CHAPTER 5

ANALYSIS AND INTERPRETATION OF QUANTITATIVE DATA: RESPONSES FROM LEARNERS

5.1 INTRODUCTION

The objective of this chapter is to present and discuss the information gathered from the questionnaires that were developed following the results from classroom observations and focus group interviews with learners. Data collection is explained in Chapter 3. The statistical information in this chapter was derived from a sample of 366 learners from ten schools comprising five high-performing schools (HPS) and five low-performing schools (LPS), analysing their performance in mathematics as described in Chapter 3.

For responses to items in the questionnaires a Likert Scale was used consisting of three categories with a score of 1 representing either Regularly, Agree or Always, a score of 2 either Occasionally, Neutral or Sometimes and a score of 3 corresponding to either Never or Disagree, depending on the nature of the question. For statements that were negatively phrased low scores support the positive version of the statement. See Appendix D for the complete questionnaire. As a number of respondents failed to answer certain questions, the total number of respondents to an item does not always add up to the total number of respondents in the questionnaires.

The decision on what specific factors to include in the questionnaire was based on classroom observations, focus group interviews and the literature review as reported upon in Chapter 4. The questionnaire consisted of six categories, namely, the

A Parental education level
B Learners' commitment
C Learners' attitude, self-concept and career prospects
D Learners' perceptions of and interaction with peers

E Learners' perceptions of teachers

F Learners' perceived causes of poor performance in mathematics.

Items in the questionnaire were grouped in the six categories. In the discussion of the results in this chapter I will, for each of the categories, firstly summarise of the results of items in the particular category, and the *p* values obtained from the chi-squared statistical test that was used to analyse the results. Subsequently I will give more detailed results of each of the items for which there was a statistically significant difference between responses of learners from high and from low-performing schools. In some instances items will also be discussed for which the difference between responses of learners from high and from low-performing schools was almost significant. Items for which there was no significant difference between the results of the high- and low-performing schools will be briefly discussed.

The reader is requested to note the following: Although the researcher is keenly aware of the fact that few of the findings reported in this thesis are practically significant (based on the calculation of effect sizes), after deliberation with my supervisors I nonetheless embarked on a thorough discussion of those findings in the case of which significant p-values were found. After all, we are of the opinion that reporting and discussing the possible meaning of statistical significance (as indicated by significant p-values) are as much a part of research and reporting at doctoral level as is reporting on practical significance. We nonetheless urge you to interpret these findings with due circumspection, especially in the light of this explanation.

For each of the categories the section will be concluded with a précis of the results of items within the particular category. Throughout the entire chapter a significant level of 5% is used. Numbers appearing in all tables in this chapter are percentages of column totals.

The item numbers that relate to each of the five categories appear in Table 5.1 below

Table 5.1 Distribution of items into categories

Category	Number of items	Variable numbers in the questionnaire
A. Parental level of education and involvement	3	2, 3, 36
B. Commitment	11	4, 5, 6, 7, 27, 28, 29, 30, 32, 35, 38
C. Attitude, self-concept and career prospects	10	10, 11, 12, 13, 14, 15, 16, 17, 21, 33
D. Perceptions of peers	7	19, 20, 22, 24, 25, 31, 34
E. Perceptions of teachers	5	8, 9, 18, 23, 26
F. Perceived causes for poor performance in mathematics	12	40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51

5.2 CATEGORY A: PARENTAL EDUCATION AND INVOLVEMENT

The questions in this section include questions on the father and mother's educational level, which was used to indicate socio-economic status of the families in these schools. No significant differences were identified for any of these items. What is notable from the results of these items are the low percentages of agreement in general. The highest percentages (around 50% for HPS and 41% for LPS) occurred for the item in Grade 8 and lower for mother or female guardian. The highest percentages (around 35% for HPS and 36% for LPS) occurred for the item in Grade 8 and lower for father or male guardian. From this section it is clear that the level of parental education was low for learners in both the high-achieving and low-achieving schools. It could be possible from this section

that some learners mostly from LPS were not completely sure about the exact educational level of their parents.

Family involvement

Results of an item on the involvement of parents or other family members in the learner's studies are indicated in Table 5.2.1.

Table 5.2.1: Comparison between HPS and LPS with regard to family involvement

		LPS	HPS	*p*-value
Item 36 "I get assistance from family."	Regularly	34.68	43.66	0.2247
	Occasionally	30.11	25.35	
	Never	35.14	30.99	

Effect size: 0.09 (Small effect size)

There is no significant difference ($p = 0.2247$) between responses from HPS and LPS and we cannot conclude that learners from HPS get more assistance from family members than those from LPS. The effect size is small, suggesting that this result has little practical value.

5.3 CATEGORY B: COMMITMENT

Category B of this study was concerned with establishing the learners' affinity for mathematics and their commitment to do well in mathematics. These items also establish learners' perceptions of influences outside the classroom on their performance. Table 5.3 contains the items that fall into this category. We were also interested in whether learners wanted to continue with mathematics at tertiary level after grade twelve.

Table 5.3: Commitment

There is a difference between HPS and LPS with respect to	***p*-value**	**Significance (5% level)**
Participation in a mathematics or science tour/excursion (Item 4)	0.0611	Not significant
Watching mathematics or science TV shows (Item 5)	0.3352	Not significant
Reading mathematics or science magazines or news articles on mathematics (Item 6)	0.6323	Not significant
Attending mathematics Saturdays or winter schools (Item 7)	0.0221	Significant
Skipping mathematics classes (Item 27)	0.0083	Significant
Coming to class without a pen or pencil (Item 28)	0.7415	Not significant
Try to solve math problems before seeking help (Item 29)	0.0828	Not significant
Attending extra classes (Item 30)	0.0195	Significant
Remaining after school to do mathematics (Item 32)	< 0.0001	Significant
Coming to class without having done mathematics homework (Item 35)	< 0.0001	Significant
Personal effort in mathematics work (Item 38)	0.0017	Significant

5.3.1 Items with a significant difference

We now report on items in which the difference between responses from HPS and LPS were statistically significant.

Attending mathematics Saturdays or winter schools

Results for this item are presented in Table 5.3.1.

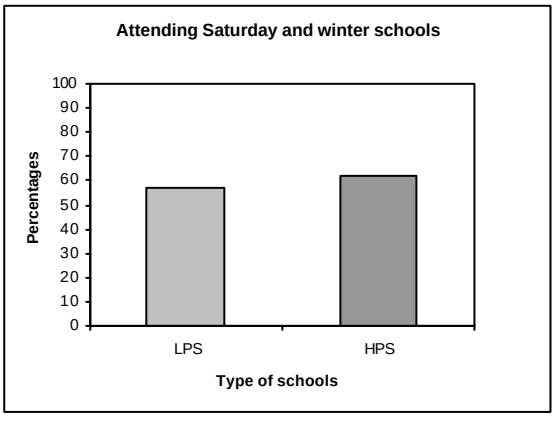
Table 5.3.1: Comparison between HPS and LPS with regard to attending mathematics Saturdays or winter schools

		LPS	HPS	*p*-value
Item 7 "I attend mathematics Saturdays or winter schools."	Regularly	57.34	62.41	0.0221
	Occasionally	30.73	34.04	
	Never	11.93	3.55	

Effect size: 0.05 (Small effect size)

From Table 5.3.1 we can conclude that more learners from HPS than LPS agree with the statement that they attend mathematics Saturday or winter schools, about 62% as against 57%. These results are graphically presented in Figure 5.3.1. It is noticeable how high the percentages are, in both cases, for regularly attending Saturday or winter schools. In the HPS less than 4% never attend such schools. The effect size is small, suggesting that this result has little practical value.

Figure 5.3.1: Percentages of learners of HPS and LPS that agree with the statement



Skipping mathematics classes

Results for this item are presented in Table 5.3.2.

