pronouns, for instance

A learner brought her/his bag full of books. The number of exercise books in the bag is twice the number of prescribed books. The sum of the number of prescribed books and that of exercise books is 30. Find the number of his/her prescribed books and of exercise books.
4.4 A programme to improve the self-concepts and attitudes of prospective teachers

Below follows a brief explanation of the entire programme:

4.4.1 Cooperative learning strategies

Both peer tutoring and investigation by the entire group will be used. In peer tutoring, students work together to help each other master tasks that generally stress the acquisition of information or skills. In group investigation, students learn by cooperating on tasks that involve interpretation, synthesis, the application of information, or problem solving (Kroll, Masingila & Mau 1992:620).

Students are formed into groups of five to seven members. The groups will be organised in order that almost all of them have at least one student enrolled for Mathematics as a major subject (see sections 3.7.4, 4.2.1 and 4.3.1). These groups will do assignments, projects, revise work and prepare for tests together.

Group members will take turns in explaining how they reached solutions to exercises, assignments and projects. The lecturer (researcher) will at random pick whatever member in the group to report back. This is intended to make sure that all members understand the content under consideration as well as to ensure that members do not sit passively and expect one or more group members who seem to be the so-called 'mathematical brains' to do everything for the rest (see sections 4.2.2 and 4.3.2).

Group assignments and projects will be given. The groupmark obtained for the assignments will be awarded to each group member. This will make students realise that their success is dependent on each group member's effort, not merely on an individual's. This, however, will not relegate individual accountability
to the background. To verify if individual students benefited from group activities, two tests will be written where each student will write without assistance from the members of the group. These tests are meant to establish each student’s problems and weaknesses which will be discussed with them individually. Just as the marks obtained for group assignments, marks earned for these tests will contribute towards the year-mark and final mark of each student.

4.4.2 The use of students’ life experiences as contexts

It is the researcher’s view that all that are referred to as Mathematics content were invented as tools to solve real life problems. Students must consequently be made aware of how they can use the knowledge gained through their study of Mathematics to solve non-routine personal problems, as well as in decision-making. This will enable them to see the use of the subject content not merely as a ‘gatekeeper’ into lucrative careers but also as an indispensable problem solver. Thus, those prospective teachers who will be teaching Mathematics in schools may teach the subject content the same way as they were taught (see sections 2.7, 3.7, 4.3.2 and 4.2.2).

The programme will be used in teaching the following sections prescribed for General Mathematics II:

(a) statistics, which includes basic statistical concepts and terms, measures of central tendency, data representation, graph and table interpretations and the interpretation of statistics;
(b) percentage;
(c) simple and compound interest;
(d) ratio and proportion;
(e) fractions:
(i) concepts of fractions as a part of a concrete whole, and of fractions as numerals for numbers;
(ii) the use of apparatus (Cuisenaire rods, quad paper, counters), etc;
(iii) equivalent fractions;
(iv) conversion of fractions to decimal and vice versa;
(v) number line representations;
(vi) ordering fraction;
(vii) operations with fractions;
(viii) percentages and
(ix) order of operations.

(f) an introduction to the concept of a variable and the use of a variable in mathematical writing and the solving of problems;
(g) geometric concepts in the primary school;
(h) operations which will involve operations on whole numbers, properties of the operations and their application and order of operations; and
(i) word problems.

The concepts are clearly the aspects that prospective primary school teachers will eventually teach at schools. This is intended to revisit the content using a meaning-seeking approach to foster understanding; not merely fostering the knowledge of algorithms to reach solutions. This should prepare prospective teachers to teach the subject with the conviction that they have mastered the content. In order to facilitate this, all material will be based on student teachers’ everyday life experiences.

To make the programme interesting and enjoyable, every three sections treated will be preceded by thought-provoking mathematical activities adopted from Bolt (1991:10,39&39). Furthermore, Leinwand (1992:470) says that playing and
having fun are essential ingredients for maintaining humour, sanity and enjoyment. These activities are not part of the prescribed material. They involve geometrical concepts like points, lines, triangles, parallelograms, trapeziums, and squares. They therefore become a recap of the shapes of figures in primary school geometry. The first activity will be fairly easy to arouse student teachers' interest in the activities to help develop their reasoning capacity.

The following are the three mathematical activities that will precede every three new sections treated (The solutions to the activities are found in Appendix C.):

**Mathematical activity 1: Mystifying matchsticks**

Take away four matchsticks
to leave exactly four
equilateral triangles all of the
same size.

(Bolt 1991:10)
Mathematical activity II: More matchstick mindbenders

Turn the spiral into three squares matches.

Convert this 'church moving four Tower' symbol into three identical squares by moving five matches.

(Bolt 1991:39)
Mathematical activity III: A lover's ultimatum!

I ask you, sir, to plant a grove
To show that I'm your love.
This grove though small must be composed
Of twenty-five trees in twelve straight rows.
In each row five trees you must place
Or you shall never see my face.

(Bolt 1991:51)

4.4.3 Mastery learning strategy

It will be expected from student teachers, both as groups and as individuals, to master the subject content covered by each unit before they proceed to the next. Those who have mastered the content ahead of the others will be given extra challenges to do. This is intended to develop the confidence and positive self-concepts of prospective teachers regarding their knowledge/mastery of Mathematics content (see sections 2.7 and 4.2.3).

4.4.4 Placing research articles and other reading material on self-concept and attitude in the reserve section of the library

Research articles and other reading material on self-concept will be reserved in the library for constant reference by individual students and groups. This is intended to develop self-concept sensitive teachers who are informed about
attitude-related issues. They would then teach the subject content being conscious of learners' self-concepts (see sections 2.7, 3.7 and 4.2.4).

4.4.5 The use of manipulatives and 'hands-on' activities

Manipulatives like models of geometrical figures and those formed by matches, money (for sections on the Mathematics of finance of simple and compound interest), etc will be used in the introduction of new concepts as well as throughout the development process of concepts under consideration. Hands-on activities will include literally counting stationery, types of trees on campus and drawing graphs to represent them in statistics. These activities will also be used in the presentation of the measure of the central tendency concept where objects will be counted and the mean, median and mode determined (see section 4.3.3).

4.4.6 Encouraging student teachers to attend workshops and to read biographies

The researcher will keep in touch with sister colleges of education and neighbouring universities to stay informed about workshops on Mathematics education and biographies on mathematicians. Student teachers will be encouraged to attend these workshops.

The researcher will also acquire as well as compile biographies of renowned female mathematicians. These will be placed in the reserve section of the library for constant reading. Some of the outstanding achievements of the personalities will be related to the class. Additional reading will also be recommended. It will also be expected from groups to present brief biographies of female Mathematics authorities they view in high esteem (see section 4.3.4).
4.4.7 The use of gender-neutral pronouns/emphasis on non-stereotyped roles in creating and using Mathematics word problems

Lesson presentations, test and assignment questions and chores assigned to students will as much as possible be free of gender stereotypes. In life scenarios on which mathematical problems are based as well as in word problems, gender-neutral pronouns and non-stereotyped roles will as much as possible be used (see section 4.3.5).

4.5 Summary

In this chapter a programme to improve the self-concept and attitudes of prospective Mathematics teachers was explained.

In the next chapter, chapter five, the research design to test the effectiveness of the programme and possibly improve the programme will be described.
CHAPTER 5

RESEARCH DESIGN

5.1 Introduction

Chapters 2 and 3 respectively discussed Mathematics self-concept and the improvement thereof and attitudes towards Mathematics and the improvement thereof. Chapter 4 discussed the intervention programme to be used in this study. The discussions of chapters 2 and 3 were based on findings of previous studies on topics related to this study. Chapter 4 is a synthesis of previous research findings discussed in chapters 2 and 3. In it was discussed the different intervention programmes as suggested by previous studies, the synthesis of which form an intervention programme for use in this study.

This chapter outlines the research design to indicate the effectiveness of an intervention programme to improve the Mathematics self-concepts and attitudes of prospective teachers. Specific research questions, null hypotheses and methods to be used in conducting this study will be mentioned.

5.2 Specific research questions

Below follow specific research questions that emanated from the review of the literature on similar topics to test the possible effect of the intervention programme:

(a) Is there any significant difference between the average Mathematics self-concepts of prospective Mathematics teachers before and after the intervention programme?
(b) Is there any significant difference between the average attitudes of prospective teachers towards Mathematics before and after the intervention programme?

(c) Is there a significant difference between the average Mathematics self-concepts of male and female prospective teachers before and after the intervention?

(d) Is there a significant difference between the average attitudes of male and female prospective teachers towards Mathematics before and after the intervention?

(e) Is there any significant difference between the average self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention?

(f) Is there any significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention?

(g) Is there any significant difference between the average self-concepts of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention?

(h) Is there any significant difference between the average attitudes of prospective teachers who major in Mathematics and those who do not before and after the intervention?
5.3 Hypotheses

- Research problem one

**Null Hypothesis**

$H_0$: There is no significant difference in the average Mathematics self-concepts of prospective teachers before and after the intervention.

**Alternative Hypothesis**

$H_1$: There is a significant difference in the average Mathematics self-concepts of prospective teachers before and after the intervention.

- Research problem two

**Null Hypothesis**

$H_0$: There is no significant difference between the average attitudes of prospective teachers towards Mathematics before and after the intervention.

**Alternative Hypothesis**

$H_2$: There is a significant difference between the average attitudes of prospective teachers towards Mathematics before and after the intervention.
• Research problem three

_Null Hypothesis_

\(H_0: \) There is no significant difference between the average self-concepts of male and female prospective primary school teachers before and after the intervention.

_Alt ernative Hypothesis_

\(H_3: \) There is a significant difference between the average self-concepts of male and female prospective primary school teachers before and after the intervention.

• Research problem four

_Null Hypothesis_

\(H_0: \) There is no significant difference between the average attitudes of prospective male and female primary school teachers towards Mathematics before and after the intervention.

_Alt ernative Hypothesis_

\(H_4: \) There is a significant difference between the average attitudes of prospective male and female primary school teachers towards Mathematics before and after the intervention.
- Research problem five

**Null Hypothesis**

$H_0$: There is no significant difference between the average self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention.

$H_a$: There is a significant difference between the average self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention.

- Research problem six

**Null Hypothesis**

$H_0$: There is no significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention.

**Alternative Hypothesis**

$H_a$: There is a significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention.
• Research problem seven

**Null Hypothesis**

H₀: There is no significant difference between the average self-concepts of prospective teachers who major in Mathematics and those who do not before and after the intervention.

**Alternative Hypothesis**

H₁: There is a significant difference between the average self-concepts of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention.

• Research problem eight

**Null Hypothesis**

H₀: There is no significant difference between the average attitudes of prospective teachers who major in Mathematics and those who do not before and after the intervention.

**Alternative Hypothesis**

H₁: There is a significant difference between the average attitudes of prospective teachers who major in Mathematics and those who do not before and after the intervention.
5.4 Research design

The research design of this study is divided into two parts, namely the quantitative and the qualitative research design. Below follows the discussion of each of the research designs referred to above.

5.4.1 Quantitative research design

This is not a true experimental design but a quasi-experimental design, called a one-group pretest-posttest design as described by De Vos, Strydom, Fouché, Poggenpoel and Schurink (1998:129). An experimental design is the only design that can prove empirically that any changes between a pre- and a posttest was due to the intervention (the independent variable). However, because of ethical considerations, an experimental design could not be used in this study. It would have been unethical to use a programme which focussed on the improvement of self-concept and attitude with merely some (and not all) of the students, since it would then favour some students above others. In addition, all the students write the same examinations at the end of the year (De Vos et al 1998:374 & 382).

The dependent variables (Mathematics self-concepts and attitudes towards Mathematics) are measured before the independent variable (the intervention programme) is administered. Thereafter, the independent variable (the intervention programme) is introduced for a period of three months followed by a repeated measurement of the dependent variables at the end of the semester. Moderator variables include: (a) gender, (b) level of Mathematics study and (c) whether the student majors in Mathematics or not. Nuisance variables may include such variables as the natural maturing of students between the pre-test and post-test, pre-test sensitisation and the possibility that attitudes and self-concepts deteriorate as the year progresses and the work gets more difficult.
In chapters 2 and 3 in the literature review the researcher discussed self-concept and attitudes towards Mathematics, respectively. The discussion also included intervention strategies to help enhance favourable self-concepts and attitudes towards Mathematics learning and teaching. These strategies were derived from previous similar studies, although they not necessarily focused on prospective teachers, but on children.

A negligible number of studies tested the effect of the strategies. Hence the need for a study of this kind which tests the effect of an intervention programme on the Mathematics self-concept and attitudes of prospective primary school teachers.

Furthermore, hardly any study has been conducted in the Northern Province to test the effect of an intervention programme on the two aforementioned variables. This study is intended to contribute to the literature on the improvement of Mathematics self-concept and attitudes of prospective primary school teachers towards Mathematics in the Northern Province.

5.4.1.1 Respondents

The population for this study includes all the 1999 Course II Primary Teachers' Diploma (PTD) students at Shingwedzi College of Education in the Northern Province. These students are 160 in total (56 males and 104 females).

5.4.1.2 Instruments

A questionnaire to collect data on the moderator variables as well as on Mathematics self-concepts and attitudes towards Mathematics was administered to and completed by all General Mathematics students at Shingwedzi College of Education. This group was chosen in order to study the diversity of self-concepts and attitudes of all prospective teachers studying at Shingwedzi College, irrespective of whether they specialise in Mathematics or not.
NB: The questionnaire, as well as the key to the questionnaire is attached as Appendices A and B respectively. The key indicates which items focus on which variable. The items are adopted from the literature review in chapters 2 and 3. Some items were modified to suit the respondents for this study.

5.4.1.3 Procedure

Permission for conducting the research was granted by the Rector, the Senior Head of Department as well as the Mathematics Senior Lecturer of Shingwedzi College of Education.

Before the intervention programme was used, a Mathematics Self-concept and Attitudes Questionnaire was to be administered to the student teachers. This pre-testing was intended to gather information on the state of prospective teachers' self-concepts and attitudes regarding Mathematics.

After the questionnaire had been administered, classes commenced where the intervention programme (see chapter 4) was introduced during the normal class sessions.

At the end of the semester, the same questionnaire was post-tested on the same group. This was intended to obtain an indication of whether the programme implemented had had any significant effect on the prospective teachers' Mathematics self-concepts and attitudes towards Mathematics. As indicated before, this was a one-group pretest-posttest design (see section 5.4.1 above).

5.4.1.4 Pilot study

A pilot study was conducted where the questionnaire was administered to 15 prospective teachers. This was intended to identify ambiguous and unclear
items. The wording of items/questions that were found to be ambiguous and unclear were improved.

5.4.1.5 Validity

- Content validity

Content validity is concerned with the representativeness or sampling adequacy of the items of the questionnaire (De Vos et al. 1998:84). The questionnaire was given to an expert to check if the instrument provided an adequate sample of items that represented Mathematics self-concept and attitudes towards Mathematics.

- Face validity

Face validity refers to what the questionnaire 'appears' to measure. Thus the instrument was given to experts to check its face validity. The expert checked to see, on the face of it, if the questions tested the constructs 'self-concept' and 'attitude' (De Vos et al. 1998:84).

5.4.1.6 Reliability

A questionnaire is reliable to the extent that independent administrations of it or a comparable instrument consistently yields similar results under comparable conditions (De Vos et al. 1998:85). The statistical programme which was used to analyse the results of this research used the Cronbach alpha-coefficient. This is a split-halves method. Without reliability there can be no valid results.
5.4.1.7 Analysis of quantitative data

The t-test statistical technique was used to test the hypotheses on whether there was a significant difference between the mean scores on Mathematics self-concept and attitudes before and after the intervention programme was implemented. The significance of the differences was tested at both the 5% - and 1% - levels.

5.4.2 Qualitative research design

5.4.2.1 Introduction

Part 1 of the design explained the quantitative research design. The design involved the administration of a questionnaire and statistically analysed respondents' responses. In the paragraphs that follow it will be explained how the qualitative research was designed.

5.4.2.2 Qualitative research design: focus group interview

De Vos et al (1998:314) describe the focus group interview as a purposive discussion of a specific topic or related topics taking place with eight to ten individuals with a similar background and common interests.

As recommended by De Vos et al (1998:313) the use of the focus group interview in this study is intended to elicit information regarding respondents' experiences with Mathematics. The focus group interview was conducted after the intervention programme had run its course and the posttest questionnaire administration conducted. This was intended to enable respondents to share their mathematical experiences, evaluate the intervention programme and to make suggestions on how the programme could be improved.
For the purpose of this study, the specific topics for discussion in the interview were the students' mathematical experiences during their school career, their experiences of and the evaluation of the intervention programme as well as their recommendations on how the programme could be improved.

The interview further elicited a wealth of information from the respondents. The information was intended to help the researcher to make recommendations. This, the researcher feels, can help to develop a sense of ownership of the improved programme.

5.4.2.3 Instruments

A tape-recorder was used to record the interviews. A video-tape was avoided in order to minimise detracting participants' attention from the interview. An interview guide comprising of a number of questions was prepared to guide the focus group interview.

5.4.2.4 Interview guide

To provide the agenda and structure within which the group members would interact (De Vos et al 1998:318), six open-ended questions were designed (see Appendix D). Standardised open-ended questions were prepared beforehand and participants were asked the same questions (Segale 1999:33). However, the interview guide was flexible. During the interview, probing questions were asked. This was intended to make participants speak freely and to clarify some points. Some of the questions were also rephrased during the interview sessions due to the responses given by the respondents.

The interview was guided by the following six main questions:
(a) There seems to be a general outcry by the private sector, the Government and society in general about the poor Mathematics performance, students' tendency to avoid the subject, students' general dislike of the subject and lack of Mathematics teachers. This is so despite the important role the subject plays in commerce, medicine, information technology, just to mention a few. What do you think are the possible causes of this?

This question was intended to establish a general picture of the kind of experiences with Mathematics that most of the respondents had during their learning of Mathematics. This would indicate, the researcher thought, the form the improved intervention programme would take.

(b) Some researchers e.g. EduSource advocate improved approaches to teacher training to alleviate problems cited in the first question. What are your comments on this?

This question aimed at establishing whether the prospective teachers are satisfied with the current teacher education programmes or not.

(c) How did you experience the programme I did with you in Mathematics this year? How did you feel about strategies like groupwork, e.g. in doing some of the assignments, in preparing for tests and examinations and in studying generally as advocated in the programme? What about the context-based approaches like in word problems, e.g. converting word problems into number sentences and the concrete objects-based approach used in fractions?

This is the key question in the focus group interview because it is intended to encourage the participants to evaluate the intervention programme as they experienced it and to give recommendations on how the programme could be
improved. The question was also intended to establish student teachers' feelings about the diverse aspects of the programme such as groupwork and context-based problems.

(d) How do you think this programme could be improved?

This is also a key question and was intended to elicit students' views on how the intervention programme could be improved.

(e) Many people think they are incompetent in Mathematics. Yet, their performance proves the contrary.

(i) Why do you think people think so?
(ii) How do you think this problem could be solved?

This question was intended to elicit information regarding the distorted self-concepts that some learners have. For instance, one of the prospective teachers who participated in this study and who scored the highest mark in the class was not even taking Mathematics as a major. When asked by the researcher why she is not taking Mathematics as a major subject; she indicated that she knew she was not good at Mathematics. Yet she received the highest mark in the last test that they wrote.

(f) There seems to be a belief in some circles that men perform much better than women in Mathematics. What is your view on this?

This question aimed at determining student teachers' views regarding the notion that Mathematics is a male domain.

However, during the interviews, as pointed out earlier, the need to clarify some of the questions led to encouragement and to the rewording of some of the questions above.
5.4.2.5 Selection of the interview location

One of the teaching practice recording rooms was selected for the focus group interview. The recording rooms were preferred because they are sound-proof, they have fitted tape-recorders and their locality is such that there was no external distractions.

5.4.2.6 Selection and recruitment of participants

To maximise the validity of the findings generated by the focus group interviews, the researcher selected participants who are similar in respect of their level of study (De Vos et al 1998:314). The group members were selected from the 1999 students enrolled for the Senior Primary Teachers’ Diploma, who were all enrolled for the General Mathematics course, which is a compulsory major subject for all students enrolled for a teachers’ diploma at the aforementioned College.

The two groups interviewed each composed of 9 (nine) participants as recommended by De Vos et al (1998:314). To ensure diversity in the groups, the researcher made sure that each group had at least four participants not taking Mathematics as a major subject. Also, the researcher further ensured that at least four of the 9 members of each group were female.

The researcher used the purposive sampling method to select two groups of interviewees. In this respect the following were considered: the students' backgrounds or attitudes towards Mathematics and Mathematics learning, whether they major in Mathematics and whether they are male or female. The purposive sampling method also ensured that only those students who experienced the intervention programme participated in the interview.
Personal invitations to participants were verbally extended five days before the interviews. This was easy for the researcher because he was also the group's General Mathematics lecturer. The researcher arranged a pre-interview meeting with the participants. The purpose of the meeting was to explain to the participants the purpose of the interview as well as to assure them of the confidentiality and anonymity of their responses.

For their benefit as well as for the benefit of all prospective Mathematics learners, participants were requested to respond to interview questions frankly. In their evaluation of the intervention programme, they were requested to tell exactly what they experienced, regardless of whether they felt it would offend the researcher or not. It was further highlighted to them that their constructive criticism of the programme would help the researcher to improve the programme for future use. The importance of their participation and responses in the interview was stressed for the improvement of national Mathematics teaching and learning.

This pre-interview meeting also culminated in a joint compilation of ground rules to govern the interview sessions. The following are the ground rules that were written on the board in the recording room:

(a) Everybody's views/ideas are important;
(b) nobody must be intimidated for having contrary views;
(c) there are no right or wrong ideas and answers to questions;
(d) people not invited are not allowed in the interview room;
(e) frankness is very important in participants' responses;
(f) no cellphones may be activated during interview sessions;
(g) participants' responses are confidential;
(h) each participant is expected to wear a name tag with only his/her first name written on it.
This meeting also provided the researcher with the opportunity of establishing rapport with the participants and of creating a warm and friendly atmosphere for the interview.

