

CHAPTER 4

RESULTS OF QUALITATIVE INVESTIGATION

4.1 INTRODUCTION

The purpose of this chapter is to explain the findings of the qualitative part of this investigation. The responses that are presented here were collected from teachers' individual interviews, four classroom observations and three focus group interviews with a total of eighteen learners.

Since I had been involved in teaching Grade 12 mathematics, I was familiar with the organisation and teaching content of the subject. The information gained from the focus group interviews is relevant to the objectives stated in section 1.3 of this study. A detailed description of the coding approach and research methodology was given in CHAPTER 3 and a comprehensive literature review in CHAPTER 2. Table 4.1 is a matrix showing the research questions and the source of answers.

Table 4.1 Research questions and source of the answers

Research question	Data Source		
	Observation	Interviews	Video viewing
1. What are the competencies of mathematics teachers in high-performing and in low-performing schools?	X	X	X
2. What are the learners' perceptions of their successes and /or failures in mathematics?		X	
3. What are the attitudes of the teachers in high-performing and in low-performing schools towards the learners they are teaching?		X	

4. What factors facilitate successful classroom practices in mathematics in Grade 12 schools?	X	X	X
5. What are the attitudes of the learners in high-performing and in low-performing schools towards mathematics and achievement in mathematics in grade twelve?		X	

In the next section I outline the data captured in classroom observations and in teachers' individual interviews. The classroom observations and semistructured interviews with the teachers will be discussed with respect to each school. The findings are related in the form of small quotes from the teachers, with a summary table for each school followed by the summary table for all four schools.

4.2 PHASE 1: CLASSROOM OBSERVATIONS AND TEACHER INTERVIEWS

Teachers were interviewed in order to determine their perceptions of factors that facilitate achievement in mathematics. In this respect, according to Henning, Smith and Van Rensburg (2004: 72) a sound interview guide made up of critical questions should be used to capture the research. The interviews were conducted in English but interviewees were also allowed to respond in their mother tongue if it made them more comfortable to respond to specific questions and as a result some quotes were translated. Table 4.2 below contains a summary of the interview guide and actual questions that were planned.

Table 4.2: A summary of interview guide and planned questions

Question	Question type	Planned question
1	Initial opening questions: General, factual, quick, and establishes what is shared by each teacher.	(a) Tell me how you came to be a mathematics teacher? (b) Who, if anyone, influenced your action?

2	<p>Intermediate questions:</p> <p>Introduce the topic and spark conversation.</p>	<p>(a) Will you continue as a mathematics teacher for the rest of your life? Why?</p> <p>(b) Tell me about the challenges you experience in teaching mathematics?</p> <p>(c) Tell me how you go about motivating your learners in mathematics.</p> <p>(d) Could you describe the most important factors that enhance achievement in mathematics?</p>
3	<p>Ending questions:</p> <p>Identify most important aspects of the topic, and tie up loose threads.</p>	<p>(a) Of all the factors we have raised, which are the most important ones?</p> <p>(b) Have we missed anything?</p>

4.2.1 Results from school A: High-performing school

Teacher A was in his twelfth year of teaching, all of which has been in school A and most of which has been in Grade 12. There were a total number of twenty-three higher grade learners in his class and twenty standard grade learners. Teacher A has a secondary teachers' diploma and a further diploma in education. In school A Teacher A was not the only teacher who was qualified to teach mathematics. There were three other teachers who were qualified to teach mathematics and science but these other teachers were teaching science either in Grade 12 or mathematics in lower grades.

Even though Teacher A uses some traditional methods in his teaching, he also uses some modern teaching strategies. For instance he uses some examples that relate to real world problems to show his learners that what they are doing is also applicable in life. In developing his homework and classwork questions, he tries to include some items that are thought-provoking in terms of a real world context. According to Teacher A, all papers are supposed to resemble the final examination standard. He often puts more emphasis on the thinking behind the answer rather than on the answer itself.

His learners are often asked to explain their solutions to other learners. When Teacher A was asked how he became a mathematics teacher and what influenced him, he provided the following response:

Before I started teaching I was a mathematics learner at the same school. I was very much interested in maths and I was working on this subject all the time. My mathematics teacher motivated me and fortunately it is that same teacher whom I replaced.

Teacher A was encouraged by his secondary school mathematics teacher once the teacher noted his interest. Teacher A continues and discusses some challenges in teaching mathematics in his classes, such as the attitudes of his learners towards the subject and how he tries to overcome these:

There are so many challenges in teaching mathematics today. Many learners come to school with the attitude that mathematics is a very difficult subject, so I had to eradicate that from their minds in the same way as what my teacher did to me, and in turn I become motivated to continue teaching as I see some of these learners succeeding. Also I have to show learners that I can teach this subject which many people think is a hard subject.

According to Teacher A, one of the factors that facilitate learners' success in mathematics is a light teaching load. He explains how the school management has reduced his workload in order to cope with the situation in the following way:

When I started teaching at this school I was the only teacher who was teaching mathematics in the whole school and I was not teaching mathematics only, I had to teach biology and physical science as well, which was discouraging. But now things have changed. I am concentrating on mathematics only and this has given me an opportunity to further my studies in mathematics at Wits University.

Teacher A believes that one of the reasons why his learners are motivated in mathematics is because he comes from a similar background as his learners. He contends that learners know his family background because he comes from the same local area. In this regard teacher A commented that:

Ways of motivation are different. I use myself as an example because most learners' backgrounds are like mine. I am from a very poor background and because I am from a local place most learners know me.

In order to motivate his learners to succeed in mathematics Teacher A stated that he also invites people from outside to come and motivate his learners:

In most cases we invite people from different companies to come and explain to the learners how mathematics is applied...like now we are living in the time of technology, which needs mathematics learners. So when I invite these people they come and motivate them and show them that if you are good in mathematics and obtain good symbols we can absorb you here and there.

