CHAPTER 6

RESULTS OF THE EMPIRICAL INVESTIGATION

6.1 INTRODUCTION

The previous chapter reviewed the data processing procedures and described the statistical techniques applied. This chapter provides the data analyses on the application of science process skills to the teaching of geography in secondary schools in the Free State province.

The chapter is divided into three sections. The first section, **descriptive statistics**, describes teachers' and learners' perception of the application of an inquiry approach to geography teaching. It also describes their perception of the application of basic science process skills and integrated science process skills to the teaching of geography.

The second section, **inferential statistics**, reports the results of the one-way ANOVAs computed to determine if there were significant differences among the various education districts that could hinder the districts being treated as a single main sample.

The third and final section deals with the interpretation of the results of the **interviews**. Problems encountered by teachers and learners, and identified during the interviews, are presented. Lastly, results are presented regarding the solutions suggested by the teachers and learners during the interviews.

6.2 DESCRIPTIVE STATISTICS

This section provides a demographic profile of the samples used in the study - namely the teachers, learners and schools. It also provides statistical descriptions which arise from responses to items which measured inquiry teaching methods, basic science process skills and integrated science process skills applied to the teaching of geography.

6.2.1 Biographical Data Analysis

Geography teacher questionnaires were mailed to 150 teachers whilst learner questionnaires were mailed to 700 learners (cf. 5.2.3.3). Seventy-one teachers and 355 learners returned the questionnaire. Following is the personal information for the teachers and learners who responded to the questionnaires.

6.2.1.1 Biographical Data for Geography Teachers

The questionnaire can be found in Appendix 3. On the basis of the 71 returns, the following generalisations can be made about secondary school geography teachers in the Free State Education Department (Table 6.1).

In secondary schools which offer geography, 52 percent of the teachers were males and 48 percent were females. The majority of teachers (69%) took geography as a subject to matric and 77 percent of the teachers specialised in geography at tertiary level. The teachers have an average of 15 years of teaching experience. Furthermore, most geography teachers (65%)

in the department have 5 or more years of geography teaching experience and 62 percent of these teachers teach up to and including Grade 12.

It is also interesting to note that only 10 percent of the respondent teachers were not interested in teaching geography when appointed at their schools. However, it is comforting to note that 89 percent of the teachers find geography easy to teach.

More than half of the teachers (52%) teach in urban schools and 94 percent of these schools are public schools. In general, geography teachers are reasonably experienced and have specialised in geography at tertiary level. Following is Table 6.1 which gives a summary of biographical data for geography teachers

Table 6.1 Summary of Teacher Personal Data, Experience in the Teaching of Geography and School Details Expressed as Percentage Scores

N=71

PERSONAL ITEMS	% RESPONDENTS ACCORDING TO CATEGORY	%TOTAL
1. Gender	Male (37) 52% Female (34) 48%	100
2. Matriculation Geography	Yes (49) 69% No (22) 31%	100
3. Tertiary Geography Education	Yes (55) 77% No (16) 23%	100
4. Average Teaching Experience in Years	15	
5. Highest Teaching Level	Grade 8 = (3) 4% 9 = (6) 8% 10 = (10) 14% 11 = (5) 7% 12 = (44) 62% Other = (3) 5%	100
6. Geography Teaching Experience in Years	Less than 5 (25) 35% More than 5 (46) 65%	100
7. Interested in Teaching Geography?	Yes (64) 90% No (7) 10%	100
8. Is Geography Easy to Teach?	Yes (63) 89% No (8) 11%	100
9. Location of the Schools	Rural (34) 48% Urban (37) 52%	100
10. School's Classification	Public (67) 94% Independent (2) 3% Mine (2) 3%	100

6.2.1.2 Biographical Data for Geography Learners

Geography learners' questionnaire can be found in Appendix 4. On the basis of the 355

returns the following generalisations can be made about secondary school geography learners in the Free State Education Department (Table 6.2). Secondary school geography is learned mainly by female learners (67,6%). The personal data and school details of the learners were as follows:

Table 6.2 Summary of Learner Personal Data and School Details Expressed as Percentage Scores (continues)