5.4.2.7 Physical arrangement of the group

The nine participants per session together with the researcher sat around a table. This was intended to maximise the opportunity for eye contact with the researcher as well as with the other participants (De Vos et al 1998). To enhance rapport among all the participants, nametags were worn by everybody including the researcher in the recording room. On the tag was a nickname or any name with which the participant felt comfortable.

5.4.2.8 Recording of the focus group interview

The interview proceedings were tape-recorded. Upon completion of the two interviews, the researcher transcribed the interviews (See Appendix D for fully transcribed interviews). Apart from the recording, the researcher also observed the participants’ gestures, facial expressions, intonation as well as other responses to what a particular speaker was saying.

5.4 Summary

Firstly, this chapter discussed the way in which the eight (8) research questions and their corresponding hypothesis were investigated, using a quantitative empirical research design. The statistical technique that was used in testing the hypotheses was also mentioned.

Secondly, the way in which the qualitative research was conducted using focus group interviews was also elucidated.
In the next chapter, the results of the pre- and posttests by means of a questionnaire and the focus group interviews will be presented and discussed.
CHAPTER 6

RESULTS AND DISCUSSION

6.1 Introduction

In the previous chapter the research design was explained. In this chapter the results of (a) the statistical analyses of data with regard to the self-concepts of the prospective teachers and the attitudes of the prospective teachers towards Mathematics as well as (b) the focus group interviews regarding the origins of self-concepts and attitudes towards Mathematics, the evaluation of the intervention programme and how the programme can be improved are presented and discussed.

6.2 Results of the quantitative research: the questionnaire

6.2.1 Reliability of the questionnaire

According to the calculated Cronbach-Alpha-Coefficient, the reliability of the questionnaire is 0.9, which is very good.

6.2.2 Results of statistical analyses

6.2.2.1 Biographical data

The biographical data of the respondents are as follows:

Number of students who wrote the pre-test = 160
Number of students who wrote the prost-test = 160
Number of males who wrote the pre-test = 56
Number of females who wrote the pre-test = 104
Number of males who wrote the post-test = 55
Number of females who wrote the post-test = 105
Number of students who did Mathematics up to standard 8 in the pre-test = 98
Number of students who did Mathematics up to standard 10 in the pre-test = 62
Number of students who did Mathematics up to standard 8 in the post-test = 95
Number of students who did Mathematics up to standard 10 in the post-test = 65
Number of students who major in Mathematics in the pre-test = 33
Number of students who do not major in Mathematics in the pre-test = 127
Number of students who major in Mathematics in the post-test = 37
Number of students who do not major in Mathematics in the post-test = 122

6.2.2.2 Problem statement one

Is there a significant difference between the average Mathematics self-concepts of prospective Mathematics teachers before and after an intervention programme?

Null Hypothesis

\( H_0: \) There is no significant difference in the average Mathematics self-concepts of prospective teachers before and after the intervention programme.

Alternative Hypothesis

\( H_1: \) There is a significant difference in the average Mathematics self-concepts of prospective teachers before and after the intervention programme.
A t-test (for related groups) was given. The results are shown in table 4.

Table 4  
<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>160</td>
<td>120,58</td>
<td>22,502</td>
<td>-0,4334</td>
<td>318</td>
<td>p&gt;0,05</td>
</tr>
<tr>
<td>Posttest</td>
<td>160</td>
<td>121,66</td>
<td>22,123</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 4, p is greater than 0,05 (Freund & Williams 1982:555; Huysamen 1987:164; Mulder 1989:236 – 237), thus the null hypothesis cannot be rejected. Therefore, there is no significant difference between the average Mathematics self-concepts of prospective Mathematics teachers before and after an intervention programme even though there is an improvement of self-concept in the post-test.

6.2.2.3 Problem statement two

Is there a significant difference between the average Mathematics attitudes of prospective Mathematics teachers before and after an intervention programme?

*Null Hypothesis*

H₀: There is no significant difference between the average Mathematics attitudes of prospective Mathematics teachers before and after the intervention programme.
**Alternative Hypothesis**

H₂: There is a significant difference between the average Mathematics attitudes of prospective Mathematics teachers before and after the intervention programme.

A t-test (for related groups) was done. The results are as follows:

Table 5  

t-value and probability of attitude of prospective teachers before and after an intervention programme.

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>160</td>
<td>223,23</td>
<td>23,096</td>
<td>1,0031</td>
<td>318</td>
<td>p&gt;0,05</td>
</tr>
<tr>
<td>Posttest</td>
<td>160</td>
<td>220,48</td>
<td>25,972</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5 indicates that there is no significant difference between the two means since the calculated t-value is 1,0031 which is less than the table value t₀.₀₅=1,960 for a two-tailed test at degrees of freedom = infinity (Freund & Williams, 1982:555; Huysamen 1987:164; Mulder 1989:236 – 237). Therefore, there is no significant difference between the average Mathematics attitudes of prospective Mathematics teachers before and after an intervention programme - p>0,05. The small and insignificant decline in attitude could be attributed to an increase in subject content difficulty as the year progresses.

6.2.2.4 Problem statement three

Is there a significant difference between the average Mathematics self-concepts of male and female prospective Mathematics teachers before and after an intervention programme?
**Null Hypothesis**

H<sub>0</sub>: There is no significant difference between the average Mathematics self-concepts of male and female prospective Mathematics primary school teachers before and after the intervention programme.

**Alternative Hypothesis**

H<sub>3</sub>: There is a significant difference between the average Mathematics self-concepts of male and female prospective Mathematics primary school teachers before and after the intervention programme.

Four t-tests were done: (i) between male and female self-concepts before the programme; (ii) between male and female self-concepts after the programme; (iii) between males' self-concepts before and after the programme; (iv) between females' self-concepts before and after the programme.

The results appear in tables 6, 7, 8 and 9 below.

**Table 6**
t-value and probability of self-concept of male and female prospective teachers before an intervention programme.

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>56</td>
<td>122,95</td>
<td>22,896</td>
<td>0,9780</td>
<td>158</td>
<td>p&gt;0,05</td>
</tr>
<tr>
<td>Female</td>
<td>104</td>
<td>119,30</td>
<td>22,294</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 6, there is a difference between the average Mathematics self-concepts of male and female teachers before the intervention programme in favour of male student teachers. However, the difference is not significant, since p>0,05.
Table 7  t-value and probability of self-concept of male and female prospective teachers after an intervention programme.

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>55</td>
<td>125.16</td>
<td>21.026</td>
<td>1.4565</td>
<td>158</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Female</td>
<td>105</td>
<td>119.92</td>
<td>22.556</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7 shows that there is a difference between male and female prospective Mathematics teachers after an intervention programme still in favour of male student teachers. However, the difference is still not significant since the probability is greater than 0.05.

Table 8  t-value and probability of self-concept of male prospective teachers before and after an intervention programme.

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>56</td>
<td>122.95</td>
<td>22.896</td>
<td>-0.5311</td>
<td>109</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Posttest</td>
<td>55</td>
<td>125.16</td>
<td>21.026</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In accordance with table 8, comparing the mean self-concept scores of male prospective teachers before and after an intervention programme shows a slight but not significant (since p>0.05) improvement in their Mathematics self-concepts.
Table 9  

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>104</td>
<td>119,30</td>
<td>22,294</td>
<td>-0.1679</td>
<td>207</td>
<td>p&gt;0,05</td>
</tr>
<tr>
<td>Posttest</td>
<td>105</td>
<td>119,82</td>
<td>22,556</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 9, p>0,05. Thus, there is no significant difference between the self-concept of female prospective teachers before and after an intervention programme. However, the fact that their mean score after intervention exceeds the one before the intervention shows that their self-concepts improved, though not significantly.

Tables 8 and 9 show that the Mathematics self-concepts improved a little after the intervention programme. However, since the p>0,05, the improvement was not significant.

6.2.5 Problem statement four

Is there a significant difference between the average Mathematics attitudes of male and female prospective Mathematics teachers before and after an intervention programme.

**Null Hypothesis**

H₀: There is no significant difference between the average Mathematics attitudes of male and female prospective Mathematics teachers before and after the intervention programme.
Alternative Hypothesis

H₄: There is a significant difference between the average attitudes of prospective male and female primary school Mathematics teachers towards Mathematics before and after the intervention programme.

Four t-tests were done: (i) between male and female attitudes before the programme; (ii) between male and female attitudes after the programme; (iii) between males' attitudes before and after the programme; (iv) between females' attitudes before and after the programme.

T-value statistical analysis reveals the following results in tables 10 to 13:

Table 10  t-value and probability of attitude of male and female prospective teachers before an intervention programme.

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>56</td>
<td>222.98</td>
<td>24.975</td>
<td>-0.0998</td>
<td>158</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Female</td>
<td>104</td>
<td>223.37</td>
<td>22.143</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 10, the male and female prospective teachers did not differ significantly with regard to their average Mathematics attitudes before the intervention programme. However, the female mean score was higher than the male mean score implying that female attitudes may be more positive.
Table 11  t-value and probability of attitude of male and female prospective teachers after an intervention programme.

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>55</td>
<td>224,07</td>
<td>25,339</td>
<td>1,2706</td>
<td>158</td>
<td>p&gt;0,05</td>
</tr>
<tr>
<td>Female</td>
<td>105</td>
<td>218,59</td>
<td>26,219</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 11, the male and female prospective teachers did not differ significantly in respect of their average Mathematics attitudes after the intervention programme since the probability value is greater than 0,05. Noteworthy, however, is the observation that in this instance it is the male student teachers who obtained a higher attitude mean score.

Table 12  t-value and probability of attitude of male prospective teachers before and after an intervention programme.

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>56</td>
<td>222,98</td>
<td>24,975</td>
<td>-0,2284</td>
<td>109</td>
<td>p&gt;0,05</td>
</tr>
<tr>
<td>Posttest</td>
<td>55</td>
<td>224,07</td>
<td>25,339</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 12 indicates that, though not significantly, there is a difference in the attitudes of male prospective teachers before and after the intervention programme. The average mean of the males’ attitudes is higher after the intervention programme than before.
Table 13  
t-value and probability of attitude of female prospective teachers **before and after** an intervention programme.

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>104</td>
<td>223.37</td>
<td>22.143</td>
<td>1.4217</td>
<td>207</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Posttest</td>
<td>105</td>
<td>218.59</td>
<td>26.219</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 13, there is a difference between the attitudes of female prospective teachers before and after an intervention programme though not significant, since p>0.05. Furthermore, noteworthy is the finding that the mean attitude score of female prospective teachers declined after the intervention programme. This could be attributed to both societal gender expectations as cited under table 9 as well as an increase in content difficulty as lessons moved towards the advanced level of content (see section 3.5).

However, on the whole, tables 12 and 13 bring contrasting and interesting results to light. The fact that, though not significant, male student teachers' attitudes improved during the intervention while that of female student teachers declined (though attitudes did not deteriorate significantly) is indicative of the wealth of frontiers still to be explored in this area.

6.2.2.6  Problem statement five

Is there a significant difference between the average Mathematics self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 **before and after** an intervention programme?
Null Hypothesis

$$H_0:$$ There is no significant difference between the average Mathematics self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 before and after the intervention programme.

Alternative Hypothesis

$$H_1:$$ There is a significant difference between the average Mathematics self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 before and after the intervention programme.

Four t-tests were done: (i) between standard 8 group's and standard 10 group's self-concepts before the programme; (ii) between standard 8 group's and standard 10 group's self-concepts after the programme; (iii) between standard 8 group's self-concepts before and after the programme; (iv) between standard 10 group's self-concepts before and after the programme.

Results are shown in tables 14, 15, 16 and 17 below.

<table>
<thead>
<tr>
<th>Standard</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight</td>
<td>98</td>
<td>114,98</td>
<td>22,935</td>
<td>-4,1514</td>
<td>158</td>
<td>p&lt;0,01</td>
</tr>
<tr>
<td>Ten</td>
<td>62</td>
<td>129,42</td>
<td>18,804</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
According to table 14, p<0.01. Thus, the null hypothesis is rejected on the 1%-level of significance. Therefore, there was a significant difference between the average Mathematics self-concepts of the standard 8 and standard 10 groups before any intervention on the 1%-level of significance. The Mathematics self-concepts of the standard 10 group were significantly better than that of the standard 8 group. This may be attributed to the fact that students with more positive Mathematics self-concepts may be more inclined to continue their studies to a later stage.

Table 15  
t-value and probability of self-concept of prospective teachers with standard 8 or standard 10 Mathematics after an intervention programme.

<table>
<thead>
<tr>
<th>Standard</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight</td>
<td>95</td>
<td>117.52</td>
<td>23.724</td>
<td>-3.0801</td>
<td>156.1</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>Ten</td>
<td>65</td>
<td>127.71</td>
<td>18.071</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 15, there was a significant difference between the average self-concepts of the standard 8 and standard 10 group after intervention on the 1%-level of significance. The Mathematics self-concepts of the standard 10 group were significantly better than that of the standard 8 group.

In this instance variances were unequal. Under the assumption of unequal variances, the approximate t is computed as

\[ t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \]

The formula for Satterwaite's approximation for the degrees of freedom is as follows:

\[ df = \frac{(s_1^2/n_1 + s_2^2/n_2)/\{[(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)]\}^{1/2}}{[(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)]} \]


Table 16  

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>98</td>
<td>114.98</td>
<td>22.935</td>
<td>-0.7551</td>
<td>191</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Posttest</td>
<td>95</td>
<td>117.52</td>
<td>23.724</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 15, the self-concept of prospective teachers with standard 8 Mathematics improved, though not significantly. This small improvement may be attributed to groupwork, hands-on as well as context-based approaches used in the intervention. This possibly made them realise how practical and transferable Mathematics is to real life situations. The group assignments that made them share the success and pride of obtaining a relatively high score may have boosted their self-concepts as well. The conducive environment created by groups for help-seeking could also have contributed towards this improvement. However, since \( p>0.05 \) the null-hypothesis may not be rejected.
Table 17  t-value and probability of self-concept of prospective teachers with standard 10 Mathematics before and after an intervention programme.

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>62</td>
<td>129.42</td>
<td>18.804</td>
<td>0.5231</td>
<td>125</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Posttest</td>
<td>65</td>
<td>127.71</td>
<td>18.072</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 17, the self-concept mean score of prospective teachers with standard 10 declined somewhat, though not significantly since p>0.05. The score may have deteriorated as a result of the relatively low level at which the content was taught. This might have made the content less challenging and more boring and monotonous to those who have done Mathematics up to standard 10.

6.2.2.7 Problem statement six

Is there a significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 before and after an intervention programme?

**Null Hypothesis**

H₀: There is no significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 before and after the intervention programme.
Alternative Hypothesis

H₆: There is a significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 before and after the intervention programme.

Four t-tests were done: (i) between the standard 8 group's and the standard 10 group's attitudes before the programme; (ii) between the standard 8 group's and standard 10 group's attitudes after the programme; (iii) between the standard 8 group's attitudes before and after the programme; (iv) between the standard 10 group's attitudes before and after the programme.

The results are depicted in tables 18, 19, 20 and 21 below.

Table 18  t-value and probability of attitude of prospective teachers with standard 8 or standard 10 Mathematics before the intervention programme.

<table>
<thead>
<tr>
<th>Standard</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight</td>
<td>98</td>
<td>220,092</td>
<td>24,340</td>
<td>-2,1872</td>
<td>158</td>
<td>p&lt;0,05</td>
</tr>
<tr>
<td>Ten</td>
<td>62</td>
<td>228,194</td>
<td>20,187</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 18 there was a significant difference between the average attitudes of the standard 8 and standard 10 group before any intervention on the 5%-level of significance. As may be expected, the Mathematics self-concepts of the standard 10 group were significantly better than that of the standard 8 group.
Table 19  t-value and probability of attitude of prospective teachers with standard 8 or standard 10 Mathematics after the intervention programme.

<table>
<thead>
<tr>
<th>Standard</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight</td>
<td>95</td>
<td>218,495</td>
<td>28,906</td>
<td>-1,2391</td>
<td>157,5</td>
<td>p&gt;0,05</td>
</tr>
<tr>
<td>Ten</td>
<td>65</td>
<td>223,369</td>
<td>20,839</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 19, there was a difference between the average attitudes of the standard 8 and standard 10 group (in favour of the standard 10 group) after the intervention programme. The difference was, however, not significant.

In this instance variances were unequal. Under the assumption of unequal variances, the approximate t is computed as

\[ t = \frac{(x_1 - x_2) \cdot (s_1^2/n_1 + s_2^2/n_2)^{1/2}}{(s_1^2/n_1)^{1/2}/(n_1 - 1) + (s_2^2/n_2)^{1/2}/(n_2 - 1)} \]


The formula for Satterwaite's approximation for the degrees of freedom is as follows:

\[ df = \frac{(s_1^2/n_1 + s_2^2/n_2)\cdot[(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)]}{(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)} \]

Table 20  
t-value and probability of attitude of prospective teachers with standard 8 Mathematics before and after an intervention programme.

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>98</td>
<td>220.092</td>
<td>24.340</td>
<td>0.4157</td>
<td>191</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Posttest</td>
<td>95</td>
<td>218.495</td>
<td>28.906</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 20 depicts a difference between the average attitudes of prospective teachers with standard 8 Mathematics before and after the intervention programme. The difference was, however, not significant. The average Mathematics score of this group deteriorated after the intervention programme. This may be attributed to the greater difficulty level as the course advanced during the course of the year. So, with the group like this one, some of whose mathematical experiences were not favourable, the more the content becomes difficult, the more negative their attitudes may become in spite of the intervention programme.

Table 21  
t-value and probability of attitude of prospective teachers with standard 10 Mathematics before and after an intervention programme.

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>62</td>
<td>228.1935</td>
<td>20.1867</td>
<td>1.3242</td>
<td>125</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Posttest</td>
<td>65</td>
<td>223.3692</td>
<td>20.8391</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 21 shows that there is a difference between the attitudes of prospective teachers with standard 10 Mathematics before and after the intervention programme. The difference, however, was not significant as p>0.05. The mean
attitude score of prospective teachers with standard 10 Mathematics deteriorated in spite of the intervention programme. This decline could be attributed to the concrete level at which most of the content was treated. Therefore, in the case of students who had exposure to advanced level Mathematics like these, content presented in this manner could be less challenging, boring and monotonous. This can result in a decline in attitudes towards the subject as a whole.

6.2.2.8 Problem statement seven

Is there a significant difference between the average self-concepts of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after an intervention programme?

**Null Hypothesis**

$H_0$: There is no significant difference between the average Mathematics self-concepts of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention programme.

**Alternative Hypothesis**

$H_7$: There is a significant difference between the average Mathematics self-concepts of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention programme.

Four t-tests were done: (i) between the average self-concepts of the group who majors in Mathematics and the group who doesn’t major in Mathematics before the programme; (ii) between the average self-concepts of the group who majors
in Mathematics and the group who doesn't major in Mathematics after the programme; (iii) between the average self-concepts of the group who majors in Mathematics before and after the programme; (iv) between the average self-concepts of the group who doesn't major in Mathematics before and after the programme.

Results appear in tables 22, 23, 24 and 25 below.

Table 22  

<table>
<thead>
<tr>
<th>Major</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>33</td>
<td>137.70</td>
<td>14.647</td>
<td>6.7078</td>
<td>158</td>
<td>p&lt;0,01</td>
</tr>
<tr>
<td>No</td>
<td>127</td>
<td>116.13</td>
<td>22.085</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 22 there was a significant difference between the average self-concepts of the groups who major or do not major in Mathematics before any intervention on the 1%-level of significance. The Mathematics self-concepts of the group majoring in Mathematics were significantly better than that of the group who does not major in Mathematics.

In this instance variances were unequal. Under the assumption of unequal variances, the approximate t is computed as

\[ t = \frac{(\bar{x}_1 - \bar{x}_2)}{(s_1^2/n_1 + s_2^2/n_2)} \]

The formula for Satterwaite's approximation for the degrees of freedom is as follows:

$$df = (s_1^2/n_1 + s_2^2/n_2)/[(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)]$$


Table 23 t-value and probability of self-concept of prospective teachers who major or do not major in Mathematics after an intervention programme.

<table>
<thead>
<tr>
<th>Major</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>37</td>
<td>130.73</td>
<td>16.294</td>
<td>3.5285</td>
<td>83,5</td>
<td>p&lt;0,01</td>
</tr>
<tr>
<td>No</td>
<td>122</td>
<td>118.76</td>
<td>22.979</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 23 there was a significant difference between the average self-concepts of the groups who major or do not major in Mathematics after intervention on the 1%-level of significance. The Mathematics self-concepts of the group majoring in Mathematics were significantly better than that of the group who does not major in Mathematics.

In this instance variances were unequal. Under the assumption of unequal variances, the approximate t is computed as

$$t = (\bar{x}_1 - \bar{x}_2)/(s_1^2/n_1 + s_2^2/n_2)$$


The formula for Satterwaite's approximation for the degrees of freedom is as follows:
df = \frac{(s_1^2/n_1 + s_2^2/n_2)/[(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)]]}{161x663}\text{ (SAS User's Guide 1985:797)}

Table 24  
<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>33</td>
<td>137.70</td>
<td>14.647</td>
<td>1.8724</td>
<td>68</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Posttest</td>
<td>37</td>
<td>130.73</td>
<td>16.294</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 24, there is no significant difference in the self-concepts of prospective teachers who major in Mathematics before and after an intervention programme.

Table 25  
<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>127</td>
<td>116.13</td>
<td>22.085</td>
<td>-0.9231</td>
<td>247</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Posttest</td>
<td>122</td>
<td>118.76</td>
<td>22.979</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 25 indicates that there is no significant difference in the self-concepts of prospective teachers who do not major in Mathematics before and after the intervention programme since p>0.05. However, the average self-concept scores improved a little after the intervention. This improvement could be attributed to the context-based and hands-on approach as well as the groupwork used in the
programme. The context-based, real-life context approaches used might have improved students' understanding and performance. Group work might have provided students who did not do Mathematics as a major with partners to provide help and support where they did not understand. As a result, all this might account for the small improvement in self-concept of this group of students.