Teacher A believes that for learners to succeed they have to associate themselves with other learners who are serious at school. He encourages his learners to associate with other successful and serious learners in their class.

Personally I have observed one thing. When you associate yourself with failures you are likely to fail. I am a person who usually associates myself with successful people. So for my learners to succeed they must associate themselves with learners who are serious about mathematics.

Answering the question on challenges he faces, Teacher A mentions learners' background and some of their strengths:

Most of the learners here have a good background in mathematics, and some are very intelligent. I think they were born just like that. If you just come without being prepared you will be in for a great shock. They prepare themselves before coming to the class. In this school there is a culture of learners willing to learn on their own.

Précis (Summary of aspects from school A relevant to research question)

The results of interviews with the teacher and classroom observations in school A can be summarised as follows:

- The teacher in this school was motivated by his former teacher.
- There is a low teaching load.
- Motivators from outside are invited.
- Some modern teaching techniques are used.
- Learners are encouraged to associate with serious learners of this subject.
- Career guidance in science and mathematics is offered.
- Learners can associate well with the teacher.
- There is a culture in the school of learners willing to learn on their own.

Table 4.3 Summary of the results from school A

Questions	Results
How did you become a mathematics teacher?	Motivated by mentor and personal interest in mathematics
Who, if anyone influenced your actions?	Mathematics teacher
Will you continue as a mathematics teacher for the rest of your life? Why?	He is motivated to continue teaching despite some challenges in teaching, because there are some learners who are succeeding
Describe the most important factors that facilitate achievement in mathematics.	Role models in mathematics and science, Exposing learners to science related career, Teacher development in the subject. Teacher self-efficacy. Learner association. Gifted learners. Learners' willingness to work hard.

<p>Tell me about the challenges you experience in teaching mathematics.</p>	<p>Learners' attitudes towards mathematics. Teaching different subject in addition to maths. Ill-discipline. Lack of career guidance among learners.</p>
<p>Tell me how you go about motivating your learners in mathematics.</p>	<p>Invite people from different companies, and using himself as an example</p>
<p>Of all the factors we have raised, which are most important ones?</p>	<p>Good background in mathematics. Learner preparation. Self-concept. Learner discipline. Proper study techniques.</p>

4.2.2 Results from school B: High-performing school

Teacher B, after graduating from the university has taught secondary level mathematics for a total of ten years, all of which have been in school B and most on Grade 12 level. He has 155 learners in Grade 12 with three classes of about fifty learners each. All learners in his classes are registered for higher grade and eight have registered for additional mathematics. He has a Bachelor of Science degree in mathematics education. He regularly attends workshops organised by mathematics teachers associations and meets regularly with some local teachers to discuss mathematics teaching issues.

Teacher B's classes appeared too large for effective teaching and learning to take place, and learners were not afforded enough opportunity for personal contact. In spite of the large classes, Teacher B always applies some strategies to engage learners in effective learning. During my class observations, learners were always in attendance and keen to participate in class discussions. Teacher B promptly started all his classes on time.

There were no disruptions during his lesson. He monitored learners' work, explaining problems to different groups of learners as his class was large. There was much respect from his learners. During each lesson he would call upon one of the learners to come and

elaborate on a homework given the previous day. For instance, when introducing sequences and series, he gave his learners a practical exercise to be presented the following day and a prize was offered for the group that could come with the correct solution the following day. During the presentation Teacher B always encouraged his learners to participate in class discussions.

Despite teacher B's belief that one of the most important factors that contribute to his learners' good performance in mathematics is a result of interacting with other learners, he also advocates that there must be competition between learners. In this regard, Teacher B stated that:

I believe learners must be able to work together and give assistance to one another. They must be able to create a sort of competition among themselves. Not a destructive competition, I mean, a competition to motivate each other as friends. We have two Grade 12 classes in this school and learners are ranked from the highest to the lowest levels based on the recent examination results. This encourages them to always fight to be in the best group. Another thing I think is to involve their parents to supplement the motivation given by teachers at school.

He also mentioned that learners should develop an interest in the subject and be conscious of the career they want to follow after Grade 12.

On the question of how to motivate learners in mathematics he stated that one of the factors that contribute to his learner's good performance is motivating them through career choices in mathematics. He stated that:

Most of our learners in Grade 12 do not know what they want to do after grade twelve. The year I took my learners on a trip to Gauteng to visit science laboratories and some other companies, our results improved in mathematics and physical science. When we came back from the trip everyone was encouraged to work very hard, because they were shown the importance of studying mathematics in high school.

Furthermore, from Teacher B's point of view, the root of his learners' success in mathematics is the fact that he examines them frequently and finishes the syllabus early. Learners who do not do well in the test or examinations are given more time to master the topics with the assistance of the teacher.

Teacher B’s learners change seating arrangements depending on their performance in the tests and examinations. A learner in another class will be transferred to a low-performing class if he/she performs lower than some learners in that lower performing class. In this regard Teacher B stated that:

Grade 12 syllabuses in our school end before June for all subjects. Our principal is very strict on that; you will feel ashamed if you do not finish the syllabus in time because you will be the only one left. The reason is that before the final examination our learners must write at least four exams with questions taken mostly from previous examination question papers, and learners who do not perform well are given thorough practice again.

Commenting on other factors that contribute to learners’ success, he alluded to the fact that it is important to teach learners application topics in mathematics. Teacher B indicated that mathematics learning is more meaningful when it is related to real life application. In this regard teacher B claimed:

I think problem-solving is one of the main reasons we teach mathematics. We do not teach mathematics so that learners can understand how to find the derivative of a function only. We teach them skills so that they can be able to solve real world problems that relate to the mathematics in class. They must be able to find the maximum and minimum values using calculus. Application of mathematics to real world problems is very important.