N=355

PERSONAL ITEMS	% RESPONDENTS ACCORDING TO CATEGORY	% TOTAL
1. Gender	Male (114) 32, 1% Female (241) 67, 8%	100
2. Age in Years	Less than 13 (9) 3% 13 to 18 (332) 88% More than 18 (14) 9%	100
3. Grade	8 = (86) 24,2% 9 = (90) 24,3% 10 = (95) 26,8% 11 = (51) 14,4% 12 = (33) 9,3%	100
4. Do You Find Geography Easy to Learn?	Yes (237) 66, 8% No (118) 32, 2%	100

Continues...

Table 6.2 Summary of Learner Personal Data and School Details Expressed as Percentage Scores

N=355

5. Location of the School	Rural (21) 5,9 % Urban (334) 94,1%	100
6. School's Classification	Public (244) 68, 7% Independent (111) 31%	100

Table 6.2 indicates that most schools did not adhere to the request that ten questionnaires should be given to the learners of each Grade (Appendix 10). It seems as if questionnaires were given mainly to Grades 8, 9 and 10 learners. Only 14,4 percent and 9,3 percent of the respondents were Grades 11 and 12 learners respectively. One of the reasons for this pattern could be the fact that Grade 12 learners write public examinations. Schools did not want to burden Grade 12 learners with work which was not related to their preparation for the examinations. Despite this minor setback, it is interesting to note that 67 percent of the learners found geography easy to learn.

94,1 percent of the learners who responded to the questionnaire attended schools which were in urban areas and most of these schools (68,7%) were public schools. This could be due to the fact that most schools in the rural Free State are privately owned farm schools which do not have secondary school grades. Hence most rural learners are forced to go to a nearby town or city for secondary school education.

6.2.2 Data Analysis for Inquiry Teaching Methods

Part Three of the learners' questionnaire and Part Four of the teachers' questionnaire dealt with inquiry teaching methods. The following section presents teachers' and learners' responses. Teachers' responses are dealt with first because teachers are the ones who are supposed to apply inquiry methods to the teaching of geography. Learners' responses are used to check teachers' responses to each item of the questionnaire.

6.2.2.1 Geography Teachers' Perception of their Application of Inquiry Methods to the Teaching of Geography

As it has already been mentioned, Part Four of the teachers' questionnaire was designed to establish geography teachers' perception of their application of inquiry teaching methods to the teaching of geography (**objective 1**). It is assumed that the application of inquiry teaching methods could lead to the application of science process skills.

Table 6.3 below indicates teacher responses in percentage to each statement. Items in the table start at 15 because items 1 to 14 in the teachers' questionnaire dealt with statistical information of the respondents. As such, the items in the table are numbered the way they were numbered in the teachers' questionnaire.

Table 6.3 Geography Teachers' Perception of their Application of Inquiry Teaching Methods Expressed as Percentage Scores

N = 71

Inquiry Teaching Method	Never	Sometimes	Often	Always
15. I focus on lessons involving exploration of important problems that can be investigated at many levels of difficulty.	7, 0	49, 3	33,8	9, 9
16. I Use learning materials that stimulate learners' interest.	2, 8	25, 4	60, 6	11, 2
17. I make available many different learning resources for learners' use.	7, 0	45, 1	39, 4	8, 5
18. My lessons present some problems that develop learners' thinking skills.	4, 2	35, 2	46, 5	14, 1
19. When I teach, the learners talk more than I do.	22, 5	56, 3	17, 0	4, 2
20. Learners are free to discuss their ideas in class.	5, 6	38, 0	34, 0	22, 4
21. When I talk, I "question", I do not "tell".	-	25, 4	38, 0	36, 6
22. I consciously use ideas my learners' have raised in class.	5, 6	35. 2	48. 0	11, 2
23. I redirect learners' questions in such a way that learners are encouraged to arrive at their own answers.	1, 4	28, 1	53, 5	17. 0
24. I consciously base my questions on learners' ideas in class.	8, 4	42, 2	39, 4	10, 0
25. Learners are free to interchange their ideas in class.	1, 4	49, 3	26, 8	22, 5
26. I encourage the learners to evaluate if their arguments are relevant to the ideas being discussed.	7, 0	36, 6	42, 3	14, 1
27. My learners gain understanding in science process skills.	8, 5	49, 3	32, 3	9, 9
28. I encourage learners to investigate geographical problems.	-	18, 3	49, 3	32, 4
29. I emphasise learning, rather than classroom discipline when learners are engaged in groupwork activities.	7, 0	39, 4	36, 6	17. 0
30. Class discussions are conducted in an orderly fashion that emphasizes courtesy and willingness to listen to each person's ideas.	2, 8	25, 3	40, 9	31. 0
31. My learners gain practice in scientific process of acquiring knowledge.	12, 7	40, 9	35, 2	11, 2