6.2.2.9 Problem statement eight

Is there a significant difference between the average attitudes of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after an intervention programme?

**Null Hypothesis**

$H_0$: There is no significant difference between the average attitudes of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention programme.

**Alternative Hypothesis**

$H_a$: There is a significant difference between the average attitudes of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention programme.

Four t-tests were done: (i) between the average attitudes of the group who majors in Mathematics and the group who doesn't major in Mathematics before the programme; (ii) between the average attitudes of the group who majors in Mathematics and the group who doesn't major in Mathematics after the programme; (iii) between the average attitudes of the group that majors in Mathematics before and after the programme; (iv) between the average attitudes of the group that doesn't major in Mathematics before and after the programme.
Tables 26, 27, 28 and 29 show the results.

Table 26  

<table>
<thead>
<tr>
<th>Major</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>33</td>
<td>232.82</td>
<td>18.802</td>
<td>2.7302</td>
<td>158</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>No</td>
<td>127</td>
<td>220.74</td>
<td>23.517</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 26 there was a significant difference between the average attitudes of the groups who major or do not major in Mathematics before any intervention on the 1%-level of significance. The Mathematics attitudes of the group majoring in Mathematics were significantly better than that of the group who do not major in Mathematics. Students with positive attitudes towards Mathematics are probably more inclined to major in Mathematics than those who do not have these favourable attitudes.

Table 27  

<table>
<thead>
<tr>
<th>Major</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>37</td>
<td>227.08</td>
<td>16.235</td>
<td>2.4111</td>
<td>104.7</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>No</td>
<td>122</td>
<td>218.21</td>
<td>27.951</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 27 there was a significant difference between the average attitudes of the groups who major or do not major in Mathematics after the
intervention programme on the 5%-level of significance. The average Mathematics attitudes of the group who majors in Mathematics are significantly better than that of the group who does not major in Mathematics.

In this instance variances were unequal. Under the assumption of unequal variances, the approximate t is computed as

\[ t = \frac{(x_1 - x_2)}{(s_1^2/n_1 + s_2^2/n_2)} \]


The formula for Satterwaite's approximation for the degrees of freedom is as follows:

\[ df = \frac{(s_1^2/n_1 + s_2^2/n_2)/\{(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)\}}{\} \]


Table 28  t-value and probability of attitudes of prospective teachers who major in Mathematics before and after an intervention programme.

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>33</td>
<td>232,82</td>
<td>18,802</td>
<td>1,3700</td>
<td>68</td>
<td>p&gt;0,05</td>
</tr>
<tr>
<td>Posttest</td>
<td>37</td>
<td>227,08</td>
<td>16,235</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 28, there is a difference in the attitudes of prospective teachers who major in Mathematics before and after the intervention programme. The difference is, however, not significant.
Table 29  

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t-value</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>127</td>
<td>220,74</td>
<td>23,517</td>
<td>0,7731</td>
<td>247</td>
<td>p&gt;0,05</td>
</tr>
<tr>
<td>Posttest</td>
<td>122</td>
<td>218,21</td>
<td>27,951</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to table 29 there is a difference between the attitudes of prospective teachers who do not major in Mathematics before and after the intervention programme on the 5%-level of significance. The difference, however, was not significant. The average attitude score of prospective teachers who do not major in Mathematics declined after the intervention programme. This decline could be attributed to the complexity of subject content as the year progresses.

6.3 Results of the qualitative research: the focus group interview

6.3.1 Examples of raw data

The pool of information that was gathered through the focus group interviews warranted the reduction of data into a whole that can be easily managed and communicated. This necessitated the need for the researcher to use open coding (Segale 1999:34). Segale (1999:34) further quotes Strauss and Corbin defining 'open coding' as a process through which we break down data, conceptualise it and then put it back together in new ways.

The researcher coded the transcribed interview data (which appear in Appendix E) by going through it and giving each separate unit of meaning a label (Segale 1999:34). Similar units were given the same label. After labeling units and
assigning a code to each, they were grouped into categories. Those that were alike in meaning were grouped under one category with a name that represent the properties that fell under it.

Examples of raw data from transcribed focus group interviews appear in tables 30 to 35.

Table 30 Examples of raw data from Question 1

<table>
<thead>
<tr>
<th>INTERVIEWEE</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>...Everything as a problem ... begins from the lower learning institutions like secondary and the primary level. The motivation ... found there is not well whereby they come to be discouraged by their peers ... they are told that Mathematics is a difficult subject. ... So, they come to a point where they come to dislike Maths and think Mathematics is difficult. That no one can make it in Mathematics. As a result, most of the people tend to dislike maths ...</td>
</tr>
<tr>
<td>Student</td>
<td>... the teachers were not well-trained ... if the teacher happens to ask questions the way he (student) was treated ... was bad. In such ways as “You stupid. How can you answer like that?” And that’s a bad motivation and a learner happens</td>
</tr>
</tbody>
</table>
to dislike the subject due to the fact that he will be
discouraged in front of other students. Even the teachers
themselves, if a learner needs clarity in a certain section, you
find that, instead of explaining to the learner, he just says well
come and meet me in the office”. Then when you go to the
office he says “Don’t bother me, I’m busy”. Then he happen to
avoid you always. Then you happen not to find the answer of
what you were in need of understanding. That may be the
cause.

... untrained teachers usually promote rote-learning. And
Maths is not a subject where one can memorise. You need to
understand the whole information ... They used to memorise
things (content) without knowing that thing. Because
sometimes when the learner ask some questions they fail to
answer ... So they made students to not be interested to
continue with Mathematics.

Another thing. That’s what happened to me ... When I was in
standard 10. I started doing maths from standard 6. Liking
maths very much. Standard 6, 7, 8 performing very well ...
When I was in standard 10, I still remember, we were being
taught by another teacher. Then, one time..., he asked the
whole class if there is no one who is having a problem. Then I
raised my hand saying that I’m having a problem. Then the
teacher responded saying “Where are you having problems?”
Then I explained. Then he told me that I mustn’t be a fool ...
Then from that day I started dodging his classes ...

... With Mathematics I can make it. I can ... i know
Mathematics, but because of the teacher I have a bad
| Student | attitude. If I try to practice Mathematics, when I start writing I see my memory seeing my teacher who is there at the table ...  
... some of the teachers ... don't have the background of the subject. You can find that the teacher teaches a class, if a learner asks a question ... "How (did) you come to the point (particular step)?" And the teacher explain saying that in the textbook they show that we have to follow these steps. He did not understand why.  
Student | ... Teachers used to come to class without preparing themselves. ... they never knew what to teach. They just came with textbook and refer. So when they get stuck it was a little bit difficult to carry forward. So they decided to stop the child from asking questions. So that is why so many students have decided not to take Mathematics  
Student | ... in secondary schools, teachers they have got a tendency of maybe recognising the excellent students in the sense that they are always next to them. They don't like to help other students who are a little bit dull ... Then as such it results in maybe students leaving Mathematics.  
Student | ... teachers failed to know their learners.... So on teaching they focus on the learners who are gifted and reject others and at the end they tell the others that "You are stupid, you are a failure, you don't cope in Mathematics. Go and do History and Geography because you are good for History ..."  |
Table 31: Examples of raw data from Question 2

**Question 2:** Many people think they are incompetent in Mathematics. Yet, there are theories that indicate that everybody learn equally well but at different paces.

(i) Why do you think people think this way?
(ii) How do you think this could be solved?

<table>
<thead>
<tr>
<th>INTERVIEWEE</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>... this might be because of the poor performance which they had before, especially in the lower primary. Something like that ... Well the attitudes which they were having the time they were doing lower standards. Say, for instance my performance was very much poor there I have to say that I am not competent in Mathematics because my performance was very much poor ... That's what my history tells me. So the first thing that I have to get is the encouragement by my friends and even the teachers themselves.</td>
</tr>
<tr>
<td>Student</td>
<td>In the part when a person do Mathematics in the class with other students, when he gets a high mark ... people ... started to take him (her) as a higher person in other words. They say that person or that lady ... knows Maths ... than others. We are doing Mathematics in the class but in most cases she gets high marks. She is very clever as if she is not a lady. So that is what is happening.</td>
</tr>
<tr>
<td>Student</td>
<td>I want to say that the dislike between two persons contributes a division between two people. If I like a Mathematics teacher, I understand more when he/she teach ... But if I hate, if I hate that person ... maybe something happened between me and</td>
</tr>
</tbody>
</table>
| Student | him. That is the contribution that learners understand or not understand Mathematics ... Learners and teachers must create a ... a more a ... good relationship. If I ... I ... little something I don't understand if I ask you can tell me in a good way. If you took me and tell me in a bad way maybe I hate you sometimes.

Another thing. I will refer this to our outcome after a test. The way we were treated by our teachers made us change ... to have a bad attitude towards Mathematics. Then you hear some of students saying I'm not competent in Mathematics. Yeah, I'm saying this because at most ... Let's take, for instance, a particular learner in a class happen to get the high score say 90%. The child was given maybe an award – maybe R5. So it was a little bit painful to me as I got say for instance 10% because there was nothing I got ... So that was another cause to make me think I'm not competent in Mathematics. So I better leave it. |
### Question 3: Some research institutions like EduSource, advocate improved approaches to teacher education to alleviate problems cited in the first question. What is your comment on this? How do you view this?

<table>
<thead>
<tr>
<th>INTERVIEWEE</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>... I think the style of teaching must be improved ... Because what I have realised there is ... you find that a teacher knows Maths very well but fails to present the matter to the learners. So maybe the problem is they have not been taught how to teach ... how to present the matter.</td>
</tr>
<tr>
<td>Student</td>
<td>... I come to realise that the problem starts from teacher training ... because teachers are trained to teach OBE ... They are just given information theoretically without demonstration that in OBE in most cases what is expected. Only from the papers (handouts) you find the information that this and this need to be done. But you see some things need to be done practically so that we copy from the practical things that one has seen. Then I think most of the teachers they have a problem ... I remember in my secondary level ... one teacher ... was teaching us Mathematics, then he is giving the formulas ... When we ask where these formulae come from he could not clearly explain where it comes from. He would just say &quot;Just memorise it and write! What is expected of you is to write and get marks. Then take it as it is.&quot; Then he go on and say &quot;This formula we cannot know where it comes from.&quot; ... Even the OBE that is orientated to teachers. Most of the</td>
</tr>
</tbody>
</table>
teachers are not going to implement that OBE very well. Why? Because they only know that there is OBE and what is expected in the OBE and no one has put it into practice.

Table 33: Examples of raw data from Question 4

<table>
<thead>
<tr>
<th>INTERVIEWEE</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>... It was very much good. We have learned so many things. We should be able to deliver to learners out there.</td>
</tr>
<tr>
<td>Student</td>
<td>Actually, ... the way you were teaching us, the strategies which you have used, we never knew that before. You have come with so many things which made us ... understand those things better. Unlike the way we learned before.</td>
</tr>
<tr>
<td>Student</td>
<td>... I'm having the view of ... the group discussion that you implemented to us. It was very good because you told the students majoring in Mathematics to mix with those doing General Mathematics only. And then that helped us. It made we as academic students to help the students that are not doing Mathematics academic. That made us to enable them to pass.</td>
</tr>
</tbody>
</table>
| Student     | ... This year, to my side, you know I gained a lot. Yeah, I 

Question 4: How did you experience the programme I did with you in General Mathematics? How did you feel about strategies like groupwork, e.g. in doing assignments and preparing for tests and examinations as advocated by this intervention programme? What about context-based approaches like word problems, e.g. in number sentences?
gained a lot. I had a big change compared to the performance that I had during my high school.

At the group, I realised that every student ... are (is) free to ask questions. But in the class we are not free ... So groupwork is very well for us.

In group work I have realised students gain a lot because in a class you can treat one problem, but when you go outside there in your groups you can treat lot of problems. And one is able to understand what he did not understand during the learning process.

Another thing in groups which is fruitful is that because they are my colleagues, I can ask anything ... I don’t understand. But to ask a lecturer because lecturers are not the same. Others when they get to the class they are just pulling the face ... So we can’t ask anything if someone is pulling one’s face, because you don’t know what’s happening ... But when you are in a group you feel free to ask ...

... We are learning in large numbers. So if I raise my hand and ask my question other students will boo at me. That makes me not to understand everything. In that way my confidence is decreasing. I can’t continue asking questions during lessons.

It had a positive influence ... because from now I can interpret things in theory again into a practical form. Because now for example ... I am a caretaker in the kitchen so yesterday the machine that is used to cut bread was not working. So ... um we divided the number of those loaves to get the number of
those students. And in a loaf we were supposed to have three thirds.

Table 34: Examples of raw data from Question 5

<table>
<thead>
<tr>
<th>INTERVIEWEE</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>... We have agreed that in every group there is one who is majoring in Maths academic. So, we must be able to make sure that we don't leave that system. We must be able to continue with that ... so that he/she can help them when they get stuck.</td>
</tr>
<tr>
<td>Student</td>
<td>I think it can be good if you can give us problems to treat before a chapter (is treated) to encourage one another. That we want to know before you can teach us.</td>
</tr>
<tr>
<td>Student</td>
<td>For my side is protection in the classroom situation ... You know, people if we are of the same age we get to undermine each other ... When a person as a question you find that somebody is grumbling on the other side. So the lecturer or the teacher that is teaching that time should protect that person who is asking the question. So that he may feel free to raise his problem that he experience. Because if there is no protection he or she will be afraid to raise a problem in front of the people. Of which she will be lost and can't cope.</td>
</tr>
<tr>
<td>Student</td>
<td>I think during learning you should promote asking questions. It will develop confidence in the learner.</td>
</tr>
<tr>
<td>Student</td>
<td>... I think in your case during learning situation, the only problem that I have experienced is whereby the approach (method) was changed suddenly. You see whereby when one is lecturing then he discovers that the approach (method) ... seems not to work well ... for the learners. Well, he suddenly change it. I somewhere, somehow wanted to be confused. I am not saying the style is wrong, but I wanted to encourage the approach whereby you choose one method. Or you compare the methods, then you choose one that you think will be best. Not changing it in a learning situation.</td>
</tr>
<tr>
<td>Student</td>
<td>... In the case of changing methods I think to use one method is very dangerous, 'cause you find that another student ... he or she doesn't understand the method. That is why it is taking us back to where the teacher ... old teachers know only one method ... Where if a ... student asks that he or she does not understand. Just because he does not have another way of explaining, it results where he will tell the students big words or what. So, I think different ways of teaching should be encouraged ...</td>
</tr>
</tbody>
</table>
Table 35: Examples of raw data from Question 6

Question 6: There seems to be a belief in some circles that men always perform far better than women in Mathematics. What is your view?

<table>
<thead>
<tr>
<th>INTERVIEWEE</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>... I can say that sometimes it really occurs in that way. But the cause is to me it seems as if ladies have a lot of work to do ... at the end of the lessons at home. They use to cook, to do all things which they are supposed to do. So by so doing it takes a lot of time from them. ... So when she decides to study, ... she starts to sleep. Then she leaves (studying) and wake up and goes to school in the morning. But boys don't have a lot of work to do. It gives them time to study.</td>
</tr>
<tr>
<td>Student</td>
<td>... The fact is that seemingly ladies are lazy somewhere. They don't want to ask questions, ... they are ... afraid of asking questions in class. If she has problems she won't ask questions.</td>
</tr>
<tr>
<td>Student</td>
<td>To me ... it's a problem of language. They ... are afraid ... because they think if they can just talk somehow or maybe she break the language (rules), the others will laugh at her. Then the thing is they should be confident. They should tell themselves that they should not allow a teacher or a lecturer to pass (go on) if they didn't understand. I think they will be equal. I don't think they are not competent ... We are all equal.</td>
</tr>
<tr>
<td>Student</td>
<td>Sometimes ... the cause that they do more work than men ... sometimes if we stay at hostels like here there is no problem.</td>
</tr>
</tbody>
</table>
The basis for the data classification system in this study is the research instrument used, i.e. the interview guide (McMillan & Schumacher 1993:487).

6.3.2 Coding of raw data

The raw data were coded and grouped into sub-categories and categories as indicated in table 36.
### TABLE 36 Conceptual categorising of coded data

<table>
<thead>
<tr>
<th>CONCEPTS</th>
<th>CODES</th>
<th>SUB-CATEGORY</th>
<th>CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved Teacher Education Programme</td>
<td>ITEP</td>
<td>Positive Self-Concept</td>
<td>SELF-CONCEPT</td>
</tr>
<tr>
<td>Use of Groupwork</td>
<td>UOGW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real Life Context</td>
<td>RLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inclusion of a Mathematics Major Student in each Group</td>
<td>IMM</td>
<td>IMM</td>
<td></td>
</tr>
<tr>
<td>Assignments and Exercises</td>
<td>AAE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Different Methods</td>
<td>UDM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor Previous Performance</td>
<td>PPP</td>
<td>Negative Self-Concept</td>
<td>SELF-CONCEPT</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----</td>
<td>-----------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Lack of Role Models</td>
<td>LRM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textbook</td>
<td>TM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Protection in the Classroom</td>
<td>LPC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Teacher Commitment</td>
<td>LTC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Content Knowledge by Teachers</td>
<td>LKT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Groupwork</td>
<td>UOGW</td>
<td>Positive Attitude</td>
<td>ATTITUDE</td>
</tr>
<tr>
<td>Real Life Context</td>
<td>RLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assignments and Exercises</td>
<td>AAE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection in the Classroom</td>
<td>PC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Motivation and Encouragement by Peers</td>
<td>LMEP</td>
<td>Negative Attitude</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td>Lack of Content Knowledge by Teacher</td>
<td>LKT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher's Attitude towards Learners</td>
<td>ATS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textbook</td>
<td>TM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Teacher Commitment</td>
<td>LTC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Protection in the Classroom</td>
<td>LPC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender Stereotypes</td>
<td>GS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Motivation by Peers</td>
<td>LMP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| ATTITUDE |
6.3.3 Presentation of categories

The following categories were compiled after data coding and clustering:

(a) Self-concept which was further subcategorised into positive self-concept and negative self-concept and
(b) attitudes which were also further subdivided into positive attitudes and negative attitudes.

Category one: Self-concept

The data analysis in this category showed that improved teacher programmes may culminate in the development of positive self-concepts in prospective teachers. These improved teacher programmes entail the use of groupwork, real-life contexts, the inclusion of a Mathematics major student in each group, giving assignments and exercises on sections before they are treated, as well as the use of different methods while teaching.

On the other hand, poor previous performance, lack of role models, lack of protection in the classroom, lack of teacher commitment, lack of content knowledge by the teacher and adhering to the textbook (poor teaching methods) are associated with a negative Mathematics self-concept. Poor previous performance of student teachers tends to adversely affect their self-concept. Lack of protection in the classroom discourages learners from asking questions because there is no mechanism in place to prevent their peers from passing degrading remarks. Educators who strictly adhere to the textbook portray lack of confidence in their content knowledge and thus encourage rote learning. This results in the development of poor Mathematics self-concepts in learners.
Category two: Attitudes

From the data analysis, this category brought to light that the use of groupwork, real-life contexts, giving assignments and exercises to learners on sections before they are treated and protection in the classroom breed positive attitudes towards Mathematics. Respondents emphasised the need for protection from threats and degrading remarks by peers. Groupwork provides an environment conducive for asking questions. Real-life contexts enable learners to transfer and relate Mathematics content to their daily life experiences.

Lack of motivation and encouragement by peers and teachers, lack of content knowledge by the teacher, teachers’ attitude towards learners, poor teaching methods (e.g. teachers’ strict adherence to the textbook, lack of teacher commitment, lack of protection in the classroom and negative gender stereotypes) were identified to be accountable for negative attitudes towards Mathematics in student teachers (see section 6.3). A teacher who has a poor background regarding content tends to lack confidence in teaching the content. This lack of confidence results in negative attitudes which are communicated and transferred to learners. Without a guarantee of protection by the educator against degrading remarks and threats, learners indicate that it is not easy for them to ask questions. Hence the need for protection to enhance questioning by learners in the classroom. Teachers’ strict adherence to the textbook limits the possibility to relate content to learners’ daily life experiences. This lack of relevance to learners’ daily life experiences results in learners’ dislike of the subject because they don’t see the use of the content beyond the four walls of the classroom. Teachers who do not relate well to learners also create hatred between themselves and learners. The more the learner dislikes the teacher/lecturer, the greater the possibility that a negative attitude towards the subject may develop. (see section 6.3.1).

How these categories relate to the intervention programme is explained in 6.4.
6.4 Discussion of quantitative and qualitative results

This study focused on the possible influence of an intervention programme on (a) the self-concepts of prospective primary school teachers; and (b) the attitudes of prospective primary school teachers. Eight research problems were stated.

- Research problem one

In contrast to previous studies (Newman & Schwager 1993:3; Relich 1996:187-188; Townsend et al 1998:1 & Lee et al 1991:23), this research did not find a significant difference between the average Mathematics self-concepts of prospective Mathematics teachers before and after an intervention programme (see sections 2.7 and 6.2.2.2 and table 4). However, the focus group interview implied an improvement in the self-concepts of some prospective Mathematics teachers after the intervention programme. For example, one respondent said:

... We have learned so many things. We should be able to deliver to learners out there.

- Research problem two

The second problem envisaged to establish if there is a significant difference between the average Mathematics attitudes of prospective Mathematics teachers before and after the intervention programme. The results of the t-test suggest a small difference between the average Mathematics attitudes of prospective teachers before and after the intervention programme: the study established a decline in average attitude scores of prospective Mathematics teachers. However, the average attitude score deteriorated insignificantly. On the one hand, the decline could be associated with difficulty of content as the lessons progressed towards advanced subject content for those with a weak Mathematics background. On the other hand, negative attitudes could be
attributed to lack of challenge as the content is simplified for those who have an advanced Mathematics background.