Teacher B sees a clear connection between teaching problem-solving skills and teaching learners to apply concepts to real-life applications.

TABLE: 4.4 Summary of the results from school B

Questions	Results
How did you become a mathematics teacher?	He was good in mathematics. Financial backup to follow other careers.
Who, if anyone influenced your actions?	His parents motivated him to be a teacher.
Will you continue as a mathematics teacher	He is comfortable to continue working as a

for the rest of your life? Why?	teacher.
Describe the most important factors that facilitate achievement in mathematics.	Strong leadership at school. Learners association. Learner self-discipline. Good career guidance. Teacher self-efficacy. Use of previous examination question papers, Help from other teachers. Frequent testing. Relevance to real world.
Tell me about the challenges you experience in teaching mathematics.	Poor learners' learning techniques. Learners' inadequate mathematics background. Ill-discipline.
Tell me how you go about motivating your learners in mathematics.	Application of mathematics to real world problems. Visit mathematics/science related companies. Discuss the importance of mathematics.
Of all the factors we have raised, which are most important ones?	Assess frequently. Finish syllabus early. Interest in the subject. Good career guidance mathematics. Good mathematics background. Attends workshops and meets with some local teachers. Encourages group work.

Précis (Summary of aspects from school B relevant to research questions)

The views of the teacher in school B and observations that I have made during classroom visits are that, in this school:

- There is an involvement of parents in the school activities.
- Teachers know how to handle large classes.

- Competition among learners is encouraged.
- Learners are given enough time for practice.
- Application topics and problem-solving is emphasised.
- Learners are assessed frequently.

4.2.3 Results from school C: Low-performing school

Teacher C has taught mathematics for ten years, all of which have been in school C and most of which have been for Grade 12 classes. Teacher C has thirty-seven learners in her class. There were 12 learners who registered for mathematics in the higher grade and 25 of the learners who registered for mathematics in the standard grade. She has a Bachelor of Science degree in mathematics education (BSc.Ed.) and an honours degree in education (B.Ed.). In school C there were two teachers who were qualified to teach mathematics. Every year they alternate in teaching Grade 12. Class attendance in school C was generally poor. There were some learners who were absent for most of the periods when I was there. Teacher C feels that learners take class attendance lightly, and do not always see the necessity for attending regularly because “*most of them have already lost hope in mathematics*”.

Teacher C indicates that she teaches mathematics and physical science to Grade 12 but if given an opportunity she would like to continue teaching mathematics only because it is her favourite subject. In this regard she noted that:

At the beginning I did not like mathematics. It was not my favourite subject, because learners do not like it. The attitude towards the subject is not good, but because of some good learners in my class, I now love it. Sometimes I struggle with some problems but finally I get the solution right. Also marking mathematics is easier than any other subject. It is challenging but ok. I wish I can teach mathematics even if it means so different grades.

In each class teacher C’s teaching was constantly characterised by evidence of traditional methods. Classes began with a review of previous work; and then adhered closely to the textbook and most of the exercises were taken from the same textbook. She gave step-by-step instruction to the learners, and then assigned some problems, which learners were to

complete individually. She then walked around, monitored learners' work, explaining problems to individual learners. The learners were expected to learn the assigned material in small amounts, memorising algorithms with little or no intention of the understanding of underlying concepts.

When asked what helps learners to be successful in mathematics, teacher C responded:

Unfortunately, I would probably say working with a classmate helps learners the most. I'd rather say I help them the most, but I do not think this is true.

Even though she thinks working with a classmate is helpful, teacher C does not see this strategy as helpful to learners by encouraging them to express their ideas mathematically and to explain their ideas to others. She defended this position by saying that most of her learners are playful and they discuss other business rather than concentrating on the task given, Teacher C always asks questions during the teaching process in order to gain the attention of her learners. However, these questions were not utilised in order to help learners make their own connections.

Attending extra lessons (like Saturday lessons) was also mentioned as a factor which can contribute to learners' good performance in mathematics. In this regard Teacher C stated:

...but here at our school only bright learners ask to be taught extra classes, the rest come because I threaten to punish them, and still not all of them are motivated to come. The lazy learners are a problem at this school.

During the interview she was asked about how she motivates learners in mathematics.

Teacher C replied:

Learners should have good examples in their communities. They do not have enough examples of people in the community that have passed mathematics. They think mathematics is for special people and that not all the people can do mathematics.

Teacher C is of the opinion that one of the factors that makes learners perform well in mathematics is to respect and manage time profitably in learning the subject. Teacher C describes this fact in the following way:

I believe in time and time only. I normally tell my learners that it is not that mathematics is a subject which requires more time, because if you offer it enough

time, it will be very simple. They need to practise regularly and give this subject time and avoid bad social behaviours.

She also cites a few problems that she considers fundamental in the teaching of mathematics. The first is that the teacher may present mathematics to the learners but the learners ‘do not understand you’ especially in linear programming and application of differential calculus. ‘I do not know whether the problem is language or what?’ In her class, Teacher C also feels that the level of the learners’ understanding is not always what she would like and that most of the learners are limited in their potential for learning the subject. In this respect she remarked:

I think most of the learners are just pushed to do maths by their parents or friends. They just can’t do it.

Of all the teachers in this study, the teacher in school C demonstrates most a teaching practice which most closely exemplifies traditional methods of teaching mathematics. In responding to questions about why she teaches the way she does, Teacher C expressed beliefs which were in large part correspond with traditional methods (explained in Chapter 2).

The following is a summary of what goes on in school C and includes responses from Teacher C.

Table: 4.5 Summary of the results from school C

Questions	Results
How did you become a mathematics teacher?	Did not like to be a mathematics teacher at first.
Who, if anyone influenced your actions?	Good learners in her class.
Will you continue as a mathematics teacher for the rest of your life? Why?	Teacher C is motivated to continue teaching.