Continues...

Table 6.3 Geography Teachers' Perception of their Application of Inquiry Teaching Methods Expressed as Percentage Scores

N = 71

Inquiry Teaching Method	Never	Sometimes	Often	Always
32. I reward the free exchange of ideas in class.	12, 7	35, 2	36, 6	15, 5
33. I allow learners to move freely in the classroom while they are engaged in group work activities.	38, 0	40, 9	15, 5	5, 6
34. I encourage the testing of ideas in class.	7, 1	38, 0	33, 8	21, 1
35. I avoid criticising ideas offered by learners in class.	8, 5	23, 9	32, 4	35, 2
36. Each learner's contribution is considered important in class.	-	1, 4	31, 0	67, 6
37. I evaluate learners on growth in many aspects of the learning experience, rather than simply on the basis of facts required.	8, 5	28, 1	43, 7	19, 7
38. All geographical topics are critically examined, not "taught" as closed issues with a single "correct" solution.	4, 2	39, 5	35, 2	21, 1
39. Use of unfounded, emotionally charged language is minimized in guided didactic conversations.	7, 0	15, 5	31, 0	46, 5
40. I emphasize that values are permissible areas of discussion.	4, 2	18, 3	40, 9	36, 6
41. I allow for maximum learner use of learning materials.	2, 8	19, 7	45, 1	32, 4
42. I play low-key role in directing the learning experience of my learners.	11, 3	59, 1	26, 8	2, 8

Teacher responses to items 15 to 42 of the questionnaire enabled the researcher to apply *The Means Procedure* to establish if geography teachers perceived that they were inquiry teachers (cf. 5.3.1.3). Table 6.4 shows *The Means Procedure* for teachers' perception of their application of inquiry methods to the teaching of geography.

Table 6.4 The Means Procedure for Teachers' Perception of their Application of Inquiry Teaching Methods

Variable	N	Mean	Standard Deviation	Minimum	Maximum
SV20V47	71	2.7	0.4	1.8	3.9

Table 6.4 indicates the mean value which is the average or arithmetic mean of the data for the inquiry teaching methods variable. The Standard Deviation is a measure of the spread (variation) around the mean. The higher the Standard Deviation, the more variation is the data around the mean. The mean for teachers' perception of their application of inquiry methods to the teaching of geography is 2.7. *This mean implies that teachers are of the opinion that they "often" apply inquiry methods to the teaching of geography.* As the application of inquiry methods is likely to lead to the application of science process skills, *Table 6.4 also implies that teachers are likely to apply science process skills to the teaching of geography.*

6.2.2.2 Teacher Application of the Inquiry Teaching Methods according to Geography Learners' Responses

Items 11 to 38 in Part three were to establish learners' perception of their teachers' application of inquiry methods to the teaching of geography. Table 6.5 indicates learners' perception of their teachers' application of inquiry methods. The items start at 11 because items 1 to 10 in the learners' questionnaire dealt with personal data and school details of the respondents. Therefore, the items are numbered the way they were numbered in the learners' questionnaire.