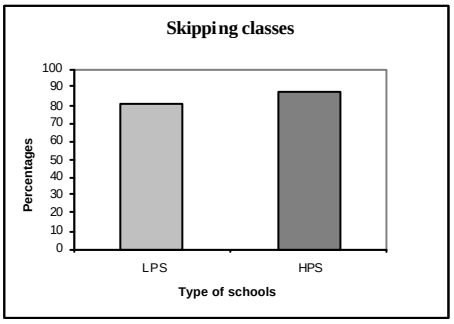
Table 5.3.2: Comparison between HPS and LPS with regard to attendance of mathematics classes

		LPS	HPS	*p*-value
Item 27 "I skip mathematics classes."	Regularly	3.18	7.04	0.0083
	Occasionally	15.91	6.34	
	Never	80.91	86.62	

Effect size: 0.16 (Small effect size)

The participants indicated varied responses to the statement on skipping classes. The statement in this item was negatively phrased, and so low percentages would support the positive version of the statement. Around 3% of learners from LPS say they regularly or occasionally skip mathematics classes compared to only about 7% of learners from HPS, both small percentages indicating that skipping classes is not a regular occurrence for either of the groups. Skipping classes is clearly not perceived as a major problem. The significant difference arises as a result of the responses of learners who occasionally or never skip classes. More than twice as many learners from LPS say they occasionally skip classes than from HPS. In addition a large group of around 87% of learners from HPS say that they never skip mathematics classes compared to around 81% of learners from LPS. The effect size is small, suggesting that this result has little practical value.

Figure 5.3.2: Percentages of learners of high-performing schools and low-performing schools that disagree with the statement



Attending extra classes

Results for this item are presented in Table 5.3.3.

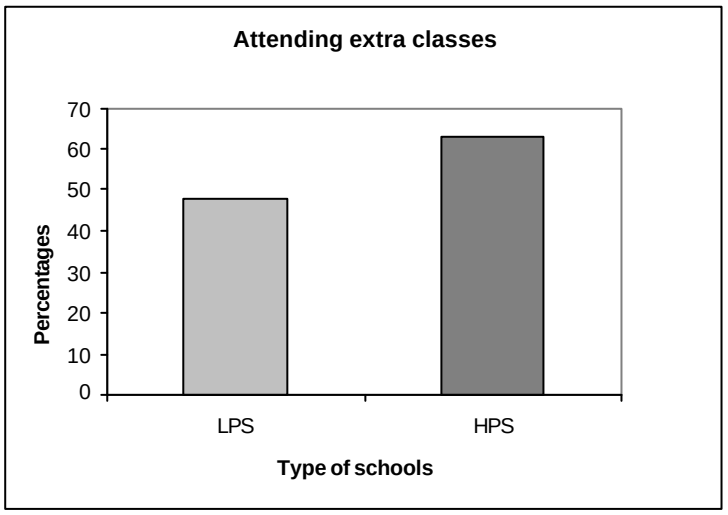
Table 5.3.3: Comparison between HPS and LPS with regard to attendance of extra mathematics classes

		LPS	HPS	*p*-value
Item 30 "I attend extra classes."	Regularly	47.73	62.86	0.0195
	Occasionally	35.91	25.71	
	Never	16.36	11.43	

Effect size: 0.1479 (Small effect size)

Around 63% for learners from HPS compared to around 48% for learners from LPS say that they attend extra classes, a significant difference. In addition, around 16% of students from LPS say they never attend extra classes compared to only around 11% of students from HPS. Because the difference is significant we can conclude that learners from HPS attend extra classes more than learners from LPS. The effect size is small, suggesting that this result has little practical value.

Figure 5.3.3: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



Remaining after school doing mathematics

Results for this item are presented in Table 5.3.4.

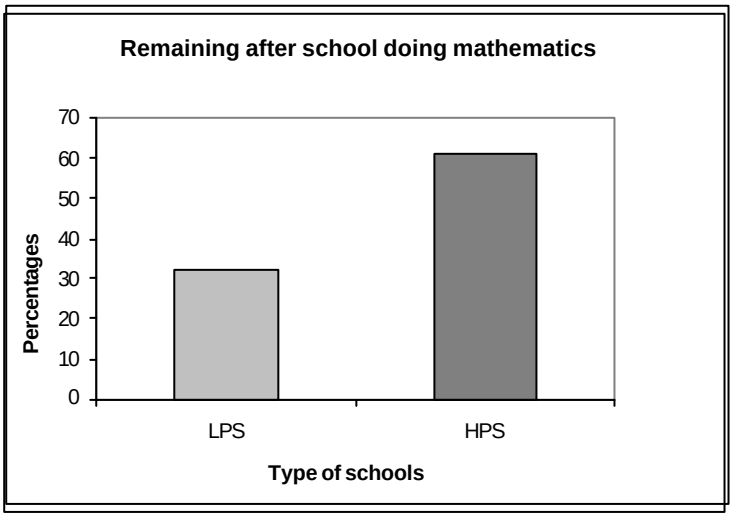
Table 5.3.4: Comparison between HPS and LPS with regard to remaining after school doing mathematics

		LPS	HPS	*p*-value
Item 32 "I remain after school doing mathematics."	Regularly	31.82	60.56	0.0001
	Occasionally	40.00	30.28	
	Never	28.18	9.15	

Effect size: 0.3059 (Medium effect size)

In this item almost twice as many learners from HPS than learners from LPS agree that they remain after school practising mathematics (around 61% compared to around 32%). In addition about three times as many students from LPS as students from HPS say that they never remain after school doing mathematics (around 28% compared to around 9%). These results offer a clear indication that remaining after school doing mathematics is an activity characteristic of HPS. The effect size is medium, suggesting that in practice, remaining after school has some effect on performance as defined in this thesis.

Figure 5.3.4: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



Coming to class without having done mathematics homework

Results for this item are represented in Table 5.3.5.

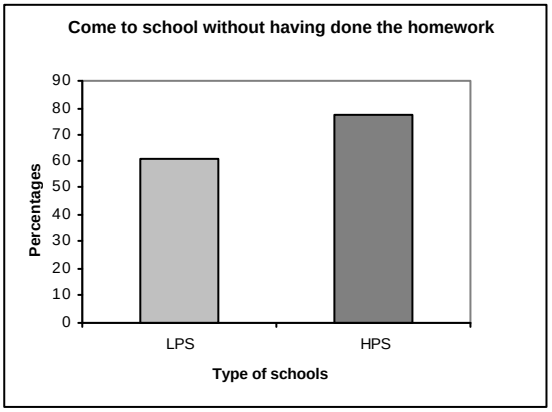
Table 5.3.5: Comparison between HPS and LPS with regard to coming to class without having done mathematics homework

		LPS	HPS	*p*-value
Item 35 "Come to class without having done my homework."	Regularly	5.00	9.29	0.0001
	Occasionally	33.64	13.57	
	Never	61.36	77.14	

Effect size: 0.23 (Small effect size)

This item required that learners respond to whether they do their homework or not. A first observation is that small percentages (5% and 9%) of learners regularly come to class without having done their homework, a pleasing result although it is surprising that more learners from HPS do this than learners from LPS. The larger percentages occur in the "Never" category. About 77% of learners from high-performing school disagree that they come to class without having done their homework whereas about 61% of learners from low-performing school disagree. Because this difference is significant the conclusion therefore is that learners from HPS are more inclined to do their homework. However the effect size is small, suggesting that this result has little practical value.

Figure 5.3.5: Percentages of learners of high-performing schools and low-performing schools that disagree with the statement



Personal effort put into mathematics work

This item was formulated somewhat differently from the other items in the questionnaire. Here a question was asked and learners had to pick one of five different options. Results for this item are presented in Table 5.3.6.

Table 5.3.6: Comparison between HPS and LPS with regard to personal effort put into mathematics work

		LPS	HPS	*p*-value
Item 38 "How much effort do you usually put into your mathematics work?"	I do not try at all	0	2.17	0.0017
	I do just enough to get by	4.50	6.52	
	I give an average amount of effort	9.46	2.90	
	I try very hard but not as hard as I could	30.63	19.57	
	I work as hard as I can	55.41	68.84	

Effect size: 0.2189 (Small effect size)

The high percentages occur in the response "I work as hard as I can" where learners from HPS outperform learners from LPS. It is noticeable that even for LPS more than half the learners (55.41%) claim that they work as hard as they can and around a third claim that they work very hard but perhaps not quite as hard as they could. Learner perceptions are not always a reliable indication of the true situation. Although they claim to work as hard as they can, it could be an indication of not accepting responsibility for their failure, trying to put the blame elsewhere. The effect is small, suggesting that this result has little practical value.