Describe the most important factors that facilitate achievement in mathematics.	Time management. Teacher knowledge of the subject. Role models in the society. Solving real world problems. Seeking help from other teachers. Working with a classmate.
Tell me about the challenges you experience in teaching mathematics.	Class attendance taken lightly. Poor learners' mathematics background. Poor learners' mathematics self-concept. Mathematics role models in their communities. Ill-discipline. Lack of extra classes. Learners are playful during class discussion.
Tell me how you go about motivating your learners in mathematics.	Tell them to work hard. Sometimes have motivational talks.
Of all the factors we have raised, which are most important ones?	Poor class attendance. Not knowing what to do after Grade 12. Lack of teacher respect.

Précis (Summary of aspects relevant to research questions from school C)

The results of interviews with the teacher and classroom observations in school C can be summarised as follows:

- Learners are frequently absent from the class. (Unmotivated)
- Traditional, algorithmic approach in teaching is employed.
- Teacher does not believe in learners helping each other
- Not enough role models

4.2.4 Results from school D: Low-performing school

Teacher D has taught mathematics for fifteen years in school D. His teaching has mostly been on Grade 12 level. The total number of learners in his three classes is 138. Teacher D graduated from a teacher training college with a secondary teachers' diploma and never registered for any further mathematics course. Teacher D was not interested in becoming a teacher, let alone a mathematics teacher. In this regard he said:

The event that led me to become a mathematics teacher was mainly that my guardians wanted me to be a teacher whereas I wanted to work in a bank. I was dependent on them financially so I didn't have any alternative. Teaching was not my choice. Sometimes due to some de-motivation from the government I feel like quitting.

In school D, mathematics has one qualified teacher. In this respect, teacher D is forced by the circumstances to teach grade ten to twelve mathematics classes alone. This causes the school subject allocation team to let some teachers teach mathematics in lower grades even if they are not qualified and do not have any interest in the subject. According to teacher D, the learners pick up the apathy rapidly and this affects their performance levels.

In our school we have a shortage of qualified mathematics teachers. As a result even people who had mathematics up to Grade 12 are forced to teach mathematics in lower grades. These teachers have no interest in the subject in the first place and this is transferred to the learners ultimately.

Teacher D's teaching was also characterized by traditional methods of teaching. He rarely discusses homework given the previous day in detail, only providing answers. He adhered closely to the examples provided in the textbook. He mostly used the lecture method, and then assigned practice problems which learners were to complete individually. He then monitored learners' work, explaining problems on the board. Learners were expected to learn the concepts through memorisation and applying algorithms with little or no understanding.

Teacher D feels that teachers in his school are not respected and this in turn affects the performance of learners in mathematics and all other subjects in general. Teacher D finds the different levels of ability for the learners quite difficult to work with in the classroom. According to teacher D, his classes are far too big, resulting in difficulties with assessing and recording learners' progress, conducting tests and teaching, with the result that he is unable to provide time or motivation to help the weak learners.

According to teacher D, his experience in teaching mathematics is that learners have common problems. He said:

Since I started teaching and especially Grade 12, I found that learners have the common problem because they do not understand some topics, mostly those that involve application and they also forget easily. I do not know what the problem is. You teach, they understand but immediately they forget what you have just taught.

Table: 4.6 Summary of the results from school D

Questions	Results
How did you become a mathematics teacher?	Teacher D was not interested in becoming a mathematics teacher, but his guardians wanted him to be a teacher.
Who, if anyone influenced your actions?	His guardians.
Will you continue as a mathematics teacher for the rest of your life? Why? Describe the most important factors that facilitate achievement in mathematics.	No. In case there is an alternative he will quit. Disciplined class. Homework controlled regularly. Learners knowing their careers choice.
Tell me about the challenges you experience in teaching mathematics.	Heavy teaching loads. Large classes. Learners negative attitudes. Lack of respect for teachers. Difficulty with teaching

	different levels of ability for the learners. Understaffing in mathematics.
Tell me how you go about motivating your learners in mathematics.	Motivation to help the weak learners.
Of all the factors we have raised, which are the most important ones?	Learners background in mathematics. Ill-discipline. Poor study techniques.

Précis (Summary of aspects relevant to research questions from school D)

The results of interviews with the teacher and classroom observations in school D can be summarised as follows:

- The teachers in this school are underqualified in mathematics and disinterested.
- Teachers are de-motivated.
- There is a lack of respect for teachers by learners.
- Teachers always complain that learners do not understand and forget mathematical concepts easily.

In the following section we summarise the results of the teacher interviews and classroom observation.

4.2.5 Summary of results from Phase 1

Overall it appears that teachers from low-achieving schools in this study were more inclined than teachers from high-performing schools to attribute learners' poor performance either to factors which were related to learners' background or behaviour. Teachers from high-performing schools convey high expectations for learners' backed up with support services, caring and devotion, creating a positive learning experience. For example, such teachers organise special classes for underperforming learners and recruit guest speakers to encourage their learners. Supplementary teaching based on learners' assessment was also encouraged in high-performing schools so that learners could

improve their performance. Although teachers offered various factors that facilitate achievement in mathematics, results suggest that the most frequently endorsed factors were related mostly to learners' characteristics.

With regard to staff stability, the study found that all four secondary schools investigated had teachers that had been in their respective schools for long periods, had more years of experience, were older and had a similar level of education. Teacher education level cannot be construed as a reason for higher achievement.

In the next section the qualitative data collection technique of using the focus group interviews will be discussed. The finding from this section will be in the form of excerpts from the explanations from learners' responses.

4.3 PHASE 2: FOCUS GROUPS INTERVIEWS

In this section the discussion focuses on factors that facilitate achievement in mathematics in historically disadvantaged schools derived from three focus group interview with learners. The focus group interviews involved twelve males and six females from ten schools that participated in the research. The first interview group consisted of seven learners, the second group of five learners and the third group of six learners. The three groups met independently, and each group session was in the afternoon. Interviews explored learners' experiences in the subject, focusing on issues observed in the classroom observation of phase 1 and teachers' individual interviews concerning, among others, motivation, work patterns and help-seeking behaviour of learners.