Table 6.5 Teacher Application of Inquiry Teaching Methods According to Geography Learners' Responses Expressed as Percentage Scores

N = 355

Inquiry Teaching Method	Strongly Disagree	Disagree	Agree	Strongly Agree
11. My geography teacher focuses on lessons involving exploration of important problems that can be investigated at many levels of difficulty.	8,1	14,7	58,3	18,9
12. My geography teacher uses learning materials that stimulate my interest.	7,9	22,0	49,9	20,2
13. My geography teacher makes available many different learning resources for my use.	6,2	26,8	53,0	14,0
14. My geography teacher's lessons present some problems that develop my thinking skills.	7,9	24,5	52,1	15,5
15. When the lesson is in progress, I talk more than my geography teacher.	36,9	39,4	17,8	5,9
16. I am free to discuss my ideas with other learners in the class.	7,0	28,5	42,3	22,2
17. When my geography teacher talks, (s)he "question", (s)he does not "tell".	15,2	42,8	34,4	7,6
18. My geography teacher consciously uses ideas I have raised in class.	13,2	38,0	40,6	8,2
19. My geography teacher redirects my questions in such a way that I am encouraged to arrive at my own answers.	8,2	29,0	48,7	14,1
20. My geography teacher consciously bases his/her questions on my ideas in class.	11,8	55,5	29,0	3,7
21. I am free to interchange my ideas with other learners in class.	10,7	28,7	46,8	13,8
22. My geography teacher encourages us to evaluate if our arguments are relevant to the ideas being discussed.	7,9	29,0	49,9	13,2
23. I gain understanding in the usage of science process skills.	10,7	25,6	47,6	16,1
24. My geography teacher encourages us to investigate geographical phenomena.	10,4	20,3	53,8	15,5
25. My geography teacher emphasizes learning, rather than classroom discipline when we are engaged in groupwork activities.	10,7	30,4	43,7	15,2
26. Class discussions are conducted in an orderly fashion that emphasizes courtesy and willingness to listen to each person's ideas.	7,9	18,6	45,9	27,6
27. I gain practice in scientific process of acquiring knowledge.	9,3	25,6	50,2	14,9

Continues...

Table 6.5 Teacher Application of Inquiry Teaching Methods According to Geography Learners' Responses Expressed as Percentage Scores

N = 355

Inquiry Teaching Method	Strongly Disagree	Disagree	Agree	Strongly Agree
28. My geography teacher rewards free exchange of ideas in class.	8,2	32,3	48,5	11,0
29. My geography teacher allows us to move freely in the classroom while we are engaged in group work activities.	52,4	38,3	7,6	1,7
30. My geography teacher encourages the testing of ideas in class.	7,3	27,6	49,3	15,8
31. My geography teacher avoids criticising ideas offered by us in class.	12,1	18,0	44,3	25,6
32. Our contributions in discussions are considered important in class.	5,4	15,5	58,0	21,1
33. My geography teacher evaluates us on growth in many aspects of the learning experience, rather than simply on the basis of facts required.	8,7	24,5	49,0	17,8
34. All geographical topics are critically examined, not "taught" as closed issues with a single "correct" solution.	9,0	29,6	44,2	17,2
35. Use of unfounded, emotionally charged language is minimized in guided didactic conversations.	12,4	27,6	48,7	11,3
36. My geography teacher emphasizes that values are permissible areas of discussion.	10,1	30,4	52,7	6,8
37. My geography teacher allows for my maximum use of learning materials.	5,4	22,5	55,2	16,9
38. My geography teacher plays a low-key role in directing my learning experience.	25,3	45,4	24,8	4,5

Responses to items 11 to 38 also enabled the researcher to apply *The Means Procedure* to establish if learners perceived that their teachers applied inquiry methods to the teaching of geography. Table 6.6 indicates The Means Procedure for teacher application of inquiry teaching methods according to learners' responses.