5.3.2 Items with a difference that was not significant

For three items the differences between high- and low-performing schools were not significant. Items for which the difference in opinion between learners from HPS and learners from LPS was not significant are listed in Table 5.3.7.

Table 5.3.7: Items for which the different was not significant

		LPS	HPS	*p*-value	*w*-value
Item 4 "I participated in a mathematics or science tour/ excursion."	Regularly	31.94	20.57	0.0611	0.1251
	Occasionally	26.39	29.79		
	Never	41.67	49.65		
Item 5 "I watch mathematics or science TV shows."	Regularly	37.27	31.43	0.3352	0.0779
	Occasionally	47.73	55.71		
	Never	15.00	12.86		
Item 6 "I read mathematics or science magazines or news articles on mathematics."	Regularly	30.56	27.86	0.6323	0.0507
	Occasionally	47.69	52.86		
	Never	21.76	19.29		
Item 29 "I come to class without a pen or pencil.	Regularly	6.36	5.63	0.7415	0.1360
	Occasionally	12.73	15.49		
	Never	80.91	78.87		

It is clear from Table 5.3.7 that external activities such as participating in a mathematics or science tour, watching mathematics or science television shows or reading mathematics or science magazines or news articles on mathematics have no significant influence on mathematics achievement. It is notable and commendable that fair percentages of students do regularly participate in these activities (around 30% of both HPS and LPS in Items 4, 5 and 6). Item 28 and 29 indicate the level of preparedness for a class situation and again there is no significant difference.

5.3.3 Précis of findings

Learners from high-performing schools are more inclined to the following activities than learners from low-performing schools:

- Attendance of mathematics classes on Saturdays or winter schools.

- Attendance of extra classes.
- Remaining after school doing mathematics.

Learners from low-performing schools are more inclined to the following activities than learners from high-performing schools:

- Coming to class without having done mathematics homework.
- Skipping some mathematics classes.

These findings seem to indicate that learners from high-performing schools have more commitment to their learning tasks in mathematics compared to learners from low-performing schools. The findings also show that learners from low-performing schools feel less serious about their responsibilities to attain success in mathematics.

5.4 CATEGORY C: ATTITUDES AND SELF-CONCEPT

Category C of this study centred on learners' attitudes towards mathematics, their beliefs regarding mathematics and its usefulness as well as their beliefs and perceptions concerning their own success and failure in mathematics. Table 5.4 contains the items that fall into this category.

Table 5.4: Attitudes and self-concept

There is a difference between HPS and LPS with respect to:	***p*-value**	**Significance (5% level)**
Looking forward to mathematics classes (Item 10)	0.0104	Significant
Personal perception of mathematics as being difficult (Item 11)	0.2759	Not significant
Self-discipline in doing mathematics (Item 12)	0.2322	Not significant

Usefulness for future career (Item 13)	0.0681	Not significant
Mathematics as a cause of being nervous and upset. (Item 14)	0.1952	Not significant.
Planning to study tertiary mathematics (Item 15)	0.2944	Not significant
Enjoyment of mathematics (Item 16)	0.2014	Not significant
Importance of studying hard (Item 17)	0.9704	Not significant
Perception of Mathematics as a difficult subject to do (in general (Item 21)	0.0092	Significant
Loss of concentration when solving mathematics problems (Item 33)	0.2299	Not significant

5.4.1 Items with a significant difference

Looking forward to mathematics classes

Results of this item are presented in Table 5.4.1.

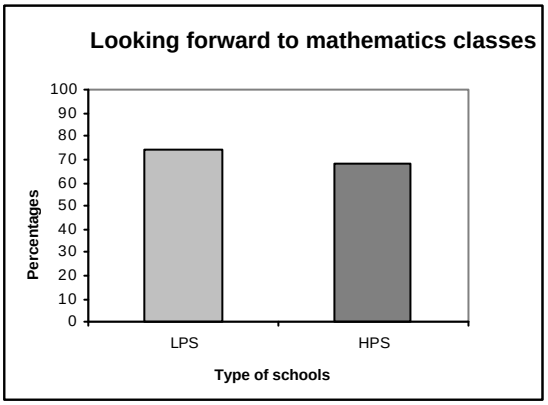
Table 5.4.1: Comparison between HPS and LPS with regard to looking forward to mathematics classes

		LPS	HPS	*p*-value
Item 10 "I look forward to mathematics classes."	Regularly	74.31	68.09	0.0104
	Occasionally	20.18	17.02	
	Never	5.50	14.89	

Effect size: 0.1594 (Small effect size)

In terms of looking forward to mathematics classes, contrary to what could be expected, around 68% of learners from HPS agree that they look forward to mathematics classes whereas a higher percentage of around 74% of learners from LPS agree. The *p* value of $p = 0.0104$ indicates that this difference is significant. An explanation for this result is that learners from HPS see mathematics as a serious subject that requires hard work and devoted attention whereas learners from LPS are less concerned and not fully aware of their predicament. This finding will be expanded on during discussions on other findings in this section. The effect size is small, suggesting that this result has little practical value.

Figure 5.4.1: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



Mathematics is a difficult subject (in general)

Results for this item are presented in Table 5.4.2.

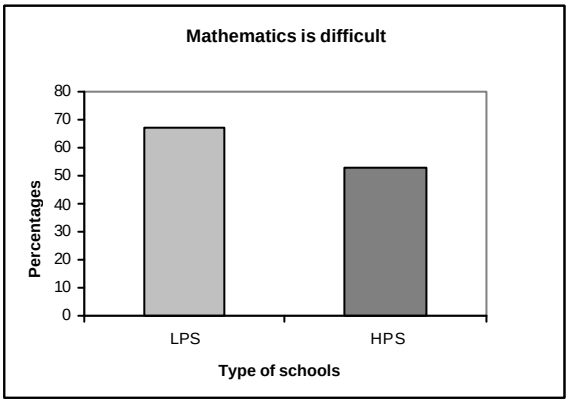
Table 5.4.2: Comparison between HPS and LPS with regard to mathematics being a difficult subject (generally)

		LPS	HPS	*p*-value
Item 21 "I believe mathematics is difficult to do unless you have the brain for it."	Agree	14.61	26.76	0.0092
	Neutral	18.72	20.42	
	Disagree	66.67	52.82	

Effect size : 0.1612 (Small effect size)

The outcome of this item is as unexpected as that of the previously discussed item. Almost twice as many learners from HPS agree that mathematics is a difficult subject than the learners from LPS (around 27% compared to around 15%) and more learners from LPS disagree than learners from HPS (around 66% compared to around 53%). Again, students from HPS seem to be more conscious of the general perception that mathematics is a notoriously difficult subject whereas students from LPS are less concerned. This finding links up with to the previous finding of learners from LPS looking forward more to mathematics classes than learners from HPS. Another angle on this finding is that students from HPS possibly know that a prestige value is often attached to high performance in mathematics and they prefer to think that the reason for their better performance is that they "have the brain for it." The effect size is small, suggesting that this result has little practical value.

Figure 5.4.2: Percentages of learners of high-performing schools and low-performing schools that disagree with the statement



5.4.2 Item for which the difference was almost significant

For one item the difference between learners from LPS and HPS was almost significant ($p < 0,1$). The relevant data are listed in Table 5.4.2.

Mathematics is useful in my future career

Results for this item are presented in Table 5.4.3.

Table 5.4.3: Comparison between HPS and LPS with regard to usefulness in future career

		LPS	HPS	*p*-value
Item 13 "Mathematics is useful in my future career."	Agree	80.82	71.83	0.0681
	Neutral	9.13	9.86	
	Disagree	10.05	18.31	

Effect size: 0.1220 (Small effect size)

In this item the results were that around 72% of the learners from HPS agree with the fact that mathematics is useful for their future career whereas around 81% of learners from low-performing schools agree. Although not significant, the outcome is reminiscent of the general perception that "mathematics is useful". A study by Leitze (1996) concerning attitudes towards mathematics showed that mathematics major students were overwhelmingly convinced that "mathematics is useful". However, they could name at most two professions using mathematics. The statement "mathematics is useful" appeared to be more of an automated response rather than a belief shaped by the students' mathematics experiences. The effect size is small, suggesting that this result has little practical value.