Immediately after each focus group session, the tapes were listened to and transcribed. Simon (1999) stressed the importance of summarising findings immediately after each group ends so that one not only recorded the content of the group's discussions, but also how each participant expressed themselves. Through the use of focus groups, I was able to listen to the dialogue of historically disadvantaged learners to uncover common themes among participants.

Table 4.7 below is a summary of the interview guide and some actual questions that were planned for all the focus group interviews.

Table: 4.7 Summary of the interview guide for all focus groups

Question	Question type	Planned Question
1	Opening question: General, factual, quick establishment of what is shared by group	What is life like here in your school?
2	Introductory question: Introduces the topic and sparks conversation	Tell me why you chose mathematics as one of your major subjects?
3	Transitional question: Participants become aware of how others see the topic	In your opinion, what is the biggest success area for learners in Grade 12 mathematics?
4	Key question (a)	What are the learners' challenges for success in mathematics?
5	Key question (b)	Could you describe the most important factors that enhance achievement in mathematics?
6	Key question (c)	How do you know that a learner in your class will perform well in mathematics?
7	Ending question: Identifies most important aspects.	Of all the factors we have raised, which are most important ones?
8	Final question: Ties up loose threads	Have we missed anything?

The findings of the discussions from the three focus groups will be discussed with respect to each group. They will be related in the form of vignettes, with a summary for all the

focus group interviews. The quotes listed in the discussion form just a small part of the larger conversation.

4.3.1 Focus group interviews: High-achieving learners

The first group consisted of six high-achieving learners, four of which were registered for an extra mathematics subject called Additional Mathematics. This group consisted of learners from high-performing schools.

Most learners in this group considered **learners' characteristics** such as work ethics, peer encouragement, hard work, and discipline as causes of good performance for learners in mathematics. Learners in this group were always working together with other learners in their class, mostly those who were motivated to do well in mathematics. These learners were there even when normal teaching was over and they never missed any mathematics classes. It was clear from the discussions that **intrinsic motivation** to achieve in mathematics was also a significant factor for the success of learners from this group. As three learners said during the interview:

One thing that motivates me is that math is interesting. I want to do something that is not common, something that other people are afraid of, something unique which is not done by many people, approaching life differently.

I used to prepare myself a few days or a week before the examination or test but this time I have realised that I cannot manage. There is a lot of work that we need to finish. I used to play a lot but this year I have changed.

I think this is the subject that requires someone to give himself more time to study and serious dedication. Not only relying on the teacher to give you information, because the teacher cannot do everything for you, teachers also have their own personal issues to deal with.

Self-motivation was the item considered most likely to influence success by both learners from high-achieving schools. Focus group interview responses with this group suggested that learners' motivation was largely directed towards performance goals, such as homework completion, examination and test success. Unlike many of the learners who depend on teachers for mathematics exercises and solutions, successful learners (from

high-performing schools) worked very hard on their own. Although some of them were critical about their teacher's mastery of some topics, they respected their teachers. When asked in a follow-up question about the advice to other learners to succeed in mathematics, one learner responded in the following way:

If I were to be asked to give advice to any learner, I can encourage a person to love the teacher who teaches him/her. It is difficult to be successful if you do not love and respect your teacher.

Learners from high-performing schools tend to spend considerably more time on exercises that afford a great challenge and require well developed skills. The power of good self-concept to achieve good results in mathematics was echoed by other two learners from high-performing schools:

You must spend less time on the chapters that you already know and a lot of time with those that you do not understand well. If they are difficult for you, you must go to the teacher or a fellow classmate and ask him, but mostly to your classmate because if the teacher gives you the correct answer, you will think it is obvious because he/she is a teacher but if it is your fellow classmate you will tell yourself that if he/she can do it, so can I.

I think the most important thing is dedication on your part. Some of the topics you can teach yourself and understand. It is also better that you try to be ahead of your teacher every time so that when the teacher comes, you will only be adding to what you already know.

From the interviews most learners in this group were always working together with other learners in their class who were motivated to do well in mathematics. Here are some two quotes from learners regarding their study techniques :

I practise maths with classmates who are serious about the subject, even our teacher used to encourage us to make up some groups. We used to have group discussions when practising previous years' question papers.

As learners we sometimes turn to concentrate on the chapters that we understand better leaving out the ones that we do not understand and at the end we tend to be unsuccessful because in the exam or test teachers ask all that is in the syllabus, and so we need to balance all the topics not only picking up the ones that are easy.

Learners in this group also recognised that their teachers wanted them to succeed in mathematics. These teachers were willing to stay longer with learners who were struggling to find the correct solutions. In this regard the positive effort from teachers who encourage their learners to do their best academically is illustrated by this comment:

In our school there was a time when our teacher used to keep some of us longer until we get the given exercises right and we had to get those exercises correctly. In fact most of those exercises were similar to the ones from previous examination papers. You have to get those exercises right because you will only get out of the classroom after completing the correct answers, It was like a punishment but it helped.

Most of the successful learners indicated that mathematics is not a difficult subject for them. They indicated that in order to succeed you have to practise it daily. Some of the respondents indicated that they were always at the top of their class and were very disappointed when they received a lower score. In case they could not understand certain topics they were willing to seek assistance from other mathematics teachers besides their own teachers to help them. The majority of participants from high-performing schools seemed to receive a significant measure of encouragement and motivation to succeed from their teachers. Learners' descriptions of the influence of teachers reiterated that attitudes of teachers towards learners influence their persistence and achievement in mathematics. Two participants' comments help summarise what other teachers said when they communicated their expectations and their support of academic achievement to their learners:

Our teacher told us that universities are really different from high school, more hours of studying and no spoon feeding. He talks to us a lot about university mathematics, what we have to do in school to succeed and that a good symbol in mathematics is where it all starts and Grade 12 is a key to unlock the doors.