Table 6.6 The Means Procedure for Teacher Application of Inquiring Teaching Methods According to the Learners' Responses

Variable	N	Mean	Standard Deviation	Minimum	Maximum
SV11V38	355	2.6	0.3	1.4	3.7

In Table 6.6 the arithmetic mean for teacher application of inquiring teaching methods according to learners' responses is 2,6. This arithmetic mean is almost identical to the mean in Table 6.4. *This arithmetic mean implies that learners "agree" that teachers apply inquiry teaching methods to the teaching of geography.*

Therefore, analyses of both teacher and learner responses to items 15 to 42 and 11 to 38 of their respective questionnaires indicate that *secondary school geography teachers and their learners are in agreement with regard to the application of inquiring methods to the teaching of secondary school geography.* As such, *the researcher concludes that respondents perceive that geography teachers use inquiry teaching methods in their classrooms* **(objective 1).**

Therefore, *teacher and learner responses justify the researcher's assumption that the application of inquiry teaching methods could lead to the application of science process skills to the teaching of geography.* The following section presents teachers' and learners' perception of science process skills applied to the teaching of geography.

6.2.3 Data Analysis for the Application of Science Process Skills to the Teaching of Geography

Items 43 to 55 in the learners' questionnaire and items 47 to 54 & 59 to 63 in the teachers' questionnaire dealt with basic science process skills applied to the teaching of geography. Furthermore, items 56 to 58 & 63 to 68 in the learners' questionnaire and items 64 to 72 in the teachers' questionnaire dealt with integrated science process skills applied to the teaching of geography. Factor analysis and item analysis were used to establish the science process skills applied to the teaching of secondary school geography.

6.2.3.1 Factor Analysis

Items that dealt with the application of science process skills in the teachers' questionnaire were subjected to factor analysis (cf. 5.7.1.1). Factor analysis is used to determine if certain items in the questionnaire have something in common with some of the variables which are used in the research (Black 1999: 220; Boniface 1995: 131 and Mulder 1989: 132). With the aid of the eigenvalues of the intercorrelation matrix the principal components to be singled out were determined. The principal components were sorted out by the descending order of the eigenvalues. Table 6.7 shows the eigenvalues of the correlation matrix for science process skills. Items in this table are numbered according to the numbering system used in the teachers' questionnaire.

Table 6.7 Eigenvalues of the Correlation Matrix for Science Process Skills

Eigenvalues of the Correlation Matrix: Total = 22 Average = 1

N = 71

Questionnaire Items on Science Process Skills	Eigenvalue	Difference	Proportion	Cumulative
47. I give my learners many opportunities to **identify** geographical important problems.	11,5	9,7	0,5	0,5
48. I organize classroom activities in which learners **classify** the observed geographical features.	1,9	0,6	0,1	0,6
49. I encourage learners to use any means to **communicate** learned information, i.e. to draw maps, charts, symbols, graphs and diagrams to **communicate** the information.	1,2	0,3	0,1	0,7
50. I link the work in geography on **diagrams** to the everyday life of the learners, i.e. getting learners to bring examples from newspapers and magazines for discussion in class.	1,0	0,2	0,1	0,7
51. I organize activities in which my learners **compare** objects using standardize units of measure and suitable measuring instruments.	0,9	0,4	0,0	0,7
52. I organize my learners to **observe** geographical phenomena such as the maximum and minimum air temperatures, wind direction and speed, atmospheric pressure, relative humidity, amount and type of rainfall.	0,7	0,0	0,0	0,8
53. I encourage my learners to **predict** future geographical events based upon their observations.	0,7	0,0	0,0	0,8
54. I encourage learners to use various forms of data to determine the **correctness of geographical theory**.	0,6	0,1	0,0	0,8
59. I encourage learners to **describe** a geographical feature's position in relation to other geographical features.	0,5	0,0	0,0	0,9
60. I give my learners many opportunities to **observe** geographical important problems.	0,5	0,0	0,0	0,8
61. I encourage learners to use any means to **communicate** investigated information.	0,4	0,0	0,0	0,9
62. I link the work in geography on **graphs** to the everyday life of the learners, i.e. getting learners to bring examples from newspapers and magazines for discussion in class.	0,4	0,0	0,0	0,9
63. I organize activities in which my learners arrange geographical features in logical **order** according to their structures.	0,3	0,0	0,0	0,9

Continues..