This disappointing finding, although consistent with previous research, confirms the fact that the task of modifying deeply entrenched beliefs and attitudes developed early and maintained over many years is not an easy one (Swetman, Munday & Windham 1993:422; Townsend et al 1998:7). Another suggestion which may account for this result is that the period over which this intervention programme was conducted may not have been long enough to overcome the negative attitudes towards Mathematics that many students have developed before leaving high school (see section 6.3.1). However, some responses in the focus group interview, where students reported that they felt confident to teach Mathematics may lead one to suspect that the questionnaire may not have been sensitive enough to detect subtle changes in attitudes that may have occurred (See section 6.3.1).

- Research problem three

The third problem aimed at finding out whether there is a significant difference between the average Mathematics self-concepts of male and female prospective Mathematics teachers before and after the intervention programme. Though not significant, the t-test found an improvement in the average Mathematics self-concepts of both male and female prospective Mathematics teachers. This study also found that males obtain higher Mathematics self-concept scores compared to their female counterparts. This finding is consistent with previous research (Valas & Søvik 1993:293) (see sections 2.7 and 6.2.2.4).
• Research problem four

In replying to the fourth problem, this study found a higher female mean attitude score before the intervention programme, though the difference was not significant. This supports Swetman et al's (1993:421) finding in their study of third-, fourth-, fifth- and sixth-grade learners (see section 3.5). However, the average attitude score of male prospective teachers was higher than that of their female counterparts after the intervention programme. Furthermore, the mean attitude score of male students improved while that of female student teachers deteriorated after the programme. This high male score is in keeping with previous studies that attribute the score to gender role stereotypes, differentiated teacher expectations and societal socialisation (Hackett & Betz 1989:261; Hensel 1989:650; Moyana 1996:36; Plucker 1996:738-739) (see section 3.5 and Tables 10, 11, 12 & 13). This study further established that attitudes did not improve, but did not deteriorate significantly either. This supports assertions by previous studies that it is difficult to change attitudes developed over a long period of time (Swetman et al 1993:422; Townsend et al 1998:7) (see section 6.3.1).

• Research problem five

Research problem five focused on the difference between the average self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 before and after the intervention programme. This study established a significant difference between the average self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 on the 1%-level of significance: the Mathematics self-concepts of the standard 10 group were significantly better than that of the standard 8 group. This is in keeping with Townsend et al's (1998:6) and Merseth's (1993:551) findings that students with advanced Mathematics have a higher self-concept. In this regard, Townsend et al (1998:11) reported that self-concept will be significantly greater for students who have studied
Mathematics at the senior high school level or higher. This may be attributed to favourable mathematical experiences that the students who did Mathematics up to standard 10 had through at high school, e.g. high performance scores. The interviews indicated that unfavourable experiences in the Mathematics classroom negatively impact on self-concept.

- Research problem six

The sixth problem examined the question if there is a significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 before and after the intervention programme. The t-test revealed a significant difference between the attitudes of prospective teachers with standard 8 and those with standard 10 Mathematics before an intervention programme. This supports Ernest (b) (1989:28) when he asserts that teacher knowledge, especially of Mathematics, can be expected to influence the teacher's Mathematics attitudes via the perceived adequacy of the teacher's knowledge. Thus, with inferior subject background, it is not surprising that prospective teachers with standard 8 Mathematics scored significantly lower than those with standard 10 Mathematics (see section 6.2.2.7 and the interview data in 6.3.1). The mean attitude scores of both groups deteriorated after the intervention programme, though not significantly (see section 6.3.2). This could be attributed to the difficulty of subject content which may cause Mathematics anxiety for those with poor Mathematics background (Austin et al 1992:390) (see section 3.6). For those with a strong mathematical background (those with standard 10 Mathematics), the decline may be associated with the less challenging content taught at a very concrete level.
• Research problem seven

The seventh problem focused on establishing whether there is a significant difference between the average self-concepts of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention. As Townsend et al (1998:6 & 11) and Merseth (1993:551) established in their studies, prospective teachers with advanced (standard 10) Mathematics and majoring in Mathematics have higher average self-concept scores than those who did Mathematics up to standard 8. In this study there was a significant difference after the intervention programme in favour of those majoring in Mathematics on the 1%-level of significance. Of interest is the observation that the average self-concepts of those who major in Mathematics deteriorated while that of those who do not major in Mathematics improved (see section 6.2.2.8). This could be attributed to the simplified, real life context-based content which becomes less challenging and boring to the Mathematics majors who already have the skills to manipulate advanced Mathematics. On the other hand, this real life context-based approach makes the content meaningful and interesting and as a result easy to follow for those not majoring in Mathematics.

For instance, during the focus group interview, one prospective teacher not majoring in Mathematics said:

It had a positive influence.... Because from now I can interpret things in a theory again into a practical form. Because now for example I am a caretaker in the kitchen so yesterday the machine which is used to cut the bread was not working. So ... um we divided the number of those loaves to get the number of those students. And in a loaf we were supposed to have 3 thirds.

This shows how the programme can help students to associate fractions with real life problems. From this quote it appears the student enjoyed applying his newly learnt knowledge of fractions in solving a real life problem. This is consistent with
Toom's (1999:38) assertion that learners are only interested in things that are related to everyday life. After all, education is simply the better preparation for life (Toom 1999:38). This also supports Townsend et al (1998:7) who reported Mayers's finding in an intervention programme that only the Mathematics self-concept of those with a relatively weak background in Mathematics, successfully improved.

- Research problem eight

The last research problem aimed at investigating if there is a significant difference between the average attitudes of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention programme. A t-test established a significant difference between the attitudes of prospective teachers who major in Mathematics and those who do not major in Mathematics (See section 6.2.2.9). This observation supports findings by previous studies that teachers with a strong mathematical background portray positive attitudes (Swetman et al 1993:426) while those with poor background have negative attitudes (Austin et al 1992:390; Hungerfold 1994:16; Gliner 1987:86). However, after the intervention programme, the difference was significant at the 5%-level. Noteworthy is the finding that though the difference remained significant, the average attitudes scores of both groups deteriorated after the intervention programme. For those students majoring in Mathematics, the decline could be attributed to lack of challenge in the simplified, context-based subject content. On the other hand, the attitude scores of those not majoring in Mathematics could be associated with difficulty as the subject content becomes abstract. This can result in Mathematics anxiety developing which manifest in irrational fear and a decline in attitudes (see examples of interview data in section 6.3.1).
• Additional research findings from focus group interviews

Coding and categorising the raw data from the focus group interviews indicated that the intervention programme to improve the self-concepts and attitudes of prospective Mathematics teachers, should include the following:

- the use of cooperative learning strategies
  "... in groups I can ask anything ... I don't understand") (see table 33)
- the use of everyday life contexts
  "... in the kitchen ... we divided the number of ... loaves to get the number of students ..." (see table 33)
- encouraging the asking of questions during lessons
  "I think ... you should promote asking questions. It will develop ... confidence in the learner" (see table 34)
- a positive relationship between the lecturer and prospective teachers so that students do not "... hate Math almost as much as the teacher" (see table 31)
- writing assignments on topics before they are treated (see table 34)
- content relevance for what they are going to teach so that they may "... have the background of the subject" (see table 30)
- positive communication of test and assignment results.
  "... The child was given maybe an award – maybe R5. So it was a little bit painful to me as I got say for instance 10% (see table 31)
- use of mathematical games and activities (see table 32)
- use of various approaches to solving problems. One student stated: "I think to use one method is very dangerous ..." (see table 34)
- use of any language in which the learner is comfortable for asking questions and then "... the lecturer ... that is teaching ... should protect that person who is asking the question." (see table 34) and "it's a problem of language" (see table 35).

- Avoid gender stereotypes, such as the following: "... The fact is that seemingly ladies are lazy somewhere. They don't want to ask questions ..." (see table 35).

6.5 Summary

This chapter presented and discussed the results of the quantitative study where a questionnaire was used, as well as the results of the qualitative study which used a focus group interview.

In the next chapter conclusions from the literature review as well as from the quantitative and qualitative approaches will be made.

Recommendations for an improved intervention programme focusing on the self-concept and attitudes of prospective Mathematics teachers will be highlighted.
CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This study aimed at:

(a) designing an intervention programme to improve the self-concepts and attitudes of prospective primary school Mathematics teachers,
(b) developing an instrument (in the form of a questionnaire) to test the intervention programme referred to in (a),
(c) implementing the intervention programme for a trial period of three months and making observations,
(d) testing the possible effect of the programme on prospective teachers' self-concepts and attitudes in relation to Mathematics by means of the questionnaire in a one-group pretest-posttest design and
(e) conducting a focus group interview to help improve the programme (if necessary).

This study is a topical one in South Africa since there is a shortage of well-qualified Mathematics teachers. Thus, results of studies like this one can provide the basis on which would-be Mathematics teachers could be helped to add to the shortage of Mathematics teachers. Furthermore, hardly any studies in the South African, specifically Northern Province context, has been conducted to research the development of self-concept and attitudes during preservice teacher training, and how they can be developed. The development of an intervention programme as purported by this study would hopefully provide one to future researchers for practical implementation and for further research in this area.
The following eight research problems and their corresponding hypotheses were developed to test the possible influence of the intervention programme after a period of three months (NB: Only in a true experimental design can cause and effect be determined. Hence, quantitative conclusions are tentative).

*Problem statement 1:* Is there any significant difference between the average Mathematics self-concepts of prospective Mathematics teachers before and after the intervention programme?

*Null hypothesis 1:* There is no significant difference between the average Mathematics self-concepts of prospective Mathematics teachers before and after the intervention programme.

*Problem statement 2:* Is there any significant difference between the average attitudes of prospective teachers towards Mathematics before and after the intervention programme?

*Null hypothesis 2:* There is no significant difference between the average attitudes of prospective teachers towards Mathematics before and after the intervention programme.

*Problem statement 3:* Is there a significant difference between the average Mathematics self-concepts of male and female prospective teachers before and after the intervention programme?

*Null hypothesis 3:* There is no significant difference between the average Mathematics self-concepts of male and female prospective teachers before and after the intervention programme.
Problem statement 4: Is there a significant difference between the average attitudes of male and female prospective teachers towards Mathematics before and after the intervention programme?

Null hypothesis 4: There is no significant difference between the average attitudes of male and female prospective teachers towards Mathematics before and after the intervention programme.

Problem statement 5: Is there any significant difference between the average self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention programme?

Null hypothesis 5: There is no significant difference between the average self-concepts of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention programme.

Problem statement 6: Is there any significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention programme?

Null hypothesis 6: There is no significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention programme.

Problem statement 7: Is there any significant difference between the average self-concepts of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention programme?
Null hypothesis 7: There is no significant difference between the average self-concepts of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention programme.

Problem statement 8: Is there any significant difference between the average attitudes of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention programme?

Null hypothesis 8: There is no significant difference between the average attitudes of prospective teachers who major in Mathematics and those who do not major in Mathematics before and after the intervention programme.

7.2 Conclusions

7.2.1 Conclusions from the literature study

7.2.1.1 Conclusions regarding how self-concept can be improved

The literature review shows a significant improvement in the self-concepts of prospective teachers who are engaged in teacher education programmes that involve co-operative learning (groupwork), real-life context problem content (the use of manipulatives and hands-on activities), mastery learning and the provision of research articles and dissertations to acquaint prospective teachers with academic developments on self-concept (see section 2.7 and 4.2).
7.2.1.2 Conclusions regarding how attitudes can be improved

The literature shows that it is difficult to modify beliefs and attitudes that developed early and over a long period of time (see section 6.4.2). This discovery by means of previous studies imply that it will take time to change negative attitudes to positive ones. However, a number of studies identified activities that form part of the intervention programme used in this study to improve attitudes. For example, mastery learning is reported to improve attitudes. Cooperative learning is also associated with favourable attitudes towards Mathematics. Other studies suggest the use of concrete materials and manipulatives as well as hands-on-activities for the improvement of attitudes towards Mathematics. With so many positive influences enumerated in favour of the activities included in the intervention, we can conclude from the literature review that there may be a significant improvement of Mathematics attitudes of prospective Mathematics teachers after the intervention programme. This is anticipated despite the contrary assertion reported previously (see sections 3.4 and 3.7).

The use of mathematical games and activities brings an element of play into the Mathematics classroom, which makes learning very interesting. This interest may breed positive attitudes (see section 3.7). Therefore, there is a need for an improved intervention programme to include mathematical games, just as it was the case in this study.

Gender stereotypes like expecting female learners to perform poorly, the view of Mathematics as a male domain, etcetera need to be discouraged. This could be achieved by using gender-neutral pronouns, providing examples of prominent female Mathematicians, and creating a classroom environment that encourages female students to ask questions (see section 3.4).
7.2.2 Conclusions from the quantitative study

7.2.2.1 Conclusions regarding how self-concept can be improved

Though insignificant, this study established a small improvement in the Mathematics self-concepts of prospective Mathematics teachers after the intervention programme was implemented for three months.

Thus, this study supports the conclusions reached by previous studies in the use of certain strategies employed in the intervention programme to improve the Mathematics self-concepts of prospective teachers. However, a period of three months is probably too short and the intervention programme need to be implemented for a longer period.

Consistent with previous studies, this study found a significant difference between the self-concepts of prospective Mathematics teachers who did Mathematics up to standard 8 and those who did it up to standard 10 before and after the intervention. This is in agreement with Merseth (1993:551) and Townsend et al (1998:6) when they report that students with advanced Mathematics show better self-concepts than those with a poor Mathematics background. Important in this study is the finding that, though not significant, the self-concepts of those with only a standard 8 Mathematics, improved. This supports Townsend et al's (1998:7) contention about Mayer's finding that an intervention programme designed to improve the attitudes of student teachers in New Zealand was successful only for those with relatively weak backgrounds in Mathematics. In support of this finding, this study established a small decline in the average self-concept score of those students with advanced Mathematics (standard 10 Mathematics) (see section 6.3.2). It may indicate that the level of presentation of Mathematics need to be challenging.
In line with the aforementioned, this study established a significant difference between the average self-concepts of prospective teachers who major in Mathematics and that of those who do not major in Mathematics before and after the intervention programme. Noteworthy is the improvement of the average self-concepts of prospective teachers who do not take Mathematics as a major subject. This supports previous findings that an intervention programme especially improved the self-concepts (and attitudes) of students with relatively weak backgrounds in Mathematics (see section 3.4).

Thus, the findings of this study support the use of an intervention programme. However, the programme need to be improved to cater for a multi-background Mathematics environment to ensure that both the student teachers with weak backgrounds and those with poor backgrounds benefit from the programme. It also needs to be implemented for a longer period of time than three months.

7.2.2.2 Conclusions regarding how attitudes can be improved

The empirical research in this study found a decline in the average Mathematics attitudes of prospective Mathematics teachers before and after the intervention programme. However, the decline was not significant. Thus, the null hypothesis cannot be rejected with regard to prospective teachers' average attitudes before and after the intervention. However, it may be that the attitudes of prospective teachers naturally deteriorate as the year progresses – without the programme, attitudes may have been even worse!

In concurrence with previous studies, this research found a difference between the attitudes of male and female prospective teachers after the intervention programme: the mean attitudes of male prospective teachers improved while that of their female counterparts declined. This finding could be associated with gender stereotypes that discourage higher Mathematics performance by female students and the view of Mathematics as a male domain (see Sections 3.5 and
3.7). Noteworthy is the observation that female prospective teachers obtained higher scores before the intervention programme. This is contrary to previous studies. This study advocates the use of many of the strategies used in the intervention programme since the mean attitudes of male prospective teachers improved. However, there is a need for an improved version which can cater for the improvement of the Mathematics attitudes of female prospective teachers as well.

In support of previous studies, this study found a significant difference between the average attitudes of prospective teachers who did Mathematics up to standard 8 and those who did Mathematics up to standard 10 before the intervention programme (see sections 3.2 and 3.3). However, the average attitudes of both groups declined significantly after the intervention programme (see section 6.3.2). The decline in the attitudes of those who did Mathematics up to standard 8 could be accounted for by the difficulty level of content as the lecturer proceeds towards advanced Mathematics. This could result in anxiety which could render students unable to grasp the new content. On the other hand, the insignificantly deteriorated attitudes of prospective teachers who did Mathematics up to standard 10 could be associated with less challenging content as a result of hands-on, concrete and context-based content approaches used in the intervention programme.

Thus, the findings of this study seem to suggest a need for an improved version of the intervention programme. The intervention programme needs to take the students' diversified content backgrounds into account and needs to be implemented for a longer period of time.
7.2.3 Conclusions from the qualitative empirical study

7.2.3.1 Conclusions regarding how self-concept can be improved

Quite a number of factors were identified by interviewees during the focus group interviews as accountable for poor Mathematics self-concept (see section 6.3, and appendix D).

Interviewees furthermore suggested a number of strategies that could be incorporated in the intervention programme used in this study in order to improve self-concept. Just as it was the case in this study, respondents advocated the use of real life contexts to enable them to see the relevance of content in their daily lives. The use of group work and the inclusion of at least one person taking Mathematics as a major subject, as used in the implemented intervention programme were strategies strongly advocated by the respondents (see section 6.3 and appendix D). The inclusion of at least one person taking Mathematics as a major subject provides student teachers with poor Mathematics backgrounds with peer assistance in the event of an impasse, and consequently boosts their confidence and self-esteem (see section 2.7).

The participants added to the strategies used in the programme other strategies as means of improving the intervention programme. They suggested giving assignment exercises on sections before they are done, encouraging questions and creating a secure atmosphere for asking questions (protecting those asking questions from peer threats and degrading remarks) and the use of different problem solving approaches to optimise learning by all in the classroom (see section 6.3 and appendix D). The more secure students feel in a learning environment, the more confident they become to ask questions on aspects of the content that they don't understand.
Gender stereotypes came to light during the interviews. Female learners voiced the opinion that if a female learner performs well in Mathematics there is a tendency by peers to say that this "lady" performs so well in Mathematics as if she is a man. Another male student emotionally pointed out that for female students, it is natural not to ask questions in class because they are born 'fearful'. These are some of the stereotypes that need to be eliminated by providing female role models who are exceptional in Mathematics and by using gender-neutral pronouns and by assigning traditionally female chores, to males as well, and vice versa.

7.2.3.2 Conclusions regarding how attitudes can be improved

Taking the causal relationship of self-concept on attitudes, strategies to improve self-concept may also improve attitudes (see section 1.2.1).

The participants suggested that they do not relate well to some educators. They further indicated that as their relationship with the teacher/lecturer became sour, the negative feelings that developed in the learner towards the teacher also resulted in a negative attitude towards the subject which that teacher teaches (see section 6.3). Hence, the need for teachers to take stock of the way they respond to learners' problems as well as their day to day interaction with students. Some teachers have a tendency to communicate test results in a way that degrade learners who perform poorly (see section 6.3), and this tends to cause a negative attitude in learners towards both the teacher and the subject itself. Thus, the way results are communicated needs to be improved.

The more the number of approaches used to enable learners to understand the subject content, the more learners develop positive attitudes towards Mathematics. Hence the suggestion by respondents for the use of various approaches to solve Mathematics problems (see section 6.3).
7.3 Conclusions regarding what an intervention programme to improve self-concept and attitudes of prospective teachers should look like

For South Africa to produce a generation characterised by interest in Mathematics, confidence in the manipulation of numbers, the preparation of a generation of teachers who have positive self-concepts and attitudes towards Mathematics could be a proper starting point in the light of the conclusions alluded to in the previous sections (see sections 7.2.1, 7.2.2 and 7.2.3).

Therefore, the following recommendations are made on how the intervention programme to improve prospective Mathematics teachers' self-concepts and attitudes should look like.

7.3.1 The use of cooperative learning strategies

Throughout the focus-group interview, the dominant aspect, amongst others, reiterated by participants, was the use of cooperative learning. A number of advantages have been indicated in favour of co-operative learning. These include that one may be free to ask questions, that there be a relaxed atmosphere, and that the pooling of ideas created by the environment makes the environment conducive to learning. Mistakes made by learners in a cooperative learning setting need to be discussed, rather than an evil to be avoided. Previous studies and respondents in the focus group interview in this study also advocated the need for the learner to develop an ability to work as a member of a team, a group, an organisation and in a community (see sections 1.1 and 6.3). In order to make groups beneficial to learners, it is suggested that each group should have at least one member majoring in Mathematics (see section 6.3).
It is further suggested that even though the intervention programme implemented in this study advocated the use of groupwork for revising homework, for doing revision, for studying for tests and examinations, as well as for doing assignments, an improved version of the programme needs to use this strategy in class as well (see section 2.7).

7.3.2 The use of everyday life contexts, manipulatives and hands-on activities

Mathematics is defined as the use of numbers, patterns and shapes to describe and explain the world (see section 3.7). With Mathematics invented to describe and explain the world, it should be explained in real world contexts. This ought to make abstract concepts easy to follow. Previous studies also identified overemphasis on rote memorisation of facts and procedures rather than on understanding as one of the reasons for the failure of many learners in Mathematics (see sections 1.2.2 & 3.7)

7.3.3 Encouraging the asking of questions during lessons

Student teachers need to be encouraged to ask questions during lessons whenever they do not understand.

As the student teachers' knowledge and understanding improve, their mathematical self-concepts as well as their attitudes towards the subject will improve. However, student teachers need an environment conducive to asking questions. Thus there is a need for the lecturer to ensure that student teachers are neither threatened nor belittled by their peers by the passing of degrading remarks (see section 6.3).
7.3.4 Lecturers' relationship with prospective teachers

The way the teacher educator interacts with his learners has an emotional impact on the learner. This is shown by Martin, Moore, Strickland and Williams (1991:173) quoting Frank:

I was a very good student in Mathematics until about the middle of the fourth grade in elementary school. Because I continuously used my fingers to count, I was belittled and rudely treated ... I was "wacked" on the knuckles many times until they hurt ... My interest in Math became poorer and poorer ... I can actually say I then hated Math almost as much as I came to hate that teacher.

This quote shows the degree of dislike of Mathematics that can result from the learner's dislike of the teacher presenting the subject. A teacher's relationship with his learners has been known to account for the learners' dislike of Mathematics. Student teachers' responses during the focus group interview support this observation (see section 6.3). After explaining the traumatic experiences she went through in her interaction with her Mathematics teacher, one female respondent indicated that she knows Mathematics, but whenever she starts studying the subject, she always sees the Mathematics teacher next to her. Because she dislikes the teacher the subject became an enemy as well (see section 6.3). This is a clear warning to teachers/teacher educators to be mindful of their words and actions in their interaction with learners. Therefore, the improved programme ought to take note of this aspect as well.