5.4.3 Items for which the difference was not significant

Seven items in this category for which the difference in opinion between learners from HPS and learners from LPS was not significant are listed in Table 5.4.4.

Table 5.4.4: Items for which the different was not significant

		LPS	HPS	*p*-value	*w*-value
Item 11: "Mathematics is difficult for me."	Agree	9.95	45.60	0.2759	0.0843
	Neutral	46.61	43.79		
	Disagree	43.44	40.43		

Item 12: "I have self-discipline in doing Mathematics."	Agree	69.68	71.43	0.2322	0.0899
	Neutral	23.53	17.86		
	Disagree	6.79	10.71		
Item 14: "Doing mathematics makes me nervous or upsets me."	Agree	7.66	11.35	0.1952	0.0949
	Neutral	15.77	20.57		
	Disagree	76.58	68.09		
Item 15: "I will continue with mathematics after Grade 12."	Agree	78.48	72.54	0.2944	0.0819
	Neutral	13.00	14.08		
	Disagree	8.52	13.38		
Item 16: "I enjoy mathematics."	Agree	66.67	71.83	0.2014	0.0942
	Neutral	27.40	19.72		
	Disagree	5.94	8.45		
Item 17: "Studying hard in mathematics is important."	Agree	4.50	5.63	0.8828	0.0262
	Neutral	5.41	5.63		
	Disagree	90.09	88.73		
Item 33: "I lose concentration when solving math problems."	Agree	8.11	13.38	0.2299	0.0899
	Neutral	45.50	40.14		
	Disagree	46.40	46.48		

Although these items do not point to significant differences between HPS and LPS a previously identified and surprising line of thought is strengthened. Almost five times as many students from HPS than from LPS (45.6% versus 9.95%) say that mathematics is difficult for them. In addition more students from HPS than from LPS (around 11% compared to around 7%) say that mathematics makes them nervous or upsets them. What

emerges is the notion that students from HPS realise that achievement in mathematics does not come easy. It is a difficult subject that requires hard work and could even make one nervous or upset one. Yet the high performers are willing to do the hard work required. They are fully involved. There is even an indication that they enjoy it more than students from LPS (around 72% compared to around 67%), despite the fact that they find it difficult.

5.4.4 Précis of findings

- Learners from high-performing schools see mathematics as a difficult subject, more so than learners from low-performing schools.
- Learners from HPS do not necessarily look forward to mathematics classes but realise that hard work is required to achieve success.

5.5 CATEGORY D: PERCEPTIONS OF AND INTERACTION WITH PEERS

Category D of this study focused in particular on the role of peers as agents of mathematics socialisation including their beliefs and goals for learners' motivation. We included questions about their interaction with peers after obtaining inputs from students in this regard from the interviews.

Table 5.5: Perceptions of peers

There is a difference between HPS and LPS with respect to:	***p*-value**	**Significance (5% level)**
Friends' interest in mathematics (Item 19)	0.0496	Significant
Performance of close friends in mathematics (Item 20)	0.1488	Not significant
Encouragement from friends (Item 22)	0.0155	Significant

Learners' desire to perform (Item 24)	0.0072	Significant
Respect for mathematics teachers (Item 25)	0.0007	Significant
Collaboration with class mates (Item 31)	0.0737	Not significant
Participation in class discussion (Item 34)	0.0046	Significant

5.5.1 Items with a significant difference

Friends' interest in mathematics

Results for this item are presented in Table 5.5.1.

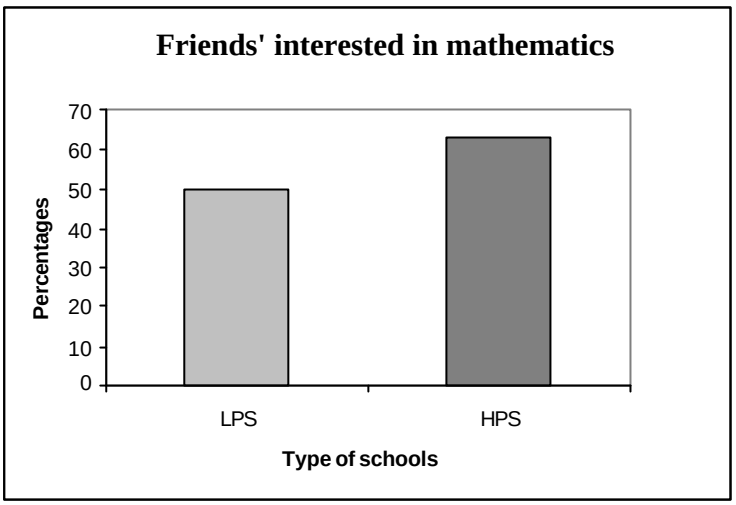
Table 5.5.1: Comparison between HPS and LPS with regard to friends' interest in mathematics

		LPS	HPS	*p*-value
Item 19 "My friends are interested in mathematics."	Agree	49.55	62.68	0.0496
	Neutral	35.45	26.06	
	Disagree	15.00	11.27	

Effect size: 0.1288 (Small effect size)

Students from HPS associate more with friends that show interest in mathematics (around 63% versus around 50%). It is also to be expected that in HPS the community of students interested in mathematics will be larger. The effect size is small, suggesting that this result has little practical value.

Figure 5.5.1: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



Encouragement from friends

Results for this item are presented in Table 5.5.2.

Table 5.5.2: Comparison between HPS and LPS with regard to encouragement from friends

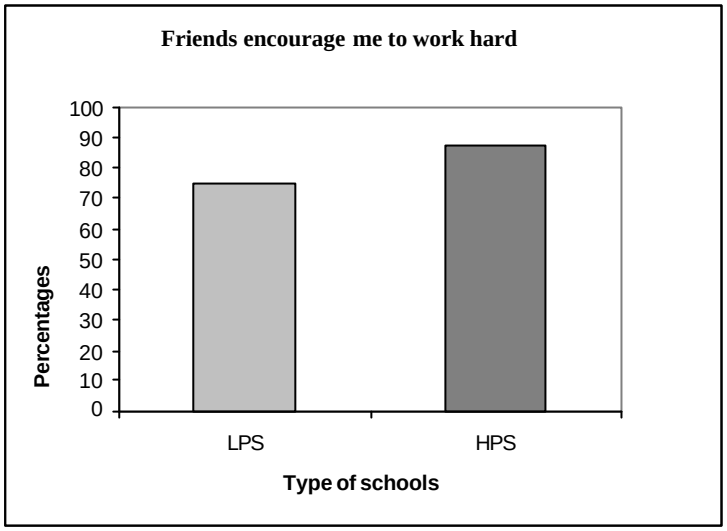
		LPS	HPS	*p*-value
Item 22 "My friends encourage me to work hard."	Agree	75.11	87.32	0.0155
	Neutral	17.19	7.75	
	Disagree	7.69	4.93	

Effect size: 0.1515 (Small effect size)

From Table 5.5.2 we see that around 87% of learners from HPS experience encouragement from their friends versus 75% of learners from LPS. This again points to a community that fosters hard work. These percentages are large (in both cases) compared to small percentages of students that disagree (around 8% and 5%), somewhat

surprising for LPS. The effect size is small, suggesting that this result has little practical value.

Figure 5.5.2: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



Learners in my class want to do well

Results for this item are presented in Table 5.5.3.