Table 6.7 Eigenvalues of the Correlation Matrix for Science Process Skills

Eigenvalues of the Correlation Matrix: Total = 22 Average = 1

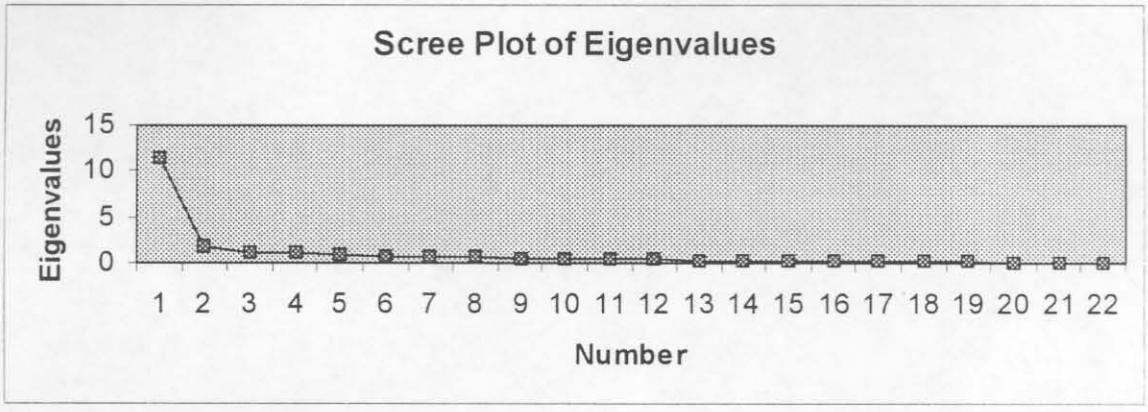
N = 71

Questionnaire Items on Science Process Skills	Eigenvalue	Difference	Proportion	Cumulative
64. I encourage learners to **identify variables** that affect geographical phenomena, e.g. how variables such as air temperature, air pressure, humidity, and cloud cover influence the occurrence of rainfall.	0,3	0,1	0,0	0,9
65. I devise exercises in which my learners have to **construct tables of data**.	0,2	0,0	0,0	1,0
66. I devise exercises in which learners have to **construct graphs**.	0,2	0,0	0,0	1,0
67 I devise exercises in which my learners **conduct investigations**.	0,2	0,0	0,0	1,0
68. I devise exercises in which my learners **identify the variables** understudy.	0,2	0,0	0,0	1,0
69. I give my learners geographical problems in which they are encouraged to **construct hypotheses**.	0,1	0,2	0,0	1,0
70. I give exercises in which my learners **define** geographical features by using observable characteristics of the features.	0,1	0,0	0,0	1,0
71. I give my learners hypotheses and request them to **design investigations** to test the given hypotheses.	0,1	0,0	0,0	1,0
72. I devise exercises in which learners have to **describe the relationship between variables** on a graph.	0,1	0,0	0,0	1,0

An inspection of the factor loadings in Table 6.7 reveals that two factors are retained by the NFACTOR criterion. The first principal component has 11.5 eigenvalues whilst the second principal component has 1.9 eigenvalues. The fact that factorial analysis could distinguish between two factors that could be identified as basic and integrated science process skills confirms that the respondents distinguished mentally between the two constructs. It also confirms that the respondents have come to terms with the fact that these two factors include skills that could be applied to the teaching of geography. The intention of the factor analysis

was to determine whether certain factors could be isolated and after this was done, the factors were identified and labelled as basic and integrated science process skills. Following is a graphical representation (scree curve) of the percentage of variance explained by each consecutive factor.

Figure 6.1 Scree Plot of Eigenvalues



The varimax method of rotation was also used as an analytical approach to obtain an orthogonal rotation of factors. Its purpose was to obtain as many high positive and near zero loadings as possible. This application of the varimax rotation method also revealed that there were two categories of science process skills. Table 6.8 on the next page shows this rotated factor pattern. The homogenous clustering of items with high internal consistencies (correlations) implies that respondents were comfortable with the assumption, according to them, that the science process skills could be grouped into two main clusters. It therefore confirms a high construct validity of the questionnaires.