My teacher used to motivate us every time. He talked about the importance of Grade 12 and that one must keep focused because this is the time that determines one's future.

In each of these quotes, learners indicated an understanding that their teachers were encouraging them to do their best in order to succeed. All learners in this group were positively influenced by the things their teachers said and did to encourage them, and

they had a basic understanding of what was required to be successful in mathematics. In the same vein, some learners shared the fact that the lack of home encouragement impacted on their persistence to achieve good results in mathematics. One learner commented:

In my case I do not get any help from home. In my family I am the first one who is doing mathematics and science and no one helps me with my maths.

The learners from successful schools involved in my study benefited from support of their peers and friends who encouraged them to reach for their dreams by talking and doing well in mathematics. This support and encouragement, along with the positive contact from teachers and some tertiary institutions that are recruiting learners, created a situation at school that cultivated good performance in mathematics. Most of the learners in this group also gave examples of shared situations that helped explain how their family members encouraged them to “perform well in mathematics” because their family was good in sciences.

Most successful learners were very positive about themselves and sure of their career path. They knew what they were going to do after Grade 12. Learners reported that they were taking the subject because it was a requirement for the career they would like to follow.

There was a positive attitude expressed when learners felt that there would be tangible benefits resulting from performing well in the subject. They also knew about the minimum symbols required by the institutions they wanted to register at. Most of them did not receive the information from their teachers; instead they got the information from friends who had already graduated, or from recruiting universities or universities of technology. Both learners recognised the results of not doing well in mathematics and the financial implications for their parents or guardians. Their teachers were clear in their explanations to these learners about the need to do well in mathematics if they wanted to go to university. Their actions and attitudes towards tertiary institutions were grounded in their knowing what was required to get a good career. A number of different experiences

both in and out of the classroom encouraged learners to attain better achievement in mathematics. Many learners asserted that mathematics career options influenced them to put more effort into their studies. For example learners discussed how important it was to know the career you wanted to pursue as strategy for success in mathematics achievement:

I have started thinking about what I would like to do in Grade 10, I have already set my mind on what I would like to do and this has helped me to work very hard in mathematics. In fact, I am good in mathematics.

A number of different experiences both in and out of the mathematics classroom encouraged learners' pursuit of a degree in mathematics-related programmes. Many respondents asserted that the career guidance week and other mathematics-related activities influenced their interest in mathematics related careers and in better performance. For example, one participant said:

Yes, I want to do a Bachelor of Science degree in chemical engineering. I have decided on this career while in Grade 12. What motivates me is that there is a lot of people needed in this area and is a better paying job than other careers.

Learners in this group believe that mathematics is a useful subject for obtaining employment and receiving bursaries. A comment from one of the learners was agreed on by all learners in the group:

When you go to certain companies, you find that mathematics is a requirement; you cannot enter into certain degrees without a good symbol in mathematics. A good symbol in mathematics will give you an opportunity of getting a bursary at the University.

Learners' conversations in this group also helped explain how interactions with their peers about their career aspirations played an important part in their mathematics performance. Most of the learners reflected on at least one conversation they had had with a peer or friend who was planning to go to a tertiary institution. For example one learner explained that his best friend was going to study medicine.

Summary of focus group (High-achieving learners)

In general, learners from high-performing schools expressed positive perceptions of their teachers and peers. A majority of the learners interviewed felt they were expected to work hard, that they tried hard to get good grades in tests, respect their teachers, and had a good self-image, and that it is important to do well in mathematics. They were also intrinsically motivated.

4.3.2 Focus group interviews: Middle-achieving learners

The second group consisted of eight middle-achieving learners. Learners in this group were from both high-performing and low-performing schools. Most of the learners from both high and low-performing schools in this group explain how working with peers encouraged or discouraged them to perform well in mathematics. The comments of two learners explain this fact:

Group discussions are good but during the discussions there is someone who is just watching not working at all and you find that the one who gains much is the one that is doing all the writing because he/she can see all the steps, and the teacher will think that all the people are gaining whereas this is not the case.

We used to practise with our classmates mostly those who were serious about the subject. Even our teacher used to encourage us to form some groups. Group discussions were done especially when we were practising on previous years question papers. In our case we were having our own group which was from previous years and it was not formed by the teacher. We just grouped ourselves.

It is noted that there were some teachers who took their academic responsibilities lightly and did not arrive on time for teaching, or did not arrive at all. The consequences are that those teachers did not cover their syllabuses appropriately. Learners feel that this behaviour affects their performance at the end of the year. Learners also discussed the instruction they encountered in their mathematics class. The interview with this group provided further insight into learner's opinions of 'good' teaching and teachers. One learner stated:

The teacher must give us a clear explanation. He should write down every step on the board and give examples which are related to different exercises. He must show us clearly what he is talking about.

According to this group there appeared to be teachers that did not enjoy teaching mathematics, and as a result their attitudes were negative towards both the subject matter and towards the learners that they taught. According to this group, these attitudes did not improve teacher-learner communication and discouraged real learning of mathematics. Furthermore, learners in this group boldly stated that many teachers did not know how to teach properly.

There are those teachers who do not teach some of the topics, and they will tell you that you will be taught such topics in winter or Saturday schools. In our school linear programming was not taught in Grade 11.

Some teachers skipped some of the classes without any apparent reason. Both learners from low and high-performing schools seemed to appreciate teachers who provided a structured, logical succession for learners' work as well as enough explanation, encouragement, and friendliness.