7.3.5 Prospective teachers write assignments on topics before the topics are treated

The respondents in the focus group interview proposed the writing of assignments on topics before they are treated (see section 6.3). This proposal is in line with Scheibelhut's (1994:246) advocates that at the beginning of a new unit learners should be asked to write what they know about the topic. This can take the form of written exercises. It can be a useful diagnostic tool to determine
the students' current level of knowledge. The rich information base will help the teacher to tailor lessons to meet the individual instructional needs of the class. Furthermore, writing assignments at the beginning of a unit also develops a mindset for studying the topic and helps the students to form connections between what they already know and the new material (Scheibelhut 1994:246). Meredith (1993:337) says that the lack of attention to what student teachers bring with them to training may account for the weaknesses of teacher education intervention. Thus, in the intervention programme, each section needs to be preceded by writing an assignment on the contents of the section.

7.3.6 Content relevance

Students interviewed for the purpose of this study expressed concern about the relevance of the Mathematics content that they are exposed to. Thus, in addition to the advanced content like calculus to which the respondents refer as irrelevant in their studies, there is a need to improve their knowledge and understanding of the content that they will be teaching. Furthermore, many studies indicate that teachers who have positive self-concepts and attitudes possess the confidence to teach the subject of which they have a strong background. Other studies suggest that teacher education curricula should emphasise content mastery in a balanced programme allowing prospective teachers a good understanding of what they are to teach or of what they are teaching (see section 2.7). Thus, prospective teachers need to be given a strong grounding in the Mathematics that they are going to teach (see section 6.3).

7.3.7 The way test and assignment results are communicated

Assessment data should not be used to label students, but instead should simply provide information to teacher educators on which sections students already know well and to pinpoint what they still need to learn. This could help teacher educators to determine appropriate learning experiences and to guide the
redesign of school programmes and structures so that the performance of
teacher educators and students may improve. This notion is supported by the
recommendations in previous studies (Jamentz 1994:57). Thus, in the light of
what respondents have to say about rewards after tests and assignments, these
should be used not to grade learners, but for diagnostic purposes (see section
6.3). Results should be communicated to individual learners with a view to
tailoring remedial lessons to address the learners' weaknesses. What one
student said about the giving of prizes to the best student in class suggests the
adverse effect of the meritocratic reward structure promoted in many classrooms
on the effect on the learner in relation to both the subject and the educator.

7.3.8 The use of mathematical games and activities

Previous studies suggest playing and having fun while learning to be essential
ingredients for maintaining humour, sanity and enjoyment. Thus, the intervention
programme should include mathematical activities, just as was the case in the
intervention programme used in this study. This is intended to put an element of
play in the learning process to enhance interest and enjoyment.

7.3.9 The use of various approaches to solving problems

Respondents in the focus group interview suggested the use of many methods to
solve problems when teaching. This suggestion is supported by previous studies
pointing out that telling students 'one way' of solving a mathematical problem is
not sufficient for the learning by all (Merseth 1993:553). Multiple representations
and approaches are integral to successful training programmes. Prospective
teachers ought to be provided with a repertoire of approaches to use to solve
problems.
7.3.10 Language

Many educators/teachers, confine learners to the use of a language like English, which is not the student's first language, to express themselves in class. *This limits the chances of those who are not good at English to ask questions in class.* Thus, lecturers ought to allow switching from one language to another to facilitate communication and learning in class. This could be a helpful method in historically black colleges of education where not all learners are fully conversant in English. It could also help learners to conceptualise Mathematics in their own language. This ought to make content more meaningful and may improve learners' attitudes towards Mathematics.

7.3.11 Gender stereotypes

Some societal stereotypes provide female prospective teachers with comfort zones to avoid good performances in Mathematics. For example, one female participant said that she had a classroom experience where female excellence in Mathematics would be ridiculed. Classmates would even say that she outperforms everybody as if she isn't a lady (see section 6.3).

What this female prospective teacher indicates is that female learners are not expected to be good at Mathematics. In support of this kind of mentality another male participant, in response to a concern about female students' withdrawal during lessons, indicated that it is natural for them to be withdrawn. They are born that way (see section 6.3). These are the kinds of stereotypes that set a code of conduct for female learners in their Mathematics learning. These gender role stereotypes are also supposed to indicate that all male students perform well in Mathematics. That is why many teachers specifically interact with male students. However, previous studies create an atmosphere of optimism by reporting that female learner-friendly mindsets are redeemable. Plucker
(1996:743-744) provides the following interventions attempted to correct this mindset:

(a) personal encouragement of young women in Mathematics and Science;
(b) encouragement to attend special events on women in Mathematics and Science (e.g., workshops, career fairs, etc);
(c) individual counseling of women students;
(d) female speakers on Science and Mathematics topics;
(e) use of gender-neutral pronouns;
(f) cooperative learning or laboratory assignments with rotating roles;
(g) women speakers on gender issues in Science and Mathematics classes and (h) taking women to and/or help organise workshops/conferences on women in Mathematics and Science.

Thus, the improved version of the intervention programme used in this study should include the aforementioned activities.

7.3.12 Role modeling

McDevitt et al (1993:608) suggest that preservice teacher education should encourage teacher educators to model teaching strategies that the system wishes prospective teachers to use, including cooperative learning strategies, hands-on-activities, etc. Merseth (1993:551) quotes David Cohen's and Deborah Ball's soul searching question which reads as follows:

How can teachers teach a Mathematics they never learned, in ways they never experienced?

Therefore, the improved version of the programme prescribes that in the teacher educator's lesson presentations, he or she must model what is referred to as good practice.
7.4 Recommendations for future research

(1) Further research should replicate this study with the intervention programme applied over a longer period of time and using an experimental design, if possible.

(2) It appears that this study may have implications for prospective teachers in other subjects. Further studies should consider whether this model is applicable to teacher education students studying other content areas (subjects) as well.

(3) This study based its findings, amongst other things, on structured responses given to questionnaire items. Thus, further research could be conducted where respondents answer open-ended items either orally or in writing, expressing their feelings of confidence and attitudes regarding Mathematics.

(4) Further research could also look at strategies to strengthen the mathematical backgrounds of prospective teachers with poor Mathematics knowledge.

(5) This study was conducted in one college of education only. Future research could replicate this study in other colleges and universities to establish the validity of the findings.

7.5 Limitations of the research

One limitation of this study is that it was conducted with preservice teachers faced with the prospects of unemployment. This could result in a lack of commitment indicated by a series of class disruptions and absenteeism during
the implementation of the intervention programme. This threatened uninterrupted continuity in the implementation of the programme. It could have adversely affected the intended effect and findings of the programme.

Secondly, the main instrument used to determine student teachers' self-concepts and attitudes was a questionnaire. This may not have had the desired effect to bring to light subtle changes in self-concepts and attitudes. This could threaten reliance on the findings of this study, since the instrument might have failed to identify those subtle changes.

Thirdly, the period over which the intervention was implemented may not have been long enough to overcome the negative affective feelings about Mathematics that many prospective teachers may have developed over a long period of time.

*Fourthly, because of ethical reasons, a quasi-experimental design was used.* Only a true experimental design, however, can prove cause and effect with regard to an intervention programme.

7.6 Contribution of the thesis

This thesis made the following contribution to the existing knowledge in the area of education, particularly in Mathematics education:

(a) the study designed an intervention programme to improve the self-concept and attitudes of prospective Mathematics teachers;

(b) it designed an instrument (a questionnaire) to test the self-concept and attitudes of prospective Mathematics teachers towards Mathematics;
(c) the research also indicated that in order for the intervention programme to bring noticeable improvements in the self-concept and attitudes of prospective Mathematics teachers, it must be implemented continuously. The 3 months over which the intervention programme was implemented in this study is too short;

(d) the study established that self-concept may improve easier than attitude and

(e) it also found that it is better to use both a quantitative research design as well as a qualitative research design. This is because the quantitative design (questionnaire) in this study could not detect the subtle changes that were only elicited through the qualitative design in the form of focus group interviews.

7.7 Final word

To all Mathematics educators, note that South Africa's competitive edge in the global economy is in your hands. Whether South Africa ultimately makes a mark in the economic battles of the 21st century or not depends on the degree of numeracy the generation will have that will emerge from your Mathematics teaching. Therefore, join heads and hands and make sure that our country becomes what it ought to be — an economic giant!


Sowetan, Tuesday 29 July 1997. Science as the road to wealth.


APPENDIX A

MATHEMATICS SELF-CONCEPT AND ATTITUDE QUESTIONNAIRE

Hi, there! This is not a test but a questionnaire for which you have all the answers.

(a) Please do not write anything on this questionnaire. Write only on the response page provided.

(b) Do not write above the red line – this is for office use only. Start below the red line next to number 1.

(c) For each item indicate your answer by means of a single stroke with a HB pencil or a black pen on the appropriate number: [1]; [2]; [3]; [4]; [5]; [6]; [7] or [8].

(d) Please make sure that the number on the questionnaire is the same as the number on the answer sheet.

(e) Sometimes only two alternatives are given from which to choose but sometimes more. Please ignore the numbers you do not need.

1. Gender: Male [1]
   Female [2]

2. I did Mathematics until:
   std 8 [1]
   std 10 [2]
3. I am doing Mathematics as a major subject in my teachers’ training course:

Yes [1]
No [2]
Directions for the rest of the questionnaire

(a) The rest of the questionnaire contains statements on how you feel about the activities in your Mathematics learning and prospective teaching. There are no right or wrong answers. Your opinion is what is wanted.

(b) Think how well each statement describes your feelings about Mathematics. Indicate your answer by means of a dash in the appropriate number in the square on the sheet provided.

(c) The numbers have the following meanings:

5 = Strongly Agree
4 = Agree
3 = Undecided
2 = Disagree
1 = Strongly Disagree

(d) Provide your choice to each statement TRUTHFULLY.

(e) Make sure that you indicate your answer in the space next to the same number as that of the question.

(f) Do not write down your name on the answer sheet.

Thank you for your co-operation.
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<table>
<thead>
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<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<td>(4)</td>
<td>(3)</td>
<td>(2)</td>
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4. I cannot do Mathematics.
5. Some people have a Mathematics mind and some don't.
6. I shall enjoy teaching Mathematics.
7. Men are better in Mathematics than women.
8. There is a best way to do a Mathematics problem.
9. Mathematics requires a good memory.
10. It’s bad to count on your fingers.
11. I expect boys to perform better than girls in my prospective Mathematics class.
12. I expect boys and girls to perform equally well in my prospective Mathematics class.
13. Female mathematicians are as competent as male mathematicians.
15. Teaching Mathematics will be interesting.
16. I shall be an enthusiastic Mathematics teacher.
17. I shall enjoy using group work in the teaching of Mathematics.
18. Teaching aids/media e.g. counters, ruler, etc are necessary in teaching Mathematics.
19. I am not a good Mathematics teacher.
20. Mathematics is not applicable to our daily lives.
21. Mathematics is done by working intensely until the problem is solved.
22. It is unimportant to get the correct answer to a Mathematics problem.
23. I do not have the brains to understand Mathematics.
24. I shall enable learners in my Mathematics class to do well.
25. I dislike Mathematics.
<table>
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<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tr>
<td>(5)</td>
<td>(4)</td>
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26. I am interested in Mathematics.
27. I find Mathematics difficult.
28. I do not enjoy any activities related to Mathematics.
29. Mathematics is more important for boys than for girls.
30. Mathematics is equally important for both boys and girls.
31. I regard anybody who are very interested in Mathematics as abnormal.
32. To do well in Mathematics is too much hard work.
33. I don’t like Mathematics.
34. I am not interested in teaching Mathematics.
35. Teaching Mathematics is difficult.
36. I shall be good at teaching Mathematics.
37. I am good at Mathematics.
38. I am not interested to learn more about Mathematics.
39. I feel uneasy in Mathematics class.
40. I feel tense during Mathematics class.
41. Only males should choose careers which need Mathematics.
42. I always expect myself to do well in Mathematics.
43. We learn unimportant things in Mathematics.
44. I feel worried in the Mathematics class.
45. I find it easy to do well in Mathematics tasks.
46. I shall be able to answer learners’ Mathematics questions.
47. I understand Mathematics concepts.
48. I can teach Mathematics effectively.
49. I can motivate children to be enthusiastic about Mathematics.
50. I have the necessary skills to teach Mathematics.
51. I know procedures to effectively teach Mathematics concepts.
52. I am able to effectively monitor hands-on Mathematics.
<table>
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</table>

53. I welcome students' questions about Mathematics.
54. I enjoy being observed by a supervisor while teaching Mathematics.
55. Most methods to teach Mathematics are difficult.
56. I shall enjoy it to explain mathematics to children.
57. Teachers play an important role in learners' Mathematics achievement.
58. Learners' Mathematics achievement is related to teacher effectiveness.
59. When learners do better than usual in Mathematics, it is due to teachers' extra effort.
60. Mathematics underachievement is often due to ineffective teaching.
61. Effective Mathematics teaching influences achievement of students with low personal motivation.
62. Good teaching can overcome inadequate Mathematics background.
63. Mathematics grades improve due to increased teacher effort.
64. The use of hands-on activities and manipulatives is ineffective when teaching Mathematics.
65. It is unnecessary to make instruction relevant to learners' everyday experiences in Mathematics teaching.
66. Emphasis on problem solving makes Mathematics understandable.
67. The use of cooperative learning makes Mathematics teaching effective.
68. Teachers are unable to motivate learners to learn Mathematics with enthusiasm.
69. My mind goes blank, and I am unable to think clearly when doing Mathematics.
70. I feel a sense of insecurity when doing Mathematics.
71. Mathematics makes me feel uncomfortable and/or irritable.
72. Mathematics is a course in school which I have always enjoyed studying.
Strongly Agree | Agree | Undecided | Disagree | Strongly Disagree
---|---|---|---|---
(5) | (4) | (3) | (2) | (1)

73. I approach Mathematics with a feeling of hesitation, resulting from a fear of not being able to do Mathematics.
74. I shall enjoy teaching children how to approach a Mathematics problem.
75. I enjoy Mathematics because I am good at it.
76. If I am confronted with a new mathematical situation, it makes me nervous.
77. I can solve mathematical problems without help.
78. I am unable to draw upon a wide variety of mathematical techniques to solve a particular problem.
79. I have a good working knowledge of the Mathematics courses I have taken so far.
80. Even if I work long enough on a Mathematics problem, I am unable to solve it.
81. I remember most of the mathematical concepts which I have learned.
82. I learn Mathematics by understanding the underlying logical principle, not by memorising rules.
83. I would hesitate tutoring anyone in Mathematics in grades 1 – 4.
84. I have a poor background in Mathematics.
85. Solving Mathematics problems provides satisfaction similar to that of winning a battle.
86. Problem solving fascinates me.
87. I have confidence in my ability to deal with Mathematics.
88. Mathematics classes provide the opportunity to learn values which are useful in other parts of daily living.
89. The idea of teaching Mathematics to grades 1 – 4 makes me feel insecure.
<table>
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<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
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<tr>
<td>(5)</td>
<td>(4)</td>
<td>(3)</td>
<td>(2)</td>
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</table>

90. I have a good background in Mathematics.
91. I believe that I shall be a good Mathematics teacher.
92. Mathematics taught at primary school should be useful in children's daily lives.
93. Mathematics is fun.
94. I shall try to enable all children to understand Mathematics.
95. Mathematics taught at primary school is relevant.
96. Mathematics is irrelevant to my life.
97. I see Mathematics as a subject most people rarely use in their daily lives.
98. Most people are not able to do Mathematics.
99. Studying Mathematics is just as appropriate for women as for men.
100. I would expect a woman mathematician to be the masculine type.
APPENDIX B

SUMMARY OF THE QUESTIONNAIRE INDICATING EACH VARIABLE

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<th>ITEM NUMBER</th>
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<td>Prospective teachers' attitude</td>
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APPENDIX C

SOLUTIONS TO MATHEMATICAL ACTIVITIES

Mathematical Activity I: Mystifying matchsticks

A very satisfying solution when you have found it!

(Bolt 1991:114)

Mathematical Activity II: More matchstick mindbinders

Spiral to squares

Church to squares

(Bolt 1991:130)
Mathematical Activity III: A lover’s ultimatum!

(Bolt 1991:140)
APPENDIX D

INTERVIEW GUIDE

The interview was guided by the following six (6) questions:

(a) There seems to be a general outcry, by the private sector, the government and society in general about the poor Mathematics performance, students' tendency to avoid the subject, students' general dislike of the subject and lack of Mathematics teachers. This is so despite the important role the subject plays in commerce, medicine, information technology, just to mention a few. What do you think are the possible causes of all this?

This question was intended to establish a general picture of the kind of mathematical experiences that most of the respondents went through during their Mathematics learning. This would inform, the researcher thinks, the form the improved intervention programme would take.

(b) Some researchers e.g. EduSource advocate improved approaches to teacher training to alleviate problems cited in the first question. What is your comments on this?

This question aimed at establishing whether the prospective teachers are satisfied with the current teacher education programmes or not.

(c) How did you experience the programme I did with you in Mathematics this year? How did you feel about strategies like group work, e.g. in doing some of the assignments, in preparation for tests and examinations and studying generally as advocated in the programme? What about the context-based approaches like in
word problems, e.g. converting word problems into number sentences and concrete objects based approach used in fractions?

This is the key question in the focus group interview because it is intended to probe the participants to evaluate the intervention programme as they experienced it and give recommendations on how the programme could be improved. The subquestions were intended to establish the extent to which student teachers feel about the inclusion of group work and context-based problems in the intervention programme used in this study.

(d) How do you think this programme could be improved?

This question was actually intended to elicit students’ views on how the intervention programme could be improved.

(e) Many people think they are incompetent in Mathematics. Yet, their performance proves the contrary.

(i) Why do you think people think this way?
(ii) How do you think this problem could be solved?

This question was intended to elicit information regarding distorted self-concepts that some learners have. For instance, one of the prospective teachers who scored the highest mark in the class who participated in this study is not even taking Mathematics as a major. When asked by the researcher why she is not taking Mathematics as a major subject; she indicated that she knows she is not good in Mathematics. Yet she got the highest mark in the last test that they wrote.

(f) There seem to be a belief in some circles that men perform much better than women in Mathematics. What is your view on this?
This question aimed at determining student teachers' views regarding the notion that of Mathematics is a male domain.
APPENDIX E

FOCUS GROUP INTERVIEWS

A  FIRST GROUP  NUMBER OF PARTICIPANTS: 9

RESEARCHER: There seem to be a general outcry – by the private sector, the government and the society in general about poor Mathematics performance, students' tendency to avoid the subject, students' general dislike of Mathematics and lack of Mathematics teachers. This is so despite the important role the subject plays in commerce, medicine, information technology, just to mention a few. What do you think are the possible causes of all this?

STUDENT: I think it starts from the point where people dislike maths. Everything as a problem it begins from that point whereby most of the people in the lower learning institutions like secondary and the primary level. The motivation that they found there is not well whereby they come to be discouraged by the peers. Where they are told that Mathematics is a difficult subject, no one can make it. So, they come to a point where they come to dislike maths and think Mathematics is difficult. That no one can make it in Mathematics. As a result most of the people tend to dislike maths in fact.

RESEARCHER: Is that the only cause that you think prevails regarding this dislike of the subject? He pointed out peer influence, poor motivation. Do you think it is only peers who motivate you as a student at primary and secondary level? Don't you think there are other sources of motivation? Yes, Sir!

STUDENT: Another thing is lack of well-trained teachers and ... lack of self-motivation and confidence. This results in hmm ... what can I say ... where it ends up with students having a bad attitude towards the subject.

RESEARCHER: What do you think are the possible causes of this lack of confidence?
STUDENT: He talks of lack of self-motivation and lack of confidence. What do you think are possible causes of this? Sir!

STUDENT: According to my understanding is since the teachers were not well-trained if the teacher happens to ask questions, the way he (a learner) was treated it was bad. In such ways as “You stupid! How can you answer like that?” And that’s a bad motivation and a learner happen to dislike the subject due to that fact that he will be discouraged in front of other students. Even the teachers themselves if a learner needs clarity in certain portion, you find that instead of explaining to the learner he just says well come and meet me in the office. Then when you go to the office he says don’t bother me I’m busy. Then he happen to avoid you always. Then you happen not to find the answer of what you were in need of understanding. That may be the cause.

RESEARCHER: Hmmm! Hmmm! Thank you, Sir! Okay, do you have something to say Sir?

STUDENT: Another thing. That’s what happened to me.

RESEARCHER: Yes!

STUDENT: (Continues) Yeah. When I was in standard 10. I started doing maths from standard 6. Liking maths very much. Standard 6, 7, 8 performing very well. When I get to standard 10. When I was in standard 10, I still remember, we were being taught by another teacher. Then, one time he teach, he teach. Then after the lesson he asked the whole class if there is no one who is having problems. Then I raised my hand saying that I am having a problem. Then the teacher responded saying: “Where are you having problems?” Then I explained. Then he told me that I mustn’t be a fool. (LAUGHTER). Then from that day I started dodging his classes. Where it end up with me have grudges with the gentleman there. Then, where it end up eeh ... I get him in a shebeen one day. Then we beat that guy (LAUGHTER). So from that day I never attended the class.

RESEARCHER: So, that is what he is saying. Those are his experiences. Are there some more facts?
STUDENT: Umm ... untrained teachers usually promote rote-learning. And maths is not a subject where one can memorise. You need to understand the whole information.

RESEARCHER: Okay! That's another thing. Do you have something else to say?

STUDENT: They used to memorise things (content) without knowing that thing. Because sometimes when the learners ask some questions they fail to answer. They fail to ...

RESEARCHER: Are you referring to teachers?

STUDENT: Yes. The teachers.

RESEARCHER: Okay.

STUDENT: Some of the teachers they prefer to go to others and look for answers and the following day come with the answers.