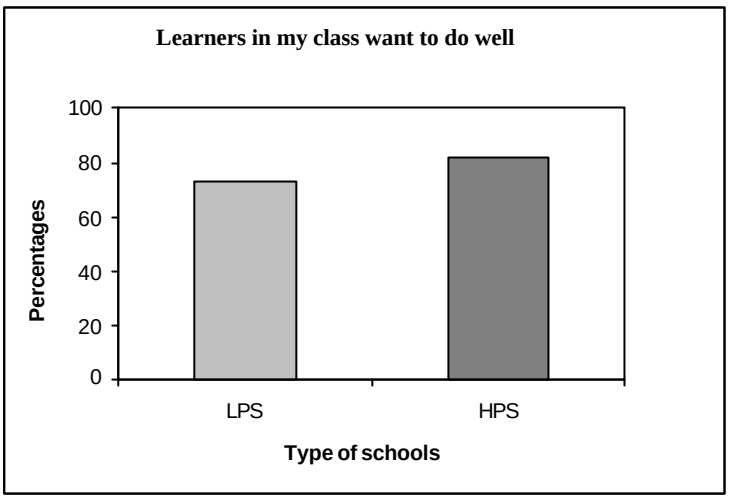
Table 5.5.3: Comparison between HPS and LPS with regard to learners' desire to perform

		LPS	HPS	*p*-value
Item 24 "Learners in my class want to do well."	Agree	72.85	81.69	0.0072
	Neutral	23.53	11.27	
	Disagree	3.62	7.04	

Effect size: 0.1649 (Small effect size)

The results show that around 82% of the learners from HPS agree with the fact that learners in their class want to do well in mathematics whereas around 73% of learners from LPS agree. The communal desire to do well fits in with the emerging image of an environment that stimulates hard work and manifests itself in success. The effect size is small, suggesting that this result has little practical value.

Figure 5.5.3: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



Respect for mathematics teachers

Results for this item are presented in Table 5.5.4.

Table 5.5.4: Comparison between HPS and LPS with regard to respect for mathematics teachers

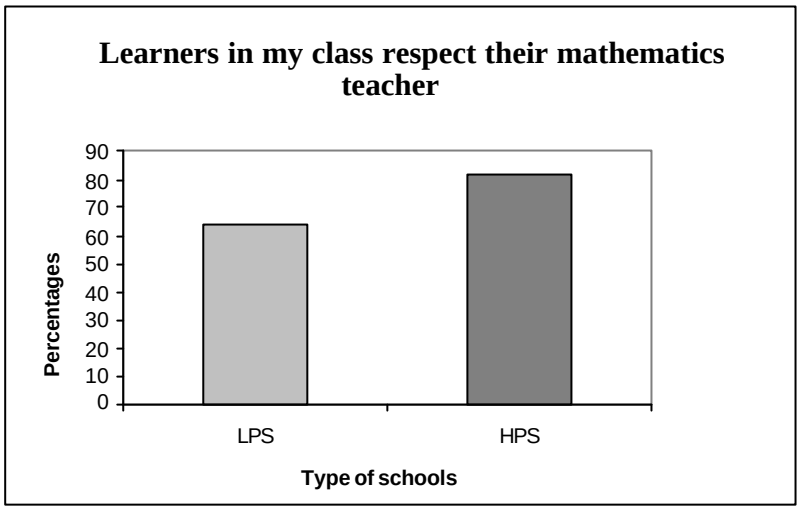
		LPS	HPS	*p*-value
Item 25 "Learners in my class respect math teachers."	Agree	63.06	81.69	0.0007
	Neutral	26.13	13.38	
	Disagree	10.81	4.93	

Effect size: 0.1992 (Small effect size)

The results indicate that around 82% of learners from HPS agree that their classmates respect their mathematics teachers whereas around 63% of the learners from LPS agree. The significant *p* value ($p = 0.0007$) indicates that learners from HPS believe more that their classmates respect their mathematics teachers than learners from LPS. Respect for a

teacher adds to create a scholarly environment. The effect size is small, suggesting that this result has little practical value.

Figure 5.5.4: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



Participation in class discussion

Results for this item are presented in Table 5.5.5.

Table 5.5.5: Comparison between HPS and LPS with regard to participation in class discussions

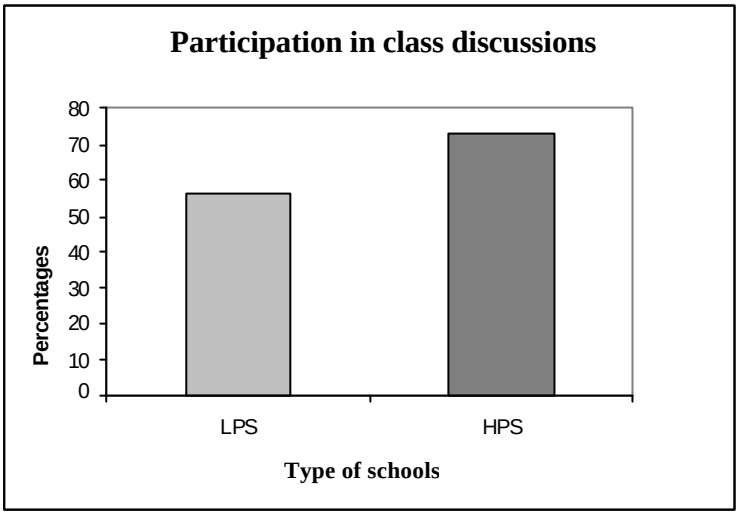
		LPS	HPS	*p*-value
Item 34 "I participate in class discussions."	Regularly	55.45	72.54	0.0046
	Occasionally	37.27	22.54	
	Never	7.27	4.93	

Effect size: 0.1723 (Small effect size)

From the data it is clear that learners from HPS participate in class discussions more regularly than learners from LPS. In this regard around 73% of learners from HPS indicate regular participation in comparison with around 53% of learners from LPS that participate regularly. It is pleasing to see that even for LPS more than half the students

regularly participate in class discussions. Very few students, of both groups, never participate in class discussions. There seems to be a culture of class participation overall, but more so in HPS. The effect size is small, suggesting that this result has little practical value.

Figure 5.5.5: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



5.5.2 Item for which the difference was almost significant

Collaboration with classmates

Results for this item are presented in Table 5.5.6.

Table 5.5.6: Comparison between HPS and LPS with regard to working with classmates

		LPS	HPS	*p*-value
Item 31 "I work with classmates in mathematics."	Regularly	66.06	76.60	0.0737
	Occasionally	29.86	19.15	
	Never	4.07	4.26	

Effect size: 0.1200 (Small effect size)

Although the overall difference is not significant for this item, results show that more than 76% of learners from HPS regularly work with classmates in mathematics compared to only 66% of learners from LPS. These percentages are high in both cases but are weighted towards the HPS. The effect size is small, suggesting that this result has little practical value.

5.5.3 Précis of findings

Learners from high-performing schools belong to a scholarly community where they

- Associate with friends who show interest in mathematics.
- Receive encouragement from their friends.
- Have classmates that show a desire to do well.
- Have respect for teachers.
- Participate in class discussions.

5.6 CATEGORYE: PERCEPTIONS OF TEACHERS

There is a difference between HPS and LPS with respect to:	***p*-value**	**Significance (5% level)**
Fear of mathematics teacher (Item 8)	0.0014	Significant
Expectations from teacher (Item 9)	0.3682	Not significant
Encouragement from teacher (Item 18)	0.4117	Not significant
Teacher's treatment of learners (Item 23)	0.4759	Not significant
Recognition by teacher (Item 26)	0.3967	Not significant

5.6.1 Item with a significant difference

Fear of mathematics teacher

Results for this item are presented in Table 5.6.1.