I think what makes learners learn better is when the teachers correct the learners' work by themselves, not giving the work to our classmates because the teacher will not know what many learners do not understand. If that is done the teacher will have an opportunity to revise the section that is not well understood so that we can work on it again.

Many learners feel that their teachers concentrate only on those learners that are performing well in the class and some of them do not get proper attention. Most of the homework assignments and classwork are marked by their fellow classmates. This practice is seen by most learners as unfair.

Nakamura (1988) described motivational differences between high-achieving and under-achieving mathematically learners. One of the primary results of her research indicated that high-achievers tend to find more pleasure in school work than low-performing learners. High achievers (High-performing schools) also spend considerably more time than low performers (Low-performing schools) in activities that afford challenges and

require well-developed skills. In other words, high performers tend to enjoy academic challenge, whereas low performers tend to feel overwhelmed by challenge.

When I practise math, I usually do those exercises that are challenging, the ones that are indicated by a star in some books. The difficult ones make those which are not marked by a star to be known even if you have not done them.

Teachers have different expectations about the mathematics ability of some learners. The comments from learners are indicative of the influence of teachers' attitudes and peer influences. In some low-performing schools some teachers encourage learners to take mathematics on standard grade level rather than the higher grade. This could indicate low expectations which may affect a learner's chances of completing high school with the grade relevant for acceptance into mathematics-related careers at the university. Low expectation demonstrated by one teacher could have a carry-over effect that might influence a learner to believe that he/she does not have what it takes to be academically successful in other classes.

Learners were influenced by peers who often talked about going to university so they could fulfil their dreams of becoming an engineer or go into medical school. Another learner describes how he got information from his cousin who is working in a similar field and was influenced to follow the same career.

I received the information about different careers from my cousin who is working as an electrical engineer and he gave me all the information about this career hence I became interested in electrical engineering.

Other learners participated in a career guidance day to cultivate their interest in mathematics and enhance their performance. According to one participant:

I got the information from the booklet provided by the recruiting institution after visiting us during career guidance day at our school.

As for me I have decided on what I would like to be last year after attending the engineering week. It is the only time when I had information about actuarial science. Before I used to think that I wanted to become a doctor. It was my first choice but now it does not even constitute my second choice. At home they wanted me to become a doctor but I can't.

The group also described how their teachers provide clues about the need to do well in mathematics. Teachers were clear in their explanations to their learners about the need to do well in mathematics if they wanted to go to universities. Their actions and attitudes towards tertiary institutions were based on knowing what is required to pursue a good career. Learners received and in most cases seemed to have internalised the messages from their teachers that mathematical success and university admission in mathematics and sciences were expected. Below are some quotes from learners regarding their teachers:

My teacher wants us to do well in mathematics. He always says that we have to do well in mathematics to make it in the world and to get a good job.

He just told us to work hard in mathematics if we want to go to the university. I mean, it's just little advice that we get from him.

Their teachers emphasised that the reason for performing well in mathematics and science was to prepare to enter universities of their choice and establish the possibility of receiving a bursary. In some low-performing schools from this group, some teachers suggest that learners take mathematics on standard grade level rather than on the higher grade.

When we passed to Grade 12, our teacher directed four of us to take mathematics on the higher grade.

According to this group this could indicate low expectations that may affect a learner's chances of completing high school with the grade relevant for acceptance into mathematics-related careers at the university. Respondents were also able to recognise obstacles to their academic success. According to learners from a low-achieving school, teachers' lack of commitment was said to contribute negatively to learners' mathematics achievement. Below is one of the participant's comments:

I think one of the things that can make learners learn better is that the teachers must look at the work of each an every learner by himself so that he can see where other learners are lagging behind, because you may find that a big percentage of learners are left behind and this will lead them to bridging programmes at the university which according to me is a repeat of Grade 12.

Summary of focus group interviews middle-achieving learners

In general the majority of middle-achieving learners (from both high-achieving and low-achieving schools) expressed the following perceptions of factors that facilitate achievement in mathematics:

- High expectation by teachers and peers;
- teacher dedication towards their work and learners;
- teacher instructional and assessment methods;
- career knowledge;
- group work with fellow classmates.

4.3.3 Focus group interviews: Low-achieving learners

The last group consisted of five low-achieving learners. Twelve participants were invited but only five turned up. Most learners in this group admitted that they were not self-disciplined enough. Some of them, when given some work to do, would simply not do it and others just copied from their classmates. Some learners agreed that they did not practise mathematics enough, attend classes late, and they did not even consult their teachers when they did not understand some topics.

Most of us learners are lazy. Because when we are given the work like today, arriving home we just put it aside and do not look at it. We are very fond of bunking the work. You only look at it when there is an announcement of a test.

Many learners say that there were no proper learning facilities at home where they could learn effectively. Many of them did not give themselves enough time to practice mathematics because of the lack of time management. They did not know how to stop their friends from visiting them when they were studying.

Learners from low-achieving schools reported on their de-motivation to attend mathematics classes. These learners stated that the reasons for de-motivation focus on poor instructional methods and perceived lack of supportiveness of the teachers. Learners from low-achieving schools tend to avoid challenging exercises. The comments of some

learners help describe and explain how their teachers encourage or discourage through instructional methods:

I think the teacher must do a lot of follow-up of the learners because he/she may think that all the rules have been understood by all learners whereas the majority of the learners haven't. The teacher should make sure that all learners have understood the basics because they are very important.

The impression is that learners in this group, generally speaking, are not well motivated. Some appear to be bored with what they were learning and others remarked that they would not pass because the subject was difficult. It was felt by some learners that teachers did not always create the right climate in the classroom, one that was conducive to raising learners' motivational levels. The following are selected comments:

I think a teacher should be close to his/her learners and he must give his/her learners more work so that they can work hard by themselves, and not the teacher doing everything for them.

I think it is the combination of several factors, mostly lack of motivation from the teacher and not studying well.