RESEARCHER: So it's lack of knowledge in the subject, in other words.

STUDENT: Yeah! So, they made students to not be feeling well interested to continue with Mathematics.

RESEARCHER: Hmm! That's another thing. Yes!

STUDENT: Another thing is when a student take maths as a major at high school. Then the teacher hate the relative of that student. So when the student answer questions that the teacher asks wrongly. In response the teacher says: "Even you you know that you know nothing. You are taking Mathematics by enjoying without knowing. So, it's better to leave because you don't understand anything." And some other teachers at the beginning of the year tell them (Students) that "Leave Mathematics because you don't understand and force to do Mathematics while you don't know anything."

RESEARCHER: Hmmm! That's bad!

STUDENT: (CONTINUE) And then if you go to writing tests that teacher marks wrong that is correct. If you go to that teacher and say: "This one teacher I got it but you marked it wrong". That teacher tell that student that "I told you that you know nothing. Don't come to me and ask the things that you don't know".

RESEARCHER: After all you know nothing! (LAUGHTER)
STUDENT: (CONTINUE) Yeah. And the last issue is that at the ... I think it's April, end of the first quarter the student is referred to the guidance teacher who tells the student that “Leave Mathematics because you force to do it and it is difficult.” And even us who did Mathematics at high school. And I leave it.

RESEARCHER: Is that a teacher who talks that way?

STUDENT: Yes. Even us who have done Mathematics at high school, we thought we don't know Mathematics. And I leave it. But I think now I am a success.

RESEARCHER: To what do you attribute your success? Because you say you feel you are making a success yet you were discouraged not to go on with Mathematics.

STUDENT: Yes. The teacher told us to leave Mathematics because. I think it's hating us. Because I have, I have, I can't have a problem because if I write exercises my work is not well marked. If I go to that teacher he doesn't answer me clearly. Daily when I learn Mathematics, I have problems concerning that teacher. If I go to that teacher he doesn't clarify me why he do this to me.

RESEARCHER: To your marking?

STUDENT: Yes.

RESEARCHER: So, what do you think. Because now that you are here (at college) you think you have adjusted. You seem to be coping well. Did I get you right?

STUDENT: Yes.

RESEARCHER: What made you change your performance and your interest?

STUDENT: (CONTINUES) It's my confidence. With Mathematics I can make it. I can ... I know. Mathematics, but because of teacher I have a bad attitude. If I try to practise Mathematics when I start writing I see my memory seeing my teacher who is there at table (LAUGHTER).

RESEARCHER: Yes Sir!

STUDENT: Another point is some of the teachers they don't have the background of the subject. You can find that the teacher in class if a learner ask a question that how the teacher come the point (particular step). And the teacher
explain saying that in the textbook they show that we have to follow these steps.

He did not understand why.

RESEARCHER: What ... What ... This lack of knowledge. What do you think could be done to supplement that?

STUDENT: I think the teacher he has to know his facts. And to prepare before the class. So that if one can ask questions it will be easy to explain.

RESEARCHER: Hmm! Hmm! Okay! Okay. Yes um ... Who speaks? Let's hear from you sir!

STUDENT: Even the type of punishment they were giving us. You find that maybe I have done wrong to the teacher. Then when he wants to teach he says "Go out. I can't teach when you are in the class." I am one of the victims. It happened to me. Where there were two teachers — one teaching first paper, the other one teaching the second paper. And in the second paper. The teacher that teaches second paper happen to expel me from the class. He said "Well, go out. I can't teach if you are here". Then from there it developed a negative attitude towards that teacher. Even what he teaches. (CHANGE OF TONE. ANGER IN HIS VOICE) You can't understand when you have a negative attitude towards a person who used to teach the subject. Then, all in all, when we were about to write the trial examination, the teacher came to me and say : "Come and try to write the trial examination." How can I write the things that I didn't learn?

RESEARCHER: Hmm!

STUDENT: (CONTINUES) I did not want to write. Because some teachers advised me not to discourage him I went there and I have made magic. And Then when they compare the students who were learning daily and myself they found that well I performed well than them. Then they started to ask themselves that if they should have given me a chance I should have made it. Then, um ... well I think the way the teachers treat the students contribute a lot. Because you can't expect a student to perform well when he/she is not given a chance to attend classes. There is not logic. You can't send a student away when you know you are going to continue with the lesson. Because When you
miss one class in maths I don't think you can cope because it has to be linked
throughout.
RESEARCHER: What you are saying reminds me of um ... I once read an
article on a math student. You know what that student said? He said um ... “I
used to like ...” Like you said. “I used to like math very much. I used to score
good marks. But I once had a teacher who used to make a laughing stock out of
me. Then because this tendency of cracking jokes on me, avoiding answering my
questions and all those things went on and on. Then, I ... Then he said: “ I
started to hate math as much as I hated that teacher” you know. So, I tend to
relate what you are saying to what that student said. (STUDENTS NOD) So. I
now have an idea of what is happening regarding this question. So secondly,
many people think they are incompetent in math. Have you realised this?
(STUDENTS NOD IN AGREEMENT) Yet there are theories that indicate that
everyone can learn equally well but at different paces. For instance, like I said to
you, do you know that in your last test one person who is not even specialising in
math scored the highest mark. Why do you think people this way that they are
incompetent. Yet their performance prove the contrary?
(SILENCE)
What are the possible causes of actually? Yes!
STUDENT: I think. Actually, those learners happen to be motivated by their
peers that “Well, you can’t make it in Mathematics. They didn’t give themselves a
chance to prove themselves that they make it or not. Then, they diverge and say
Mathematics as they say is a difficult subject. I can’t cope even if I can go that
side. I have seen that somebody when he/she wrote a test she/he gets 20% and
then what about myself. In fact, he have regarded himself or herself as if he
cannot make it because there is somebody who didn’t make it. Meanwhile, he
didn’t give himself a chance. If they should have given themselves a chance to
prove that they don’t know really or they know. They should have gone o’right
because they happen to know things at a higher level meanwhile they left it. I
think they develop confidence in themselves that even if I feel I can’t do a thing I
have to prove it (that I can’t) is then that I can diverge. Unlike saying because ...
since Mr so and so said I can’t make it let me just leave it. Then maybe he has seem something that I will be successful. Then he is against my success. I have to prove it myself.

RESEARCHER: Another this is um ... do you know that nobody knows exactly who you are (NODS AND VOICES OF AGREEMENT). You just have to prove what you are. People can have their own perceptions of you which are no exactly what you are. So, it’s in line, in fact, with what you are saying. So do you think taking you into classes like that of General Mathematics can help supplement those attitudes, that lack of knowledge due to disruptions like being kept out of class? Or, in short you talked of people saying what is not exactly what you are. How do you think this could be solved? Helping people avoid or taking into account or heeding what people say about them? Do you think there are some ways in which that could be solved? (SILENCE). Because that’s a perception. I think people can be freed of those shackles. People are just shackled and we need to free them. So that they follow exactly what they are. Yes!

STUDENT: I think in general speaking. Um ... one can say since in most of the colleges or at Shingwedzi in particular where General Maths is compulsory to everyone. I think this will play an important role to the people who think Mathematics is difficult or is a difficult subject. Because since they are bound to learn General Mathematics it will prove to most of the people that they can make it only if they concentrate in the learning of or they rub that attitude of saying maths is difficult. I think General maths will help and uplift people who think maths is difficult to understand that really they can make it.

RESEARCHER: Hmm! So ... Yes, yes!

STUDENT: I think eh ... well people need to be guided. That they should first try before they leave a thing. They have to try if they can do that think or not because diverging or leaving a thing because somebody said something is not good. And since in our school here in this institution; since we are doing General Maths there are those people who have that negative attitude also; it has been developed since they were young and they should be guided that well
they can make it; it is not too late. Let them try to see whether they can make it. They give themselves a good attitude towards that Mathematics I think when they develop a positive attitude that may assist them to know those things (Maths). They can make it.

RESEARCHER: Hmm! Hmm! Okay, Sir do you still have something to say?

STUDENT: I have something to say. Like you know concerning here in our school General Maths is taken like just a mere subject meanwhile it is important somehow somewhere. And what needs to be done is like we need to have um ... extra lessons. Like when we draw our timetable. Because seemingly it comes twice in a cycle. Maybe it will help if it can come four times in a cycle. So that maybe we, especially to those of us who take maths as a difficult subject maybe it can help us, you know to take it in a serious consideration. And maybe we can develop a good attitude towards the subject. So that we can try to make it. They say you better try than not to try.

RESEARCHER: Exactly! Exactly!

STUDENT: (CONTINUE) Yeah!

RESEARCHER: So, umm! I realise you debate centres around teacher training and there are some institutions which were commissioned by the Department to look into the improvement on problems experienced in science and maths. Attempts to help such. And some of these schools of thought, like EduSource for instance advocate improved approaches in teacher education to alleviate some of the problems that you have just cited like teachers forcing you out of class, some forcing you to keep quiet, some not so confident about content knowledge as you indicated. They feel we need to shift from the traditional style of teacher training. Right! What is your comment on this? Do you think if there can be a shift we can have such improvement? What do you think about this thinking that we need to have improved teacher training programmes? For instance, they say there is a tendency where teachers, more especially methodology teachers come into class with piles of handouts showing how to
teach. Yet they have never demonstrated/modelled to you how to do it. So what do you think about this?

STUDENT: Yeah, I think the style of teaching must be improved.

RESEARCHER: Style of teaching teachers or everybody? Because I realise your argument tend to put the teacher on focus as the most problematic variable. So the point here is there are some people who think that if we can improve teacher training programmes; maybe some of those problems can be alleviated. So the question is: What do you think about this? I realise you said we need to improve our style.

STUDENT: (CONTINUE) Improve the style of teaching.

RESEARCHER: Teaching who? Teachers or?

STUDENT: Pardon!

STUDENTS: Teachers!

STUDENT: (CONTINUE) Teachers, yes. Because what I have realised there is ... you find that a teacher knows maths very well but he fails to present the matter to the learners. So, maybe, the problem is that they have not been taught how to teach. Yes, how to present the matter.

RESEARCHER: So we need to ... What do you think could be done? Are you for the idea that teacher educators should demonstrate to student teachers what teaching should entail?

STUDENT: Yes.

RESEARCHER: Instead of giving theories on how to teach.

STUDENT: Like now, about this OBE our methodology teachers they taught us this OBE but nobody is going to prepare this lesson exactly. Everybody prepare a lesson according to himself/herself because they are not telling us the exact lesson plan for this OBE.

RESEARCHER: Hmm! Yes, Sir!

STUDENT: Yeah! I think from the point that they are driving. Eh, ... I come to realise that the problem starts from teacher training where the teachers are trained. Because in case of this time, teachers are trained to teach OBE and what they are getting trained of. They are just given information theoretically
without demonstrations that in OBE in most of the cases what is expected. Only from the papers (handouts) you find the information that this and that need to be done. But you see something need to be done practically so that we copy from the practical things that one has seen. Then I think most of the teachers they have a problem from that fact. I remember in my secondary level. I come eh ...

One teacher he was teaching us Mathematics then he is giving the formulas and something else. When we ask where these formulae come from; he could not clearly explain where it comes from. He would just say “Just memorise it and write! What is expected of you is to write and get marks. Then take is as it is. Then he go on and say this formula we cannot know where it comes from. And then I wanted to drive this point too. Even that OBE that is orientated to teachers. Most of the teachers are not going to implement that OBE very well. Why? Because they only know that there is OBE and what is expected in the OBE and no one has put it into practice.

RESEARCHER: Hmm! Okay. I think we have said enough on that one. Thank you very much, Sir! How did you experience the programme that we had this year?

STUDENT: No. This year to my side, you know I gained a lot. Yeah, I gained a lot. I had a big change compared to the performance that I had during my high school.

RESEARCHER: Because the problem ... Yes, Sir!

STUDENT: I can say well, on my side I happened to know fractions but if they give a fraction I would not be able to know how can I put it in a drawing form. So, now this year I happen to understand where do that fraction came from. I know now how can I explain to somebody if he need to know a fraction. I can have a definition correctly. I can be able to explain through the definition why do I say it this. That’s what I can say.

RESEARCHER: Okay, thank you.

STUDENT: I think it needs more practice because hmm! ... as students we are different ... myself I am a slow learner some is high gifted. So if we keep
on doing practice and you as a teacher you give yourself a chance to help us not just to achieve what you want.

RESEARCHER: How ... How ... Okay, Sir!

STUDENT: Yeah! From the question that you have asked I want to appreciate in fact the style that was used in General Maths. What I have experienced this year it was a big difference from my learning whereby I ... I was used to groups but not in such a way because in the groups of General Mathematics I have discovered something which I cannot forget in my life. Because when you do things in groups I have discovered that most of the people they come with something in deep way whereby you have taken it as something merely. So um ... I want to appreciate it because it helped a lot because if one have little knowledge then we put it together we tend to understand that matter.

RESEARCHER: Hmm! Sir!

STUDENT: I am not happy about the way we learned because they introduce OBE meanwhile they are not applying it here. OBE related to group work. We didn't learn in groups. We only did assignments in groups. Not in learning. So I am not happy about that!

RESEARCHER: So you wanted both learning and assignments in groups?

STUDENT: (CONTINUE) Yes!

RESEARCHER: Okay. So. How did you feel about strategies like group work in doing assignments, in preparation for tests and examinations as well that I advocated. Of course the previous speaker has already raised something. Was it of any help to you? If yes, how did you feel about it? How did it help you?

STUDENT: I think um ... group work ... group work help a lot. If maybe you have experienced a problem then you tackle it with your friend I don't think that problem you will experience that problem again because you will know. Even if you approach; you come across that problem it will ring in your head that these actually you will remember the place where you treated this problem and then you picture the group you were with. I don't think um ... when doing um ... such ... um ... tackling that problem you will experience problems because you can be able to remember everything that you did as a group.
RESEARCHER: Hmm! Do you still have anything to say?

STUDENT: Well, on my side it came o'right because in our group we were used to give ourselves sections. When we meet each person has to treat the section which he or she has prepared. And even for examinations where we were asked to teach each other. From what we did, it helped us a lot. All what we taught the other learners, it helps us. Therefore, we are encouraging. It helps a lot. If the members of your group are co-operative.

RESEARCHER: I think in group work it was quiet correct according to me because if we are busy discussing some issues, for instance, Maths any one of us, each an everyone of us come with your own knowledge. So when you come to other students and raise problems concerning that issue you say “I don’t understand here” some of us have a short temper. Because they understand that even that person who raise that problem know very much but according to herself/himself he doesn’t understand that problem. Some of the members of the group think that if you go to a group and ask questions (you are a fool). It’s the main point of criticising someone. Maybe to let that people down ... Hmm ... lower their dignity. (LAUGHTER) Some of the members know that he doesn’t know the subject.

RESEARCHER: Hmm! Hmm! (LAUGH)

STUDENT: (CONTINUE) It’s the fact of lowering that person’s dignity.

RESEARCHER: Yes, Madam!

STUDENT: I want to speak on my side about group work. It is good because when we do in groups I realise something. Trying to do, let’s take a problem sometimes I treat in other way. So when we do group work I explain something in another way.

RESEARCHER: Do you have something else? Yes, Sir!

STUDENT: I want to come in the line of my sister who indicate some of the problem in group work. I think the problem that she has mentioned is what is expected from the group. If the group is functioning well it should have those aspects she has indicated because I think in a group we are not learning on learning (content) only. We are even calculating the manner, and the attitude of
people. Whereby we come to understand in full that when I am working with these people I have to expect this, that and that. So I want to encourage that even though there is some challenges that she has mentioned is what is expected from the groups and a functioning well group should have some ... seemingly when we are discussing it seem as if everyone is working for her own but as a result you come with a tangible solution. So I think that's a good way of learning, especially in Mathematics.

RESEARCHER: I like the way you are contributing. Um ... What about ... You might have realised that initially we started with fractions, number sentences in diagram or word sentence form. Do you still remember? Then we moved on we started treating fractions in sentences. How did you experience that? Was it ... Did it have any impact on your understanding of the fractions?

STUDENT: It had a positive influence. Now I am talking for myself. It has a positive influence because from now I can interpret things in a theory again into a practical form. Because now for example, now I am a caretaker in the kitchen so yesterday the machine which is used to cut the bread was not working. So (STUDENTS' LAUGHTER) Um, we divided the number of those loaves to get the number of those students. And in a loaf we were supposed to have 3 thirds.

RESEARCHER: Proper fractions! (STUDENTS BURST INTO LAUGHTER). So it helped you to transfer fractions from theory to practice.

STUDENT: (CONTINUE) Yes. From theory to practice.

RESEARCHER: Is there something else you want to add?

STUDENT: Fractions theory and practically challenges someone's mind. Yeah, it activates someone's mind. So that, you know you are always thinking, summarising in a good way. So ...

RESEARCHER: Are you in a way saying you are for this context-based learning? Where you are given a context, bring it into number form then you have to get a solution. Yes!

STUDENT: To me it happened that I happened to realise that Mathematics is everywhere where even when it is outside the school. With Mathematics suppose you are going to purchase something in a store. Well, the money that
you are to use. Even if you don’t have a machine to calculate you can be able to know exactly how did you do extending the Mathematics. We have Mathematics everywhere.

RESEARCHER: Sir, do you still have something else?

STUDENT: Yeah, you have indicated whereby one is moving from one approach to another approach. In case of fractions you will have direct fractions and fractions from sentences. I have come across the challenges in our groups whereby one comes with a question and ask: “We have learnt fractions why do you say even this is fractions. Why do we calculate using this approach? Why haven’t we calculate and we finish it. And then, leave this one (LAUGHTER). Then it was a good challenge. Then I was not having a direct answer to the question here. All in all I have come to realise that moving from one approach to another approach related is good because after we have discussed we have come to see that it’s one thing. Then a particular person come to understand it that I wanted to indicate that it was good for us even though it challenges.

RESEARCHER: Yeah. After all, you cannot learn without challenges. You need to have obstacles of which you get solutions. So, if there were some demerits/weaknessess in the programme, what do you think? How do you think such weaknesses could be improved?

STUDENT: To us?

RESEARCHER: Yes. If you feel there are things that need to be improved that can improve the programme. Because I heard you talking about the merits, the good.

STUDENT: (CONTINUE) You know. Um ... I think eh for the coming sessions, Um ... for us to get used to Mathematics, throw away the negative attitude you need to give us more exercises. It’s where I see people can get used.

RESEARCHER: Okay! You said more exercises and more assignments?

(LAUGHTER BY FELLOW STUDENTS)

STUDENT: (CONTINUES) Yes.
STUDENT: For my side is protection in the classroom situation. And well. You know, people if we are of the same age we get to undermine each other (NODS OF APPROVAL AND LAUGHTER). When a person ask a question you find that somebody is grumbling on the other side. So the lecturer or the teacher that is teaching that time should protect that person who is asking the question. So that he may feel free to raise his problem that he experience. Because if there is no protection, he or she will be afraid to raise a problem in front of the people. Of which she will be lost and can't cope.

STUDENT: And later, he will develop a bad attitude towards the subject and the teacher as well.

RESEARCHER: As well. Yeah. So protection is important. So, are you supporting him?

STUDENT: Yes.

STUDENT: I think during learning you should promote asking questions. It will develop the confidence of the learner. So that they can commit themselves in their work.

RESEARCHER: Hmm! Promoting asking questions and protect the person who ask.

STUDENTS: (IN UNISON) Yes!

RESEARCHER: If I reconcile ...

STUDENT: (LAUGHTER) I ... I think in your case during learning situation, the only problem that I have experienced is whereby the approach was changed suddenly. You see whereby when the one who is lecturing when he discovers that the approach ... I understand that Mathematics has different types of approach whereby when he sees that this approach seems not to work well or is not capable for the learners. Well, he suddenly change it. I somewhere, somehow am confused. I am not saying the style is wrong, but I wanted to encourage the approach whereby you choose one method. Or you compare the methods, then you choose one that you think will be best. Not changing it in a learning situation.

RESEARCHER: Okay! Okay!
STUDENT: Um ... In case of changing methods I think to use one method is very dangerous 'cause you find that another student for the method that you are using he or she doesn't understand the method. That is why it is taking us back to where the teacher ... old teachers know only one method (LAUGHTER BY OTHER PARTICIPANTS). You understand. Where if a ... a student asks that he or she does not understand. Just because he does not have another way of explaining, it results where he will tell the students big words or what. So I think different ways of teaching should be encouraged because you will find that other students don't understand the way I present the matter. So for those who don't understand I must change the style so that all the learners can cope with the ...

STUDENT: Even myself. I met this case, um, the course threes were writing assignments. It was on the chapter of decimals. So some added those decimals thing this ... On that chapter there are two methods to solve that problem. I can calculate decimals without changing them into proper fractions; I will get the same answer, but others I have shown them just to change those decimals into proper fractions. To our answer when we use the calculator we get the same answer as that one of decimals. Yes. But they have been marked wrong. But those ones who used decimals only they got it correctly.

RESEARCHER: I think that was an oversight. Because I normally encourage different methods. I might have overlooked that one and concentrated on the ones with decimals. So in rounding up before we stop, is there something else that you think could be ...

STUDENT: Yeah. On my side there is the problem of the language. In fact, most people say Mathematicians do not know how to speak English. They say in Mathematics we always speak broken English. So I want to encourage other Mathematicians that even though there are such criticism, let us be free of ourselves ... Mathematics has its own language (LAUGHTER BY OTHER PARTICIPANTS). Most students Mathematicians concentrate on Maths only. You find that in Mathematics they perform better but when it comes to the other subjects he is poor because he gave himself more time in Mathematics and
leave the other subjects. And I think there should be a balance. You have to strike a balance in all the subjects so that the performance will be the same. If you excel in Mathematics, you excel in English, you excel even in Biology. I think that will be well.

RESEARCHER: Okay. Thank you. Are those the only suggestions that you have? Because with me here I have this thing (idea) of helping them throw away the negative attitude by encouraging them to take part, by protecting them when they ask questions, promoting asking questions to build their confidence. But at the meantime making sure that whoever speaks is kept free to speak, kept free to ask questions. There is a voice of consistency in the choice of methods which was unfortunately contradicted by some other speakers that this is encouraged because it enables everybody to come on board and the last item indicated was the issue of language. That is why you might have found there was stress on number sentences and word problems. Even in fractions you had to interpret fractions in sentence context. Those aspects are intended to develop your language in the context of Mathematics. So that you can realise that this thing is just as transferable as any other language. Do you understand?