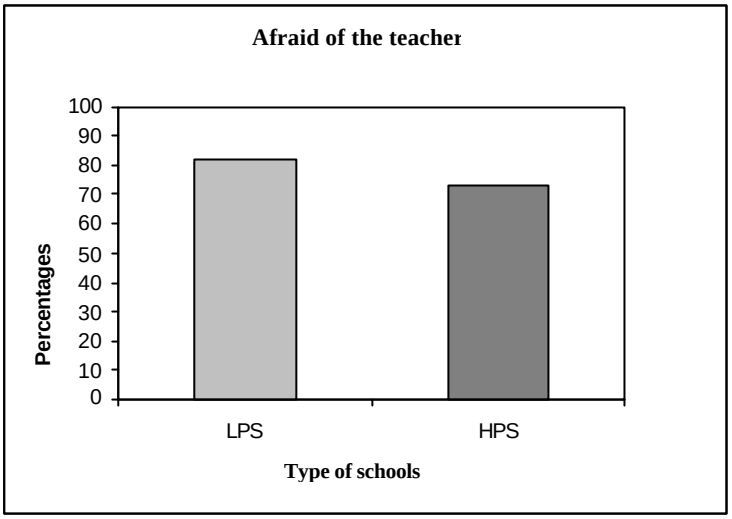
Table 5.6.1: Comparison between HPS and LPS with regard to fear of mathematics teacher

		LPS	HPS	*p*-value
Item 8 "I am afraid of my mathematics teacher."	Agree	5.43	17.02	0.0014
	Neutral	13.12	9.93	
	Disagree	81.45	73.05	

Effect size: 0.1906 (Small effect size)

A comparison of learners from HPS, and LPS on learners being afraid of their teacher reveals that learners from HPS are more afraid of their teachers than their counterparts. Percentage wise, around 82% of learners from LPS disagree with the fact that they are afraid of their mathematics teacher and around 73% of those learners from HPS disagree. In addition around 17% of learners from HPS feel that they are afraid of their mathematics teacher compared to only about 5% of LPS. This result is perhaps contrary to expectation but fits in with the perception of learners from HPS that mathematics is a difficult subject and that they do not look forward to classes. The image portrayed is that of a strict teacher that obtains results and does not necessarily make life easy for learners. Perhaps this portrayal is somewhat of the old school but one cannot conclude that the HPS teachers' approach is unreasonably authoritarian as we are dealing with learners' perceptions that may be slightly exaggerated. The effect size is small, suggesting that this result has little practical value.

Figure 5.6.1: Percentages of learners of high-performing schools and low-performing schools that disagree with the statement



5.6.2 Items for which the difference was not significant

Four items for which the difference in opinion between learners from HPS and learners from LPS was not significant are listed in Table 5.6.2.

Table 5.6.2: Items for which the difference was not significant

		LPS	HPS	*p*-value	*w*-value
Item 9 "My teacher expects me to do well."	Agree	88.24	85.92	0.3682	0.0742
	Neutral	9.05	8.45		
	Disagree	2.71	5.63		
Item 18 "My teacher always encourages me to work hard."	Agree	93.67	93.66	0.4117	0.0699
	Neutral	3.17	1.41		
	Disagree	3.17	4.93		
Item 23 "My teacher always treats learners with respect."	Agree	77.38	80.99	0.4759	0.0640
	Neutral	16.29	15.49		

	Disagree	6.33	3.52		
Item 26 "Learners' achievement is recognised by the teacher."	Agree	66.97	69.01	0.3967	0.0717
	Neutral	25.23	26.76		
	Disagree	7.80	4.23		

The picture of the teacher as a strict authoritarian figure is further negated by data in the table above. More than 85% of learners from HPS say that the teachers expect them to do well, more than 90% say that the teacher encourages them to do well; more than 80% say that the teachers always treat learners with respect and almost 70% of learners from HPS say that the teacher recognises learners' achievements. These high percentages are not significantly different for LPS. What emerges is the realisation that the blame for poor performance does not lie with the attitude of the teachers. In both cases students testify to the characteristics of encouragement and support from teachers.

5.6.3 Précis of findings

- Learners from high-performing schools are significantly more afraid of their teachers than learners from low-performing schools pointing to a strict classroom environment.
- Yet learners from both high and low-performing schools recognise in their teachers qualities of encouragement, recognition and high expectation.

5.7 CATEGORY F: PERCEIVED CAUSES FOR POOR PERFORMANCE IN MATHEMATICS

Category F of this study was about learners' perceptions on what the causes for general poor mathematics performance are.

Table 5.7: Learners' perceived causes for poor performance in mathematics

There is a difference between learners in HPS and learners in LPS with respect to what they perceive as cause for poor performance in mathematics	***p*-value**	**Significance (5% level)**
Too many learners in a class (Item 40)	< 0.0001	Significant
Not mathematically talented (Item 41)	0.2581	Not significant
Uncertainty about future career (Item 42)	0.4707	Not significant
Uneducated parents (Item 43)	0.0119	Significant
No respect for teachers (Item 44)	0.0890	Not significant
Not attending extra classes (Item 45)	0.2435	Not significant
Under qualified teachers (Item 46)	0.0094	Significant
Not expected to perform well (Item 47)	0.0006	Significant
Not respected by teacher (Item 48)	0.1116	Not significant
No extra support available (Item 49)	0.0332	Significant

No collaboration with class mates (Item 50)	0.0190	Significant
Poor background in mathematics (Item 51)	0.1098	Not significant

5.7.1 Items with a significant difference

Too many learners in the class

Results for this item are presented in Table 5.7.1.

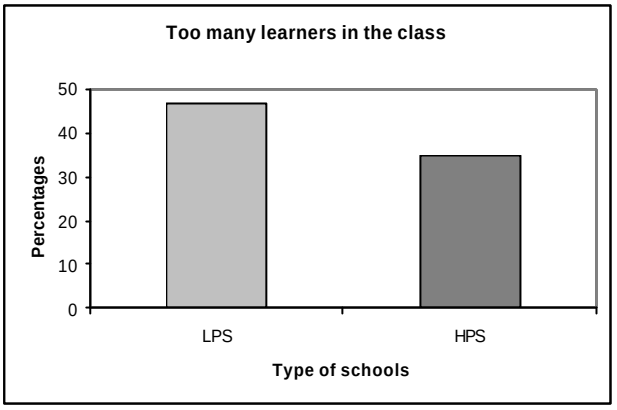
Table 5.7.1: Comparison between HPS and LPS with regard to learners perceiving the number of learners in the class as cause for poor performance

		LPS	HPS	*p*-value
Item 40 "Learners perform badly because there are too many learners in the class".	Agree	9.09	30.00	< 0.0001
	Neutral	43.64	35.00	
	Disagree	47.27	35.00	

Effect size: 0.2705 (Small effect size)

The intention was to find out if learners believe that overcrowded classes affected their performance in mathematics. The class sizes were not the same for HPS and LPS. Some high-performing schools had more learners in one class than low-performing schools and vice versa. In this regard, responses percentage-wise were that around 30% of learners from HPS agree that learners do not perform well in mathematics because the class sizes are too big whereas only around 9% of learners from LPS agree. Learners from HPS clearly experience large classes more as a detriment for performance. The effect size is small, suggesting that this result has little practical value.

Figure 5.7.1: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



Uneducated parents

Results for this item are presented in Table 5.7.2.

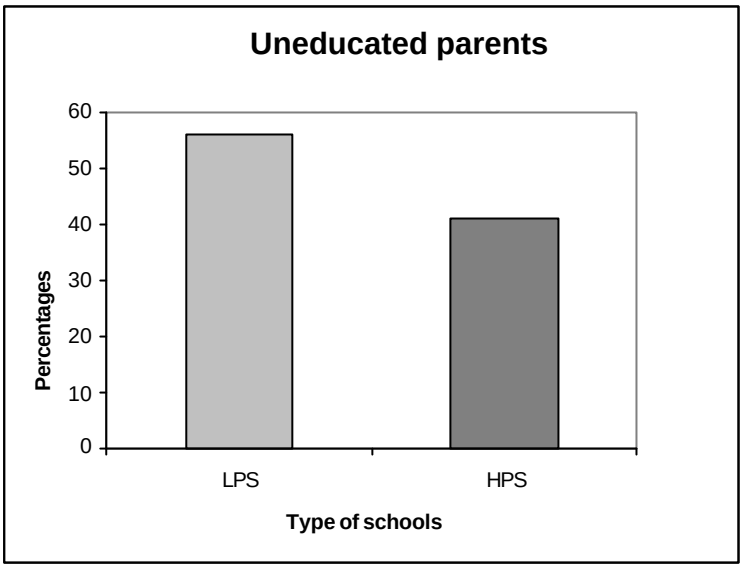
Table 5.7.2: Comparison between HPS and LPS with regard to learners perceiving uneducated parents as cause for poor performance

		LPS	HPS	*p*-value
Item 43 "Learners perform badly because they have uneducated parents."	Agree	8.18	13.57	0.0119
	Neutral	35.45	45.71	
	Disagree	56.36	40.71	

Effect size: 0.1570 (Small effect size)

In both cases, for learners from HPS as well as from LPS, low percentages agree with the statement (around 8% and just over 13%). Larger percentages disagree with the statement (just over 56% and 40% respectively). It is interesting and significant that more learners from LPS put less blame for poor performance on their parents. An explanation could be that learners from HPS realise the value of an educated home environment more because they are serious about their learning. The effect size is small, suggesting that this result has little practical value.