On the other hand, other learners from low-performing schools discussed the impact of the negative influences from their peers in mathematics. One stated that:

Most of the learners here at our school have told themselves that mathematics is difficult. When we write a test we know that many of us are going to get zeroes and most of us do not practice anymore. They are discouraged even when the lesson is on, you may find that some are asleep not listening at all. They are some learners who spread bad news that mathematics is difficult; no matter what you do you will not pass it.

Learners in this group acknowledge that their mathematics background is poor. They say that their teachers in lower grades were not active enough. Most of their teachers did not give them enough tests, homework and classwork. Even those that gave some did not correct it. Some of the mathematics topics which were supposed to be treated in Grade 11 (for instance linear programming) were not discussed. In our interviews learners from low-performing schools frequently reported doing only the compulsory exercise

questions; for the most part problems in the text books were referenced solely in connection with parallel previous examination questions. In the following quote this student discussed the role a teacher should play in the encouragement of all learners including those who are not performing well. He stated:

The problem is that after writing some test our teacher encourages only those that are doing well, the rest of us are just ridiculed. And some of us are likely forgotten and thrown at the back.

Most learners commented that they were sometimes humiliated and degraded by teachers. The teachers treated them just like little children. Some teachers are seen as unapproachable, while others do not allow learners to consult them. Learners cannot ask questions in the class because they were ridiculed. The following comments from learners support the statement:

I think everyone is afraid of her (teacher). When you ask a question you get a very negative response. You get the impression that you are bothering her. When you approach her you must be ready for anything.

The other factor that helps to make learners learn better is to avoid changing teachers. In Grade 10 you are taught by another teacher and until Grade 12, the teacher is not the same. I think someone must get used to the teacher to perform well.

Summary of focus group interviews for low-achieving learners

In general the low-achieving learners in this study do share many of the following traits. They have:

- Low motivation from their teachers.
- Prevalent attitude from their teachers that they will fail because they do not have role models in mathematics.
- Low confidence, low respect for their teachers and the perception that they are not respected.
- Limited special programs to offset the effect of lack of mathematics engagement.
- Limited access to knowledge of mathematics career opportunities

4.3.4 Comparison of all focus group interviews

For convenience the findings in this phase are also divided into five themes. All the focus group interviews with the learners are categorised and identified according the learners' responses during the focus group interviews. The five themes are:

Theme 1: Learners commitment

Theme 2: Attitudes and self-concept

Theme 3: Study and learning methods

Theme 4: Perceptions of peers and teachers

Theme 5: Influence of learners career prospect

AREA OF SUCCESS	FG1	FG2	FG3
Learners commitment			
Participated in a mathematics or science tour/excursion	✓	X	X
Teacher respect	✓	✓	X
Regular class attendance	✓	✓	X
Attend extra classes	✓	✓	X
Remain after school doing math	✓	X	X
Come to class having done homework	✓	✓	X
Desire to be rated with the best	✓	✓	✓
Regular practice	✓	X	X
Devoted teachers	✓	X	X
Study and learning methods			
Poor study technique	X	✓	✓
Work with other learners	X	X	X
Teacher change	X	X	✓
Too many in the class	X	✓	✓
Participation in class discussion	✓	X	X
Teacher gives different examples	✓	✓	X
Teacher being friendly	✓	✓	X

Chance to explain responses	✓	X	X
Attitudes and self-concept			
Active participation	✓	X	X
Homework completion	✓	X	X
Not afraid of the teacher	X	X	✓
Regular attendance	✓	✓	X
Learners' self-concept	✓	X	X
Solving extra problems	✓	X	X
Worked on challenging exercises	✓	X	X
Perceptions of peers and teachers			
Supportive teachers	✓	✓	X
Expected to perform highly	✓	✓	X
Knowledgeable teachers in lower grades	✓	X	X
Attempt challenging exercises	✓	X	X
Good teachers in lower grades	✓	✓	X
Caring teachers	✓	✓	X
Influence of learners career prospect			
Exposure to mathematics-related careers	✓	✓	X
Mathematics usefulness in future career	✓	✓	✓

4.3.5 Summary of results obtained from Phase 2

In a comparison of high-achieving schools and low-achieving schools learners' perceptions, several differences were found. Learners from high-achieving schools put more emphasis than did those from low-achieving schools on factors directly within their control, such as class attendance, active participation and homework exercises completion, whereas learners from low-achieving schools placed more importance than high-achieving schools on the instructional methods and teacher personality, either in the form of caring or not.

Both learners from high-achieving and low-achieving schools put the emphasis on study and teaching methods as a more influential factor in mathematics achievement than adequate mathematics background knowledge. This finding supports research findings which suggest that for many learners poor performance is largely due to ignorance of the study methods required, or the inability to apply these methods appropriately, rather than lack of ability (Manalo, Wong-Toi & Henning, 1996). Learners from high-performing schools also placed greater emphasis than learners from low-performing schools on those factors related to teaching and working with a classmate.

All learners in the focus interviews understand the importance of mathematics in their lives. The importance of mathematics was mostly related to future careers or considered being clever by the classmates. This trend was evident in the themes that emerged from the qualitative data.

4.4 CONCLUSION

Chapter 4 comprised the qualitative part of the research, examining factors that facilitate achievement in mathematics. The perceived factors were examined by means of classroom observation, interviews with teachers and focus group interviews with learners. Although both learners from high- and low-achieving schools discuss different factors that lead to good achievement, there were specific factors that were common to a number of high- and low-performing schools.

This study indicates that the relative perceptions of the majority of the learners in high and low-achieving schools are about the same concerning work standards, expectations of high performance level by teachers and the desire to do well in mathematics.

In the following chapter results of phase three which is the quantitative part of this research will be discussed. Comparison of the success factor in high- and low-performing schools will also be discussed in Chapter 5 based on both the results of the qualitative and quantitative method.