STUDENTS: (IN UNISON) Yes!

STUDENT: One thing was um ... I think ... In fact I still remember when we do exercises you always did not give us answers.

RESEARCHER: So, are you in a way saying we need to discuss those exercises?

STUDENT: (CONTINUE) Yeah! We need to discuss those exercises for everyone to know whether he/she is performing in a correct way or not. Yes.

RESEARCHER: Thank you. So that’s all. And the last thing which I wanted to hear from you is: There seem to be a belief in some circles. Some people believe that men perform far much better than women in Mathematics. What is your view in this regard? (SILENCE) Yes!

STUDENT: I think all of us are equal, it does not matter whether you are male or female. The thing that it is taken into account is understanding and the knowledge of the subject and application. Yeah.
RESEARCHER: Okay. Thank you.

STUDENT: Yeah, another thing is, you know um ... I know myself that I am not good in Mathematics but I don't believe that men are better than women in Maths. The fact is that seemingly ladies are lazy somewhere. They don't want to ask questions, they ... they are very afraid of asking questions in class. If she has problems she won't ask questions. And she won't ask her friend. They are very afraid to talk. In order to get new things.

RESEARCHER: Can we hear ... Okay.

STUDENT: To me ... it's a problem of language. They ... they are afraid. Even that case of protection because they think if they can just talk somehow or maybe she break the language the others will laugh at her. Then the thing is they should be confident. They should tell themselves that they should not allow a teacher or a lecturer to pass if they didn't understand. I think they will be equal. I don't think they are not competent than men. We are all equal. The problem is asking questions.

RESEARCHER: So, let's hear it from the horses' mouths (LAUGHTER BY ALL PARTICIPANTS). What do you think and what do you think could be done to help solve such problems? Our ... the direction the government has taken. Our system has changed to promote equality irrespective of gender. So, we are not just interested in taking women on board for the sake of their gender, irrespective of whether they are competent or not. So you need to be taken care of because you are women, taken care of because you are competent. So what is your view? What do you think could be done?

STUDENT (FEMALE): I think the thing is on women we do a lot of more work than men. Because if we go home, first we cook and clean and do everything concerning women. The men when they go home they stay reading newspapers or eating without doing anything and have enough time to practice. So, we women we doesn't have time to practice because we stay being tired daily.

RESEARCHER: Are you in a way saying that it is true that women tend to perform poorly compared to men?

STUDENT: (CONTINUED) Sometimes.
RESEARCHER: Hmm... Is that the only cause that you have?
STUDENT: (CONTINUED) Sometimes is the cause that they do more work than men sometimes if we stay at hostels like here there is no problem.
RESEARCHER: No difference at all.
STUDENT: No difference.
STUDENT: Hmm. There you are. What do you others think?
STUDENT (FEMALE): Okay. For me is we fail to ask something if I didn’t understand something. I fail to ask.
RESEARCHER: Why?
STUDENT: Sometimes (LAUGH) (ALL PARTICIPANTS LAUGH)
RESEARCHER: Why? (LAUGHTER CONTINUES). Because you need to be as free as any other person. (LAUGHTER CONTINUES).
STUDENT: Sorry, Sir! That is natural (ALL PARTICIPANTS LAUGH). They are born being fearful. They are very shy (LAUGHTER CONTINUES). Seemingly we can’t change it. They are being shy.
RESEARCHER: I realise you are nodding. Do you ... Are you for that? Do you agree that you can’t be changed?
STUDENT: I am against that. Myself I don’t think (LAUGHTER BY PARTICIPANTS). The only thing is they have to tell themselves that they need to do things. If they tell themselves that they want to do it they can do it. It is not the question of shyness. To be shy, you are shy. If you are shy, you are shy then you can’t get anything. Then you have to remove all the shyness and say I need to do this and then you do that. I think that will be o’right.
RESEARCHER: And tell yourself that you are just as good as any other person. I saw you nodding. Do you have something else to say? In closing. (LAUGHTER)
STUDENT: No (LAUGHTER BY ALL PARTICIPANTS).
RESEARCHER: Nothing! Thank you very much.
RESEARCHER: This is the second session with the second group of the focus group interview. As I told you that we have to attend an interview where we have to air our views about how we view our Mathematics learning. So, the first question which I think we need to look into is based on a prevailing trend. There is a general outcry out there by the private sector, by the government and the society in general about poor Math performance, about students’ tendency to avoid Math, about students’ general dislike of the subject and lack of Mathematics teachers. This is happening despite the important role that Math play in commerce, in medicine, in engineering, in information technology, just to mention a few. What do you think are the possible causes of all this? (SILENCE) This poor performance, this dislike.

STUDENT: Umm ...

RESEARCHER: Avoidance of the subject and lack of teachers because we have few. What do you think are the possible causes? Yes!

STUDENT: Most of the learners they were not encouraged since they were in tertiary level ... secondary institutions. They were not encouraged. Some they were going about ... They were just encouraged by their friends not to take Mathematics as an important subject.

RESEARCHER: So, is that the cause that you think of? Is that the cause? He speaks of the peer group as the key role player in discouraging people from taking Math. So, what ... what are your views? What do you think is the cause?

STUDENT: Yeah! I think even the way we were taught by the time. Actually, teachers themselves were not that much encouraging to learners. By then we were taught because take for instance a teacher happens to have a problem somewhere while teaching. Instead of you know taking a learner to a private place where he can show him something, he just blame him. Some sort of insulations towards that child. Like: “You are very stupid, you don’t understand, this and this". Those are the things which maybe made many students to leave Mathematics.
RESEARCHER: Are you saying that is ... was typical of many Math teachers?
STUDENT: Actually, that was because of lack of preparation. Teachers used to come to class without preparing themselves. Yeah, they never knew what to teach. They just come with textbook and refer. So when they get stuck it was a little bit difficult to carry forward. So they just decided to stop the child from asking some questions. So that's why so many students have decided not to take Mathematics.
RESEARCHER: Because their problems were not being attended to.
STUDENT: (CONTINUE) Yeah! Yeah! Their problems were not being attended.
RESEARCHER: Why do you think were the possible causes of them not preparing so well for the lessons?
STUDENT: Yeah! I can say the possible causes were that they were not serious ... They were not serious themselves. They were not serious teachers.
RESEARCHER: So, there was lack of commitment, in a way?
STUDENT: (CONTINUE) Yeah!
RESEARCHER: Are there more views?
STUDENT: Yeah! Concerning the issue of dislike. I can say it is because there is no motivation. By so saying I mean that if they can motivate them that or they can be informed that this is used in all things. For example, when you go to the shop you want to purchase something. You are going to use Math. For example if you want to purchase 2kg of Surf you find that it costs R20. So you suggest to take two 1kg packets which costs R11 each. But if you leave 2kg and take two 1kg packets it costs more than the 2kg. Therefore, that's where you should be able to use Mathematics. It's where they must be able to be informed that all ... in all things which they are thinking, they can use it (Mathematics) it should be used so that we can encourage/make them to take this subject into consideration.
RESEARCHER: So, in a way you are saying at the moment they fail to see where to apply Math in real life?
STUDENT: (CONTINUE) Absolutely!
RESEARCHER: What ... Do you all buy the idea?
STUDENTS: (IN UNISON) Yeah! Yeah!
STUDENT: It's very much true. Another one, umm ... Most of the learners while they are at home they were not encouraged by their parents. Or someone fail to pass standard 10. Learn standard 10 for 5 years. And he says that the problem was Mathematics. That was not the point, he was just ... umm ... he was just avoiding by saying about the Mathematics. And he made someone to fail to take that Mathematics into consideration.
RESEARCHER: Okay, I ...
STUDENT: That I have seen it. Even myself I wanted to leave Mathematics just because there was someone at my home who failed to pass standard 10. He repeated standard 10 for about 5 years and he said to me that it was just because of Mathematics. But myself I never took it. I went for the Mathematics. I wanted to see if what he was telling me was true. I found that he was just failing for his side. It was not the problem of Mathematics. He was not serious.
RESEARCHER: I realised you had your hand up.
STUDENT (FEMALE): In most cases most of the people when they want to do Mathematics they know that after qualification they get some job. Then this is they develop bad attitude in most cases. Because after doing that Mathematics, more especially at colleges or universities, then they go out to teach in different situations, then when they go there to teach that Mathematics. Because they don't ... In most cases they don't do Mathematics because they like it but because they want to get job. Then when they go to teach that Mathematics, they find that when they meet some difficulties they jump this problem because they want to keep people because they want that job. Instead of knowing it or to do that Mathematics thoroughly. That's what happens in most cases.
RESEARCHER: Very interesting! Very interesting! People just take Mathematics because they heard you can easily secure employment when you have math as one of your subjects. But, no commitment to mast the content
(NODS AND SOUNDS OF AGREEMENT BY PARTICIPANTS). Yes, I realise you have your hand up.

STUDENT: Furthermore, I think I can base my argument on teachers. In secondary schools, teachers they have got a tendency of maybe recognising the excellent students in the sense that they are always next to them. They don't like to help other students who are a little bit dull (LAUGHTER). Then as such it results in maybe students leaving Mathematics. Just because they are not recognised.

RESEARCHER: That's another point. What else? Yes!

STUDENT: Yeah! Another point, I think the way teachers were employed especially those times. Teachers were given irrelevant jobs (subjects they were not trained for). Yeah! I mean this in some of the schools you can find that a teacher who has never done Mathematics is being employed to teach that Mathematics. So, how could a learner become more active while getting which is a little bit irrelevant because he won't be able to give something to somebody while you haven't receive it well. Yeah! I'm saying this because say for instance as I'm doing Mathematics here or a person who has never done Mathematics before. Maybe I am doing Physical Science, they say it's long we have been looking for a teacher who has done Mathematics. But since you have been doing Physical Science, Mathematics is related. You can be able to teach.

RESEARCHER: Hmm!

STUDENT: (CONTINUES) So, there is where lies the problem, because the teacher will just memorise some information without understanding what it is all about. Then later on it kills the learners. Then they decide to depart ... leave Mathematics.

RESEARCHER: Then you go all out and cheat them, instead of teaching them.

STUDENT: (IN UNISON) Yeah! Yeah!

STUDENT: (CONTINUES) Yeah! That's what I wanted to say.

STUDENT: What I want to say is different from the last speaker. What I can say ... Another thing is that the learner does not have confidence. By so
doing I am saying that as they have heard people say that Mathematics is not so simple, they take it as it is, meanwhile it is not. It is because we are not identical. So this make them to fear to take that subject. So, what I can say is that the learners should have confidence that they can make it. In other words, they must be able to tell themselves that “When I do this really I can achieve in what I am doing.”

RESEARCHER: So, how do you think such confidence can be developed?

STUDENT: (CONTINUES) This is developed by umm ... the teachers who are teaching in that particular school. By informing them that “Fear not. This is good. If you think that you want to do this, do it. You can see that even though you are thinking that I can’t do it; do it.” Because when you try sometimes you find that you do (make) it. But just because of the fear which you have heard initially; it make you to leave it meanwhile you can succeed.

RESEARCHER: Hmm! Yes!

STUDENT (FEMALE): The previous teachers failed to know their learners. Because psychologically we have learners who are gifted and the other ones. So on teaching they focus on the learners who are gifted and reject others and at the end they tell the others that “You are stupid, you are a failure, you don’t cope in Mathematics. Go and do History and Geography because you are good for History (LAUGHTER).

RESEARCHER: Your mind is meant for History not for Math?

STUDENT: (CONTINUES) Yeah!

RESEARCHER: Which is not true.

STUDENT: (CONTINUES) Which is not true.

RESEARCHER: So, what do you think could be done to help teachers avoid such comments which are so discouraging to learners?

STUDENT: (CONTINUES) Um ... Teachers are now taught the psychology of the child. To help them to know the child they can be helped by encouraging. So it makes South African learners to cope with Mathematics. More learners. Yes.
STUDENT: One more thing that I have realised is that there is selfishness in learners. Most of the learners were just learning in order to get position 1. The learners thought that if I can show the others this problem (How to solve problems) they are going to have more marks than myself and I want to get position 1. There is no teamwork. (NODS AND SOUND OF AGREEMENT BY OTHER PARTICIPANTS).

RESEARCHER: So, are you advocating team spirit?

STUDENT: (CONTINUES) Yeah!

RESEARCHER: Where a sense of ... If ... if say one person or two people in your class fail, that implies your failure as a class. Not just that person. And if such spirit can develop, I interpret what he is saying that way; that can help everybody pass.

STUDENT (FEMALE): Yes!

RESEARCHER: So ... so ... What does ... Do you still have something else to say in this regard?

STUDENT: I just wanted to say that it is better to work as a team in class. We have to work as a team to help one another. And the teacher should not motivate the approach we were used to. Because the more the teacher talks, is the more the less we will know. But if the teacher can let the child participate more effectively than himself; we can be able to learn better and there we are going to have positive attitudes towards math especially when we are doing math in groups.

RESEARCHER: Hmm! Hmm! How do you see group work encouraging or developing positive attitudes?

STUDENT: Yeah! Well, it encourages, I mean group working ... the more you are working in groups is the more you understand one's problems (NODS). Because while I have learned here, I raised out my problem and then my friend next to me will help. There is where I think it encourages understanding.

RESEARCHER: Hmm! Hmm!
STUDENT: Based on that. Just seated in a desk with a problem unable to rise and as the teacher. Just afraid that the other teachers will laugh at you. (LAUGHTER BY PARTICIPANTS). But in a group you can ask.

RESEARCHER: So, in your group, because you are peers you feel at liberty to ask?

STUDENTS: (LIKE A CHOIR. FEMALE VOICES DOMINANT) Yeah!

RESEARCHER: You feel free to ask. I suspect that has much to do with stage fright. Just feeling scared that you have to speak in front of a multitude listening to you. Is that what you feel?

STUDENTS: (IN UNISON) Yeah!

STUDENT: Especially math. For what I have said I can just confess in that: Because the teacher himself. As I have said the employment of irrelevant teacher to a particular subject can contribute too much. Because I won't be able to ask questions to the teacher when I know that he don't know what is it that I will be asking and how to answer such. I will be insulted after all.

STUDENT: So it might be something better if we can just work in groups. I know that this one is my friend he won't ... he won't ... he will just take it easy. By asking him I will gain something from him.

STUDENT: I think as a means of uplifting the standard of confidence. I think there must be a positive polarisation relationship. For instance, in Psychology 1, and then where there is a good relationship between teachers and the learners is then that the teacher can be able to identify the problem. In that way they will enjoy Mathematics. Yeah.

RESEARCHER: So, there is a need for a healthy relationship between teachers and learners. Did I get you right?

STUDENT: (CONTINUES) Yes!

RESEARCHER: Okay! So, how do you think such relationship could be developed? I mean given the fact that ... I think the key players here are both the teacher and the learner. How do you think that can be developed?

STUDENT: I think the teacher has to be as close as possible to learners. They must be close together. By trying maybe to create jokes of some
kind. And then, in that way I think the learners will get used to that particular teacher. And the relationship will be okay.

RESEARCHER: Which means you have to try to put learners at ease and make them feel free and ... 

STUDENT: (CONTINUES) Yeah!

RESEARCHER: Hmm! You know, you remind me of a strategy more especially when you are to conduct interviews. You know what? One of the strategies is to put the person not familiar to you at ease. You just speak about common experiences. For instance, it is raining now. You just say “Hey, it was heavily raining. How was it in your place?” and all those things. You start speaking from that level. Those are things that we all experience; so that person will be at ease then as you move towards the business of the day the person is already free to talk. So umm ... Many people think they are incompetent in Mathematics. But interesting enough their performance proves the contrary. For your information, do you know that in your class – General Maths class, there are two people who scored the highest mark in your last test? One is doing maths as a major, the other one is not. One is male, the other one is female – the one who is not taking maths as a major. Yet some people believe they are not competent. And my suspicion is: The fact that this person is not taking maths as a major might be this problem of feeling incompetent. Why do you think people think this way?

STUDENT: Yeah! I heard your question.

RESEARCHER: Did you get the question well?

STUDENT: (CONTINUE) Yeah! I get the question. Why do people think they are not competent?

RESEARCHER: Exactly!

STUDENT: In Mathematics. Yeah! Well this might be because of the poor performance which they had before, especially in the lower primary. Something like that. Yeah! Well the attitudes which they were having the time they were doing lower standards. Say, for instance my performance was very much poor
there, I have to say that I am not competent in Mathematics because my performance was very much poor.

RESEARCHER: Hmm! That's what you history tells you.

STUDENT: (CONTINUES) (LAUGHTER BY PARTICIPANTS) Yeah! That's what my history tells me. So the first thing that I have to get is the encouragement by my friends and even the teachers themselves.

RESEARCHER: Hmm! More views? Yes!

STUDENT (FEMALE): In the past when a person do Mathematics in the class with other students, when he gets a high mark that people they started to take him as a higher person in other words. They say that person or that lady he/she know math rather than others. He do ... we are doing Mathematics in the class but in most cases she gets high marks. She is very clever as if is not a lady. So that is what is happening.

RESEARCHER: So, are you in a way saying such people tend to be viewed as some kind of not normal, umm ... Is that the feeling?

STUDENT: (CONTINUES) Yes.

RESEARCHER: You tend to be looked at as abnormal.

STUDENT: (CONTINUES) Yes!

RESEARCHER: That one tends to understand things that are not easily understood by other people, by a natural person and all those negative comments. Is that what you are trying to express?

STUDENT: (CONTINUES) Yes!

RESEARCHER: Okay! Yes!

STUDENT (FEMALE): I want to say that the dislike between two persons contribute a division between two people. If I like a Mathematics teacher, I understand more when he/she teach. But if I hate, if he teaches Maths I can't understand, because I hate that person naturally or maybe something happened between me and him. That is the contribution that (reason why) learners (either) understand or not understand Mathematics.

RESEARCHER: Hmm! Hmm!

STUDENT: (CONTINUES) Yes.
RESEARCHER: So, what do you think teachers could do to enhance that kind of liking, eradicate hatred if there is hatred between them and some learners? To allow that free flow of information between them.

STUDENT (FEMALE): Learners and teachers must create a ... a more a ... a good relationship. If I ... I ... little something I don’t understand if I ask you you can tell me in a good way. If you look me and tell me in a bad way maybe I hate you sometimes.

RESEARCHER: You tend to dislike me? You remind me of a certain learner. I read of this learner, he said: When I started schooling I liked math so well. But in one of the standards, I met a teacher who used to make a laughing stock out of me. Then as this kind of attitude went on and on, I turned to dislike math as much as I disliked the teacher."

STUDENT: (CONTINUES) Yeah! It happens.

RESEARCHER: Does it happen?

STUDENT: (CONTINUE) Yeah! (LAUGHTER BY ALL PARTICIPANTS).

RESEARCHER: Yes!

STUDENT: Another thing. I will refer this to our outcome after a test. The way we were treated by our teachers made us to change ... to have a bad attitude towards Mathematics. Then you hear some of students saying I'm not competent in Mathematics. Yeah! I'm saying this because at most ... Let's take, for instance, a particular learner in a class happen to get the high score say 90%. That child was given maybe an award. Maybe R5. So it was a little bit painful to me as I got say for instance 10% because there is nothing I got. (LAUGHTER BY ALL PARTICIPANTS). So that was another cause to make me think I’m not competent in Mathematics. So I better leave it.

RESEARCHER: You were not worth the reward (LAUGHTER BY ALL).

STUDENT: Yes! So I'm saying this to indicate that the way they give some awards. It's not a matter of taking something and give it to the learner. You better say try next time. You will be encouraging him by doing that. Yeah!
Well, something like that. (NODS AND SOUNDS OF CONSENT BY OTHER PARTICIPANTS).

RESEARCHER: So that has to do with the way results are communicated to learners.

STUDENTS: (IN UNISON) Yeah!

RESEARCHER: Hmm! Okay! Yes!

STUDENT: Another thing is that they used to undermine themselves. Just because, for example, if there is real information that there is someone who knows Mathematics very well, that he explains there is something that happens to him. Maybe it is that true what he is saying. They used to have negative attitude towards that subject (Mathematics). Meanwhile it is not. So they must be able to be informed for example if ... umm ... let's take for instance they are in standard 7 or standard 8 where you have to choose whether you want to take Mathematics or History or what, so they must be able to be informed that don't undermine yourself. Do what you think can help you. Because to hear something is not what exactly it is because sometimes they can cheat you. By so doing it can make you leave it meanwhile you can make it.

RESEARCHER: Is there anything else? Can we proceed?

STUDENTS: Yes!

RESEARCHER: So, some research institutions e.g. our government assigned EduSource with a responsibility to conduct a study to check what the possible causes of few people taking math and science, lack of math teachers, poor performance like cited before, to look at the possible causes thereof. So in their recommendations, they indicated that maybe if teacher education programmes could be changed, could be improved for the better, teachers could be well prepared to go out and attract more learners into the Mathematics-Science sector. What is your view on this? The talk of a need to improve teacher education programmes. What do you think?

STUDENT: Umm ... Well on this one. It is little bit complicated but I'm going to try. I think the way we are trained here at the college contributes a lot towards our future. The way we are going to deliver to the learners. The way we
are taught here it must be that much positive. We have to be given strategies which we can be able to give to learners themselves. Yeah! I'm saying this I have got a problem concerning the way we are learning somewhere somehow. Because umm ... especially as we are going to teach those young ones at primary ... The way ... We are learning things which are a little bit irrelevant I do understand that those things will help us. But we don't know the strategies which we are going to use to teach those you ones. We are just taught things, especially in Mathematics Academic. Yeah, so I think even learners themselves contribute too much.