Figure 5.7.2: Percentages of learners of high-performing schools and low-performing schools that disagree with the statement



Under qualified teachers

Results for this item are presented in Table 5.7.3.

Table 5.7.3: Comparison between HPS and LPS with regard to learners perceiving under qualified teachers as cause for poor performance

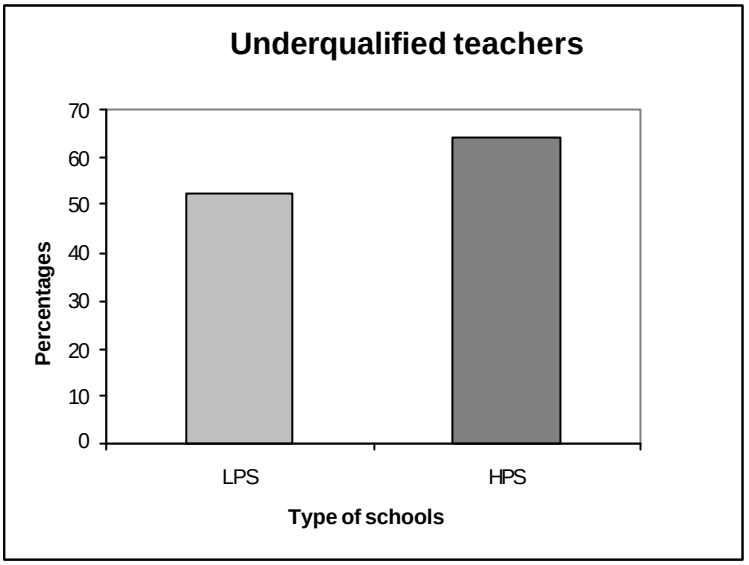
		LPS	HPS	*p*-value
Item 46 "Learners perform poorly in mathematics because they have under qualified teachers."	Agree	13.18	15.71	0.0094
	Neutral	35.00	20.00	
	Disagree	51.82	64.29	

Effect size: 0.1610 (Small effect size)

Percentage wise the learners of HPS and of LPS are similar in their agreement with the statement. However, more learners from HPS disagree with the statement than learners from LPS (around 64% compared to around 52%) and both percentages are high. It is clear that learners have confidence in their teachers and do not feel that they are under-

qualified, and that this is particularly true for learners from HPS. The effect size is small, suggesting that this result has little practical value.

Figure 5.7.3: Percentages of learners of high-performing schools and low-performing schools that disagree with the statement



No expectations from learners

Results for this item are presented in Table 5.7.4.

Table 5.7.4: Comparison between HPS and LPS with regard to learners perceiving under qualified teachers as cause for poor performance

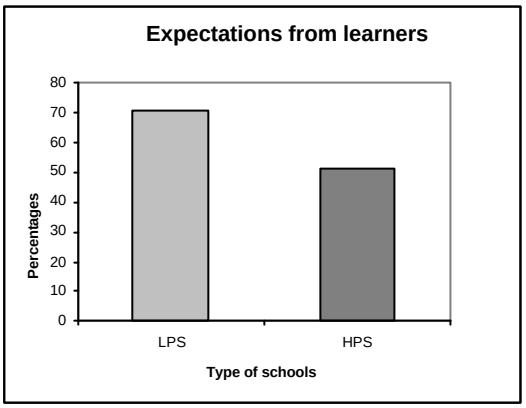
		LPS	HPS	*p*-value
Item 47 "Learners perform poorly in mathematics because they are not expected to perform well."	Agree	5.91	12.86	0.0006
	Neutral	23.18	35.71	
	Disagree	70.91	51.43	

Effect size: 0.2022 (Small effect size)

Although more than twice as many learners from HPS agree with the statement that learners perform poorly because they are not expected to perform well, these percentages are on the low side (around 6% and 13% respectively). The majority of students, from

both HPS and LPS disagree with the statement, with a significant difference in favour of the LPS (around 71% and 51% respectively). Learners from LPS clearly feel that the reason for poor performance lies elsewhere. They are probably experiencing external pressure for improved performance from the media, perhaps from the school itself although this pressure is clearly not resulting in better performance. This finding supports the belief that external pressure is secondary to internal motivation. The effect size is small, suggesting that this result has little practical value.

Figure 5.7.4: Percentages of learners of high-performing schools and low-performing schools that disagree with the statement



No extra support available

Results for this item are presented in Table 5.7.5.

Table 5.7.5: Comparison between HPS and LPS with regard to learners perceiving no extra support as cause for poor performance

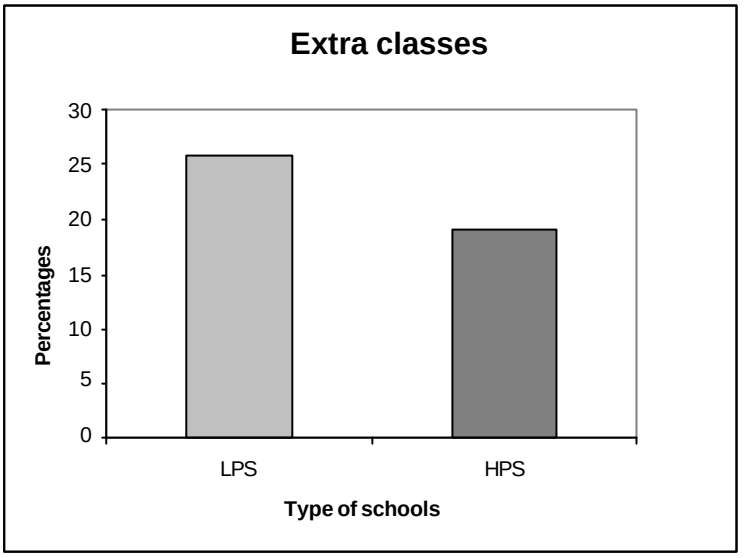
		LPS	HPS	*p*-value
Item 49 "Learners perform poorly in mathematics because they are not provided with extra support when needed."	Agree	25.57	19.29	0.0332
	Neutral	51.14	45.00	
	Disagree	23.29	35.71	

Effect size: 0.1377 (Small effect size)

According to the data around 23% of learners from LPS disagree with the statement whereas around 36% of learners from HPS disagree. Of learners from LPS around 26%

support the statement compared to around 19% of learners from HPS. It appears that learners from LPS are significantly more dependent on extra support. It seems that they want to justify their failure through external reasons, more so than learners from HPS. The effect size is small, suggesting that this result has little practical value.

Figure 5.7.5: Percentages of learners of high-performing schools and low-performing schools that disagree with the statement



Learners do not practise mathematics with their classmates

Results for this item are presented in Table 5.7.6.