Table 6.8 Orthogonal Transformation Matrix

Prerotation Method: Varimax

	Basic Science Process Skills	Integrated Science Process Skills
Basic Science Process Skills	0.73931	0.67336
Integrated Science Process Skill	-0.67336	0.73931

N = 71

Questionnaire Items on Science Process Skills	Factor 1 Basic Science Process Skills	Factor 2 Integrated Science Process Skills
47. I give my learners many opportunities to **identify** geographical important problems.	0,7	0,2
48. I organize classroom activities in which learners **classify** the observed geographical features.	0,6	0,4
49. I encourage learners to use any means to **communicate** learned information, i.e. to draw maps, charts, symbols, graphs and diagrams to **communicate** the information.	0,5	0,4
50. I link the work in geography on **diagrams** to the everyday life of the learners, i.e. getting learners to bring examples from newspapers and magazines for discussion in class.	0,5	0,5
51. I organize activities in which my learners **compare** objects using standardize units of measure and suitable measuring instruments.	0,7	0,3
52. I organize my learners to **observe** geographical phenomena such as the maximum and minimum air temperatures, wind direction and speed, atmospheric pressure, relative humidity, amount and type of rainfall.	0,6	0,3
53. I encourage my learners to **predict** future geographical events based upon their observations.	0,8	0,2
54. I encourage learners to use various forms of data to determine the **correctness of geographical theory**.	0,9	0,2
59. I encourage learners to **describe** a geographical feature's position in relation to other geographical features.	0,7	0,3
60. I give my learners many opportunities to **observe** geographical important problems.	0,7	0,3
61. I encourage learners to use any means to **communicate** investigated information.	0,6	0,5
62. I link the work in geography on **graphs** to the everyday life of the learners, i.e. getting learners to bring examples from newspapers and magazines for discussion in class.	0,6	0,5
63. I organize activities in which my learners arrange geographical features in logical **order** according to their structures.	0,6	0,4
64. I encourage learners to **identify variables** that affect geographical phenomena, e.g. how variables such as air temperature, air pressure, humidity, and cloud cover influence the occurrence of rainfall.	0,7	0,4

Continues...

Table 6.8 Orthogonal Transformation Matrix

N = 71

Questionnaire Items on Science Process Skills	Factor 1 Basic Science Process Skills	Factor 2 Integrated Science Process Skills
65. I devise exercises in which my learners have to **construct tables of data**.	0,0	0,8
66. I devise exercises in which learners have to **construct graphs**.	0,3	0,8
67. I devise exercises in which my learners **conduct investigations**.	0,3	0,8
68. I devise exercises in which my learners **identify the variables** under study.	0,3	0,8
69. I give my learners geographical problems in which they are encouraged to **construct hypotheses**.	0,4	0,7
70. I give exercises in which my learners **define** geographical features by using observable characteristics of the features.	0,5	0,6
71. I give my learners hypotheses and request them to **design investigations** to test the given hypotheses.	0,4	0,6
72. I devise exercises in which learners have to **describe the relationship between variables** on a graph.	0,4	0,7

Variance Explained by Each Factor

Factor 1 = Basic Science Process Skills	Factor 2 = Integrated Science Process Skills
7.1382852	6.2380386

Table 6.8 indicates that in Factor 1, values which are above 0.5 form one category of science process skills and values which are below 0.5 form another category. Analysis of Factor 2, also reveals the same pattern. Values which are less than 0.5 also form one category of science process skills and values which are more than 0.5 form another category. As such, in Factor 1, values above 0.5 can be classified as basic science process skills whilst values below 0.5 can be classified as integrated science process skills. In Factor 2, values less than

0.5 may be classified as basic science process skills whilst values more than 0.5 may be classified as integrated science process skills.

As a result of the factor analysis, data will be analysed under the identified 2 principal components. Item analysis is used to investigate basic science process skills (Tables 6.9 to 6.12) and integrated science process skills (Tables 6.13 to 6.16) applied to the teaching of geography in secondary schools in the Free State.