RESEARCHER: Because, for instance EduSource even said ... they went on to say there is a need for teacher educators to demonstrate what they preach. In fact, they need to close that gap between theory and practice. If you say this is how we need to teach standard 2 (Grade 4) learners, show them how to do it, demonstrate to them. So, in fact what I wanted to find out from you is how do you view this recommendation. Like you were saying, in fact, I'm saying this because what you were saying is exactly similar to what these guys recommend. Do you have anything else to say? (SILENCE)

STUDENT: Well, the ... the recommendation if just the truth. And it can be very much helpful.

RESEARCHER: I see. So no that we have been speaking so generally about math, and the problems that are experienced, let us come back to our own programme that we had this year. How did you experience the programme as I did it with you during the course of the year? The General Mathematics programme that I did with you. How did you experience it?

STUDENT: General Math?

RESEARCHER: Yes! The General Math one, the way it was presented.

STUDENT: Yeah! That's how I think that it is good for you as our lecturers to show us how things should be done. It was very much goo. We have learned so many things. We should be able to deliver to learners out there.

RESEARCHER: Hmmm! Hmmm! What else? Yes!
STUDENT: I realised that the General Math that I was having before ... umm ... the way in which I was tackling Mathematics problems, it was a summary of what you have shown me. You have shown us a background of those skills. I don't know how to say it ...

RESEARCHER: It was summed up in a word SUMMARY that you used. So, are you in a way saying it was deepened?

STUDENT: (CONTINUES) Yeah!

RESEARCHER: Yes!

STUDENT: Actually, umm ... the way you were teaching us, the strategies which you have used, we never knew that before. You have come with so many things which made us to understand those things better. Unlike the way we learned before.

RESEARCHER: Yes, Sir!

STUDENT: I can say that it was fantastic just because during our teaching practice that we were having now I have heard that we must be able to use things that we are doing. You illustrated to us and demonstrated to us. For example, where you have taught us about fractions. You shown us where ... how it comes. For example by showing where the issue of denominators and numerators come from by using concrete things.

RESEARCHER: So, are you in a way advocating the hands-on approach, where you use concrete things. Things like those that you can touch, cut into equal pieces and see that this is half of that and all those things. Is that what you are saying?

STUDENT: Yes!

RESEARCHER: Hmm! So, what are the other things that you think about the programme? Yes!

STUDENT: Umm ... I'm having the view of maybe the group discussion that you implemented to us. It was very good because you told the students majoring in Mathematics to form groups with the general students. And then that helped us. It made we as academic students to help the students that are not doing Math academic. That made us to enable them to pass.
RESEARCHER: And another thing I want to stress and expect you to keep in mind is passing must always be a bonus. The best pass you can get for yourself is understanding. In fact that is what I have been stressing throughout. Did it make you reach any level of understanding which you never reached before?

STUDENTS: (IN UNISON) Yes!

RESEARCHER: Hmm! So how did you feel about strategies like groupwork in which you have been doing assignments, preparation for tests, and exams that I advocated during the lessons? That you need to do everything in groups. How did you experience those things? Of course you referred to groupwork previously, but I just want to get the feeling of the house. How did you ... Yes, Okay! Let's hear from you.

STUDENT: At the group, I realised that every student they are free to ask questions. But in the class we are not free. So you get something from the group. If I ask umm ... let's take my group is Bethuel and others. I can ask Bethuel: “Can you add this fraction for me?” He or she must teach me what I didn’t understand in class. So groupwork is very well for us.

RESEARCHER: So, it worked very well.

STUDENTS: Yes.

RESEARCHER: Hmm! What else? I realise more people want to speak.

STUDENT: Yeah! In groupwork I have realised students gain a lot because in a class you can treat one problem but when you go outside there in your groups you can treat lot of problems. And one is able to understand what he was not understanding during the learning process.

RESEARCHER: Hmm! How?

STUDENT: (CONTINUES) I think it's because this year we went to observation, and then as you know that those teachers have never been trained about incorporating groupwork and the like. So, this year the time I was there for practicals, I mean myself I tried to implement those things – groupwork and creative thinking. Like that. So, I realise that learners understand those things better. Yeah! Groupwork has worked to much.
RESEARCHER: Hmm! So, was it helpful to them?
STUDENT: (CONTINUES) It was very much helpful.
STUDENT: I wish to say more things about group work. Umm ... What I have realised is some of them did not realise that there was a difference between definitions of fractions and division and multiplication. For example, if we are dealing with division and subtraction is where you must be able ... If you have a fraction where say add you will be able to find the lowest common multiple on addition and subtraction but concerning the issue of division and multiplication you are not allowed to find the lowest common multiple. We were used to mix issues. But what we have seen during the programme we realised that addition and subtraction it is where we find the lowest common multiple but to the division and multiplication we don't.
RESEARCHER: Hmm! So, umm ... I realise you had your hand up regarding the experiences that you had on group work. What ... what ...
STUDENT: I like to add that group work is good because before we write tests I couldn't understand exactly the tasks but when we are in groups in discussions I understand how the task. Which helped because I got 34/50 (LAUGH).
RESEARCHER: Which is above the pass mark.
STUDENT: (CONTINUES) Yes. And at the exam we did group discussions and I hope I performed well.
RESEARCHER: So, how ... why do you think group work is so helpful?
STUDENT: (CONTINUES) Because I'm free to ask. During class when the lecturer is teaching I am afraid to ask where I don't understand. And when we are in groups I'm free to ask 'cause I know every learner.
RESEARCHER: It's like most lecturers try the best they can to make you feel at ease to ask whatever question. What makes you feel so scared to ask?
STUDENT: (CONTINUES) Some lecturers are very ... (EVERONE LAUGHS) Their faces ... (FURTHER LAUGHTER)
RESEARCHER: What's wrong with their faces? (FURTHER LAUGHTER) Because I ... I ...
STUDENT: (CONTINUES) Ummm! ...(POINTS AT HER FOREHEAD MAKING A FROWNED FOREHEAD).
RESEARCHER: They have frowns or what?
STUDENT: (CONTINUES) They do not laugh at all. So... we are afraid to...
RESEARCHER: Ask questions?
STUDENT: (CONTINUES) Yes. I remember that at the high school there umm... There was this English teacher every time when he come to my class. I was very... I learned (LAUGHTER) scared. So...
RESEARCHER: So you just felt so scared that you just can't even talk.
STUDENT: Yes! But a certain day when he came he told me that you seem as if you are not free. I said yes. He said: "Why?" I said "I'm afraid of you. Your face and you used to beat us with the fists" (LAUGHTER BY EVERYONE)
RESEARCHER: So, that's the kind of behaviour which stop many people from being... feeling free to ask questions. Is that what you are saying?
STUDENT: (CONTINUES) Yes.
RESEARCHER: Yes, Sir!
STUDENT: And sometimes since we are learning in a large number most of the learners they say that if I ask questions I just want to expose myself. I ask questions which are irrelevant in order that everyone consider me. So, it is the problem which fail people to ask questions when we are in class.
RESEARCHER: So... I realise you have your hand up. Yes!
STUDENT (FEMALE): In group discussions we are sharing our ideas. In most cases when we do discussions we never forget what we have done because we are doing discussions.
STUDENT: Another thing which makes people to be afraid to raise up their problems... I'm not referring this to Mathematics only. Even in other subjects. I have realised that there are subjects, especially at this college which come once a week. So lecturers don't give chances to the learners. They complain saying that "You know I come once a week so why do you have to ask questions. If you have got something to ask just come in my office." And it is very
difficult to come in somebody's office when you don't know what kind of ... (LAUGHTER BY ALL PARTICIPANTS) and ...

RESEARCHER: How is the invitation? Does it not sound warm?
STUDENT: I understand it does depend on the invitations where he might have invited you, but it's a little bit. It is a little bit difficult to attend somebody in her private places. So it's better when I have to raise a question in a group.

RESEARCHER: You wanted to say something. Just share the joke (LAUGHTER BY EVERYONE). It's like ...

STUDENT (FEMALE): Another thing in groups which is fruitful is that because they are my colleagues I can ask anything where I don't understand. But to ask a lecturer because the lecturers are not the same. Others when they get to the class they are just pulling the face (LAUGHTER BY EVERYONE). So, we cannot ask anything if someone is pulling one's face, because you don't know what is happening. Maybe today he or she is not feeling like coming to class. Just because of the period which forced him or her to come, so he will come. But when you are in a group you feel free to ask because when you are in a group you can understand better another student than the lecturer.

RESEARCHER: Why?
STUDENT: (CONTINUES) For example, when we are writing a math test I found myself that I failed the test. But when we decided to make a group and our colleagues tried to explain to me I'm not doubting that (LAUGHTER) I wrote well both Mathematics academic and General Mathematics.

RESEARCHER: Do you attribute that to the group work you engaged yourself in? I mean do you think your confidence that you passed both Mathematics academic and General Mathematics resulted from your participation in group work?
STUDENT: (CONTINUES) Yes.

RESEARCHER: From the look of things it's like everybody here is for group work. Do I get the impression right?
STUDENT: One more thing I realised in a group if you want to make a
discussion everyone is expected to come with his views and go there being
prepared that I'm going to be asked some questions and since I will be preparing
myself for that discussion it makes me to gain a lot from others.
RESEARCHER: Hmm! Yes!
STUDENT: Umm ... Under the issue of causes of not raising
questions in the classroom situation is just because you find that sometimes they
have agreed initially that they must be able to ask ... raise questions by using
Lingua Franca called English. So you find that one of them has questions but
she/he fear or is shy because she don't know where to start. Just because they
have agreed that they must be able to use English in order to know that particular
language. So if they were having the freedom to ask using any language, then it
is good. In other words they can raise questions.
RESEARCHER: Do you think given ethnic diversity in class, racial
diversity, where people come from different linguistic backgrounds ... What is
your suggestion? Because if you raise questions in your own language ...
Suppose your lecturer is not a native speaker of the language, how do you ...
STUDENT: (CONTINUES) I can say that before they make a
covenant they must be able to see whether there is not going to be a lot of
people that cannot understand questions asked in a particular language. So if
they see that really all of them know (the language) and also the lecturers
concerned know that language, they can do so. But if no one knows that
language or there are various languages which are spoken. If they agree to use a
language like English, they must be able to agree that even though she/he
breaks the language don't laugh, because what is important is: They are in need
of help not to see that she uses tautology or not.
RESEARCHER: Okay! Yes!
STUDENT: Yeah! Even not to asking questions during the lesson. We
are learning in large numbers. So if I raise my hand and as my question other
students will boo at me. That makes me not to understand everything. In that way
my confidence is decreasing. I can't continue asking questions during lessons.
RESEARCHER: So the best way out is to save face during lessons and be active in groups. Is that what you are saying. (LAUGHTER AND NODS OF CONSENT)
STUDENTS: Yeah! Yeah!
RESEARCHER: Okay! So, you might have realised that quiet a number of activities were involved. How did you feel regarding context-based questions. For instance in fractions, we started from theory of fractions, using concrete things like drawing diagrams and all those things, then we moved towards sentences. Same applies to number sentences and percentages. Do you still remember? You were given a context in sentence form which you had to convert into a mathematical equation. How was that? How did you feel about it?
STUDENT: Yeah! That was good. Actually, it helps us to interpret things even if we can see it written in a particular context like when going to a shop we can be able to interpret what is it all about. Like when they say 2 litres of this makes 500 millilitres of this. So we will be able to apply that to the reality.
RESEARCHER: Hmm! Hmm! Yes!
STUDENT: In other words, when we are dealing with the number sentences and the like I think it helps us to use Mathematics in real life situations just because I remember the question talking about working: “I have been working for 2½ hours and the other hours doing maybe umm ... I don’t know how can I explain it. I think you remember the question well. In that way we are applying Mathematics in real life situations.
RESEARCHER: So, you are able to solve real life problems mathematically?
STUDENTS: (IN UNISON) Yeah! Yes.
RESEARCHER: So, you are in a way saying it was of help to you?
STUDENT: (CONTINUES) Yes!
RESEARCHER: So, it's like ... many of you seem to be approving of the programme. But approved as it sounds, I take it there were some weaknesses in the programme. What are the weaknesses? And how do you
think programmes like this one ... the one that we had this year can be improved?

STUDENT: Do you mean the programme that we had this year?

RESEARCHER: Yes! The programme that has an approach of learning that involves group work, context-based approach and all those other things that were involved. So, if we were to improve, to make it even more fruitful than it was this year. How do you think that could be done? And, what ... what do you think could be done?

STUDENT: (LAUGHTER) It sounds interesting. Due to the fact that all those things are ... because of this new system of learning -- the Curriculum 2005. It seems as if some of our lecturers who are delivering these things are ... they don't know this better. They know it but they don't know how to translate it to others like us. So they need to be lectured as well so that they can be able to lecture us.

RESEARCHER: Hmm! Let's ... let's ... Okay!

STUDENT: According to my feeling is that if we can start grouping ourselves at the beginning of the year. Just because last year ... this year I mean we did ourselves due to assignments. If we can start grouping ourselves at the beginning of the year it will be helpful.

RESEARCHER: Okay! So, you ... let's confine ourselves for this moment to this math because there is a likelihood that we can be together next year. What we are suggesting can be of help to other people and to ourselves. So you are saying group work need to be part of our activities right from the beginning of the academic year?

STUDENTS: (JOINTLY) Yes! Yes!

RESEARCHER: Okay! So what else? Yes!

STUDENT: One other thing concerning groups as we have agreed that in every group there is one who is majoring in Mathematics academic. So, we must be able to make sure that we don't leave that system. We make sure that we don't leave that system. We must make sure that those
groups that do not have one who is majoring in Mathematics, they must be able to have that person. So that he/she can help them when they get stuck.

RESEARCHER: Okay! So, are you in a way saying those groups that had at least one person taking Math as a major stood an advantage?

STUDENT: (CONTINUES) Of course.

RESEARCHER: As such that needs to be a general trend regarding each group. There must be at least one person.

STUDENT: If possible, I think the concerned lecturer next year can give us maybe lot of assignments specifically in Mathematics – General Mathematics. Where we can always group together trying to solve any problem that arises during the lectures. Because we can be given a lot of assignments maybe we can be able to use to (help) each other. In that way it will help us.

RESEARCHER: Okay! So, why assignments?

STUDENT: (CONTINUES) Because assignments make us to be together. Yes. Then if we are together, it is simple for us to understand anything that can arise.

RESEARCHER: Okay! Okay! Yes!

STUDENT: Maybe, each and every chapter must have an assignment.

RESEARCHER: Each chapter?

STUDENT: (CONTINUES) Yes.

RESEARCHER: An assignment of its own?

STUDENT: (CONTINUES) Group assignment.

RESEARCHER: Okay! Is that all you have?

STUDENT: Yes.

RESEARCHER: Fine! Okay! I realise you want to speak. Yes!

STUDENT: I think it can be good if you can give us problems to treat before a chapter and encourage one another. That we want to know before you can teach us. Yes.

RESEARCHER: Which means, are you in a way saying you need to be given some assignments on a chapter before it is treated?
STUDENT: (CONTINUES) Yes!
RESEARCHER: Okay! Very interesting. I like that one. I like that ... Is there anything else that you need to suggest? Nothing else! So, there seem to be a believe in some circles that men perform far much better than women in Mathematics. That's a belief that prevails. What's your view on this one? (SILENCE) Yes!

STUDENT: Yeah! I can say that sometimes it really occurs in that way. But the cause is to me it seems as if ladies have a lot of work to do. Especially at the end of the lesson at home. They use to cook, to do all those things which they are supposed to do. So when they find that they have to study you find that they use to slumber and the like. So when she decides to study, when she is busy she starts to slumber. Then she leaves (studying) and wake up and go to school in the morning. But boys don't have a lot of work to do. It gives them time to study. In other words, they know more things because they have a lot of time to study. So, perhaps this thing contribute to that.

RESEARCHER: Let's get it from the horses' mouths (LAUGHTER). What do you think are ... Is this true? How do you feel? What is your view on this? People tend ... Yes!

STUDENT (FEMALE): (LAUGHTER) One day I read a psychological book. It says that mostly, women are ... are increasing brain are increasing brain understanding while they are adults and males have understanding when they are growing up. For example, if we have umm ... umm women are more clever when they are young and males are less clever while they are still young.

RESEARCHER: But, what about female?
STUDENT: (CONTINUES) Female while growing up, the increasing of understanding are decrease and the male are increase while they are growing understanding. Something like that. A psychological book says that.

RESEARCHER: One thing you need to bear in mind when you read books is that those people are authors. They are scholars. Scholars are philosophers. They just write what they believe in. So you don't have to take it as
a cut-and-dry kind of thing. As such from your own experiences, do you think that is correct?

STUDENT: (CONTINUES) It is incorrect.

RESEARCHER: What is your view?

STUDENT: (CONTINUES) Because as I'm a woman I have a right to learn and understanding what I learn as a person same as men.

RESEARCHER: So, is that what reality dictates? Are you ... What is your observation? Do you see both male and female performing equally well?

STUDENT (FEMALE): No! They are not performing equally well.

RESEARCHER: Who seem to be underscored and why?

STUDENT: (CONTINUES) Mostly you find that women are underscored.

RESEARCHER: Why?

STUDENT: (CONTINUES) Because you find that mostly women are ... have many personal things like cooking, (LAUGHTER), cleaning the house and other domestic work.

RESEARCHER: Let's say. Predominantly. I'm aware that in an institution like this one many of you stay in hostels. Such that some of those chores or work that you do at home are minimised. Does that seem to prove to alleviate any of the problems that you have when you go home daily?

STUDENT: (CONTINUES) No. It's not minimised because women mostly cook for themselves. Because it's a habit to eat what I eat.

RESEARCHER: Hmm!

STUDENT: (CONTINUES) Yes!

RESEARCHER: There you are. That's what she thinks. Yes!

STUDENT: As far as I'm concerned, one thing that makes women not to perform very well is just because they are not committed. They are not busy with academic work. They want to do it if there is a test or assignment. Except that they don't do anything.

RESEARCHER: Hmm! Let's hear from them. (LAUGHTER). What do you think? (LAUGHTER CONTINUES) Is that true?
STUDENT (FEMALE): No commitment?
STUDENT: We don’t want to study for ...
RESEARCHER: Knowledge’s sake? So what do you think could be done to solve such problems?
STUDENT: I think it’s a matter of committing themselves. And the attitude towards Mathematics should change to be that much positive.
RESEARCHER: How? I mean, how do we help them change that negative attitude?
STUDENT: Yeah! While we are doing group work, it is then that they can be able to change their attitude, because they will be able to see that there is nothing difficult ... it’s the same as other subjects. It’s a matter of involving yourself, growing a better attitude towards Math.
RESEARCHER: Is that ... Yes!
STUDENT (FEMALE): Everyone must have a self-assessment. Ask themselves some questions.
RESEARCHER: What should the self-assessment be based on? Must it be based on the content that you learn? Or self-assessment in terms of attitudes, that I feel I need to change my attitudes, determining whether the attitudes are changing or not.
STUDENT: (CONTINUES) The question on how to improve my attitude on every subject, not math only.
RESEARCHER: Hmm! Okay!
STUDENT: Yeah! Also group assessment can work just because when you are together you can do something being together. When you find that you are about to disperse you must be able to give everybody a problem and inform him or her that go and do it. When we meet tomorrow everybody must have done it. By so doing it can make him or her to make it.
STUDENT: So how will that change these people’s attitudes? This will change them because it can make them to do it (Mathematics) daily. Which means they are going to have a habit by doing it. Even though in group discussion they haven’t been given problems. It can make him or her to study
just because it's a habit. For example, if I'm used to running daily, then the day in which I'm not going to run, it will make me feel not happy.

RESEARCHER: Hmm! Yes!

STUDENT (FEMALE): To me to understand Mathematics is very difficult to me. I don't know where I can start to do a fraction.

RESEARCHER: So wh ... Can we talk to her. Here she is presenting her own problem. She says she is ... the interest is there to know the subject but the how part of it becomes a problem for her. What do you think her problem is? Yes!

STUDENT: I think this lady she is just failing to expose herself to her group. I think if she can raise that problem to her group, the group can manage to help her whenever she has got a problem.

RESEARCHER: Yes, Sir!

STUDENT: I urge her to spend maybe 40 minutes per day practising Mathematics or if she stuck just to contact the academic students who are doing Mathematics as a major.

RESEARCHER: Hmm! Will that ... Is that fine with you?

STUDENT: Yes!

RESEARCHER: In fact, what you can do is contact whoever you feel can be of help to you. You can even see me, you can see whoever is of help. Because what we are after is not just you passing, getting 50% because 50 has got nothing to do with your understanding. What we actually need is just ... If your mark can just be understanding. Then this will be a 100% mark. Forget about the real numerical mark and think of understanding.

STUDENT: (CONTINUES) Yes!

RESEARCHER: Because what I realise is many people tend to commit some of these things to memory which is completely against math learning because one need to understand the way things are done., Not being able to tackle whatever test or exam problem. No. Do you understand?

STUDENT: (CONTINUES) Yes.

RESEARCHER: Yeah! So feel free, in fact we still have a lot of time to look at these aspects. Try to work as hard as you can, see if you can
identify your problem areas. Contact whoever you think can be of help to you. Including myself.

STUDENT: (CONTINUES) Yes!

RESEARCHER: Anything else? I think we are almost through. Yes!

STUDENT: Yeah! Before we disperse I was having another solution which can help to get people to take Math into consideration. What they can do ... I can say to the government ... They can take this issue into consideration by writing or doing advertisements where they must be able to show people that there is a running short of doctors here in South Africa. Just because without doing this Mathematics you can’t be a doctor. So, they must be able to advertise it to the various stations like radio and TV stations. So, they must be able to advertise it so that they can take it into consideration just because it is good.

RESEARCHER: Do you know that there is something interesting happening? Our government is currently taking people out, more especially those who want to pursue medicine lines to countries like Cuba for medicine. Where you spend 6 years. Then you come back for your internship, qualified doctor. And for your information I think one of your lecturers’ younger brother has got that scholarship. He is out there now. Their programme started this year. And it’s so easy. We can even expand those. In fact we have other areas like commerce which are the key areas in governing any country. You cannot govern a country without knowledge of money. Otherwise you will end up misappropriating funds every year. You see. So those are some of the things that you need to take into account. Is there any other person who has something else? Okay. Thank you.