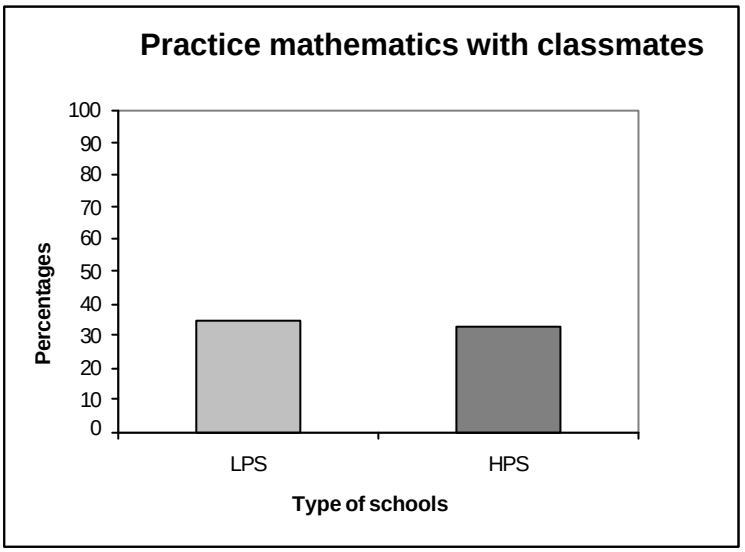
Table 5.7.6: Comparison between HPS and LPS with regard to learners perceiving no practising with classmates as cause for poor performance

		LPS	HPS	*p*-value
Item 50 "Learners perform poorly in mathematics because they do not practise math with their classmates."	Agree	35.32	33.33	0.0190
	Neutral	51.83	42.55	
	Disagree	12.84	24.11	

Effect size: 0.1486 (Small effect size)

The percentages of students from both HPS and LPS that agree with the statement are very similar (around 35% and 33% respectively). The significant difference (p = 0.0190) lies in the percentages of students that disagree. Almost twice as many students from HPS than students from LPS disagree with the statement (24% compared to almost 13%). Yet these percentages are not high and it would be rash to make conclusions on grounds of these figures alone. The finding is that about a third of both groups agree that a lack of practising with classmates is a reason for poor performance. The effect size is small, suggesting that this result has little practical value.

Figure 5.7.6: Percentages of learners of high-performing schools and low-performing schools that agree with the statement



5.7.2 Items for which the difference was almost significant

No respect for teachers

For this item the difference between learners from HPS and LPS as almost significant. The details are listed in Table 5.7.6.

Table 5.7.6: Comparison between HPS and LPS with regard to learners perceiving no practising with classmates as cause for poor performance

		LPS	HPS	*p*-value
Item 44 "Learners perform poorly in mathematics because they do not respect their teachers."	Always	14.16	20.00	0.0890
	Sometimes	54.34	42.86	
	Never	31.51	37.14	

Effect size: 0.1161 (Small effect size)

No significant difference could be identified between HPS and LPS. What is of interest is that so few students feel that poor performance is due to disrespect for teachers (around 14% and 20% respectively), a pleasing result. Around a third of both groups of students feel the reason for poor performance lies elsewhere and is not due to lack of respect for teachers. The effect size is small, suggesting that this result has little practical value.

5.7.3 Items for which the difference was not significant

Items for which the difference in opinion between learners from HPS and learners from LPS was not significant are listed in Table 5.7.7.

Table 5.7.7: Items for which the difference was not significant

		LPS	HPS	*p*-value	*w*-value
Item 41 "Learners perform poorly in mathematics because they are not mathematically talented."	Always	10.55	15.71	0.2581	0.0870
	Sometimes	48.17	41.43		
	Never	41.28	42.86		
Item 42 "Learners perform poorly in mathematics because they do not know the career they will follow after Grade 12."	Always	17.81	19.57	0.4707	0.0650
	Sometimes	52.97	46.38		
	Never	29.22	34.06		
Item 45 "Learners perform poorly in mathematics because they do not	Always	29.09	29.79		0.0885

attend extra classes."	Sometimes	54.09	46.81	0.2435	
	Never	16.82	23.40		
Item 48 "Learners perform poorly in mathematics because they do not feel respected and connected with their teacher."	Always	20.00	25.00	0.1116	0.1104
	Sometimes	49.09	37.86		
	Never	30.91	37.14		
Item 51 "Learners perform poorly in mathematics because they do not have a strong background in mathematics."	Always	22.27	28.78	0.1098	0.1109
	Sometimes	52.27	41.01		
	Never	25.45	30.22		

No significant differences were identified for any of these items. What is notable from the results of these items are the low percentages of agreement in general. The highest percentages (around 30%) occurred for the item on attending extra classes, a finding that was noted earlier (Item 30) where learners from LPS felt they did not attend extra classes regularly enough. The highest percentages occur in the Neutral category which is an indication that students do not really know what the reasons for poor performance are, no single reason stands out. The truth is probably that all the possible reasons combine to result in poor performance.

5.7.4 Précis of findings

- Learners from LPS are significantly more dependent on extra support and want to justify their failure through external reasons, more so than learners from HPS.
- Learners from LPS feel that the reason for poor performance lies elsewhere. They are probably experiencing external pressure for improved performance from the media, perhaps from the school itself although this pressure is clearly not resulting in better performance.
- It is clear that learners have confidence in their teachers and this is particularly true for learners from HPS.

- Learners from HPS clearly experience large classes more as a detriment for performance.

5.7.5 Learners' most important cause for poor performance

In this category learners were also asked to indicate the most important reason (from a given list) in their opinion, for poor performance in mathematics. The results are reflected in Table 5.7.8.

Table 5.7.8: Comparison between HPS and LPS with regard to learners' perception as the most important cause for poor performance (given as percentages of the column total)

Item 38 **"Which of the reasons do you regard as the most important cause for poor performance in mathematics?"**	LPS	HPS	Total	Percentage
Too many learners in a class	2.25 (5)	3.57 (5)	10	2.76
Not mathematically talented	5.41 (12)	3.57 (5)	17	4.70
Uncertainty about future career	10.81 (24)	11.43 (16)	40	11.05
Uneducated parents	0 (0)	3.57 (5)	5	1.38
No respect for teachers	6.31 (14)	6.43 (9)	23	6.35
Not attending extra classes	7.66 (17)	10.71 (15)	32	8.84
Underqualified teachers	11.26 (25)	4.29 (6)	31	8.56
Not expected to perform well	0.90 (2)	2.86 (4)	6	1.67
Not respected by the teacher	7.21 (16)	5.00 (7)	23	6.35

No extra support available	7.66 (17)	4.29 (6)	23	6.35
No collaboration with classmates	22.52 (50)	26.43 (37)	87	24.04
Poor background in mathematics	18.02 (40)	17.86 (25)	65	17.96
TOTAL	222	140	362	100

A comparison of high-achieving schools and low-achieving schools in Table 5.7.8 on the most important cause for poor performance in mathematics found that learners from high-achieving schools put more emphasis than those from low-achieving schools on factors directly within their control, such as collaboration with classmates, class attendance, respect for teachers and certainty about their future career whereas learners from low-achieving schools placed more emphasis than high-achieving schools on those factors of which many are polar opposites of those found in HPS and are not under their control, such as extra support, respect by the teachers, mathematical talent, underqualified teachers and mathematical background.

It is therefore interesting that the majority of respondents in this section generally viewed the most significant drawback in doing well in mathematics as lack of collaboration with classmates, the strand that was picked up earlier (Items 31) where learners from both LPS and HPS indicated that they work with classmates regularly. This may signify an underlying uncertainty with regard to mathematics teaching that collaboration with classmates facilitates achievements among learners, whether collaboration method is correctly implemented in the classroom is still a question to be answered.

5.8 SUMMARY ON CHAPTER FINDINGS

In a comparison of high-achieving schools and low-achieving school learners' perceptions, several differences were found. The majority of the learners from both HPS and LPS indicated positive perception of their teachers. What emerges is the realisation that the blame for poor performance does not lie in the attitude of the teachers. However, high percentages of learners from HPS feel that they have to work hard and it is important to do well in mathematics. In this regard the analysis of the questionnaire identified the following factors that facilitate achievement in mathematics as mostly shared among the learners from HPS.

- High learners' achievements, irrespective of education level and parental involvement.
- Peers who motivates other learners for best achievement in mathematics.
- Strong learner accountability in school work.
- A strong and determined attitude among learners that they can and will achieve after hard work.
- High level of mutual respect between teachers and learners and dedication to mathematics work.

The data in this study suggest that even though learners from these ten rural schools were similar in their home and school background, dissimilar factors for success were evident on the following:

- learners' commitment;
- learners' attitudes and self-concept;
- learners' career prospects;
- learners' perceptions of peers and teachers.

In Chapter 6, I will provide, discuss and contextualise the results of the teacher investigation.