6.2.3.2 Basic Science Process Skills

Table 6.9 to 6.12 show teacher and learner perceptions of the application of basic science process skills to the teaching of geography. Teacher and learner responses to items in their respective questionnaires attempted to measure the application of science process skills to the teaching of geography as follows:

Table 6.9 Geography Teachers' Perception of their Application of Basic Science Skills Expressed as Percentage Scores

N = 71

Questionnaire Items on Basic Science Process Skills	Never	Sometimes	Often	Always
47. I give my learners many opportunities to **identify** geographical important problems.	4, 2	32, 4	43. 7	19. 7
48. I organize classroom activities in which learners **classify** the observed geographical features.	5, 6	42, 3	40, 9	11, 2
49. I encourage learners to use any means to **communicate** learned information, i.e. to draw maps, charts, symbols, graphs and diagrams to **communicate** the information.	4, 2	29, 6	29, 6	36, 6
50. I link the work in geography on **diagrams** to the everyday life of the learners, i.e. getting learners to bring examples from newspapers and magazines for discussion in class.	2, 8	35,2	31. 0	31. 0
51. I organize activities in which my learners **compare** objects using standardize units of measure and suitable measuring instruments.	21, 1	38, 0	31, 0	9, 9
52. I organize my learners to **observe** geographical phenomena such as the maximum and minimum air temperatures, wind direction and speed, atmospheric pressure, relative humidity, amount and type of rainfall.	14, 0	26, 8	32. 4	26. 8
53. I encourage my learners to **predict** future geographical events based upon their observations.	12, 7	29, 6	35, 2	22, 5
54. I encourage learners to use various forms of data to determine the **correctness of geographical theory**.	9, 9	39, 4	32, 4	18, 3
59. I encourage learners to **describe** a geographical feature's position in relation to other geographical features.	7, 0	43, 7	39, 4	9, 9
60. I give my learners many opportunities to **observe** geographical important problems.	9, 9	35, 2	38. 0	16. 9
61. I encourage learners to use any means to **communicate** investigated information.	11, 3	31, 0	39, 4	18, 3
62. I link the work in geography on **graphs** to the everyday life of the learners, i.e. getting learners to bring examples from newspapers and magazines for discussion in class.	5, 6	38, 1	32, 4	23, 9
63. I organize activities in which my learners arrange geographical features in logical **order** according to their structures.	18, 3	38, 0	35, 2	8, 5

Teacher responses to items 47 to 63 of the questionnaire enabled the researcher to apply *the*

Means Procedure to establish the extent to which teachers perceive their application of basic science process skills to the teaching of geography. Following is Table 6.10 which shows the means procedure for the application of basic science process skills according to teachers' responses.

Table 6.10 The Means Procedure for Teachers' Perception of their Application of Basic Science Process Skills

Variable	N	Mean	Standard Deviation	Minimum	Maximum
SV68V84	71	2.6	0.7	1.4	4.0

Analysis of Table 6.10 indicates that the arithmetic mean is 2,6. *As such, teachers' responses to basic science process skills' questionnaire items reveal that they perceive that they "often" apply basic science process skills to the teaching of geography. This implies that there could be a good foundation for the application of integrated science process skills in geography classrooms.*

Items 43 to 55 in Part four of the learners' questionnaire were used to establish learners' perception of their teachers' application of basic science process to the teaching of geography. Table 6.12 indicates learners' perception of teacher application of basic science process to the teaching of geography and the items start at 43 because the items are numbered the way they were numbered in the questionnaire.

Table 6.11 Geography Teacher Application of Basic Science Skills According to Learners' Responses Expressed as Percentage Scores

N = 355

Questionnaire Items on Basic Science Process Skills	Strongly Disagree	Disagree	Agree	Strongly Agree
43. My geography teacher gives us many opportunities to **identify** geographical important problems.	9, 9	17, 8	49, 0	23, 3
44. My geography teacher organizes classroom activities in which we **classify** the observed geographical features.	15, 5	30, 7	39, 4	14, 4
45. My geography teacher encourages us to use any means to communicate learned information, i.e. to draw maps, charts, symbols, graphs and diagrams to **communicate** the information.	5, 4	12, 7	39, 1	42, 8
46. My geography teacher links the work in geography on **diagrams** to our everyday life, i.e. getting us to bring examples from newspapers and magazines for discussion in class.	12, 1	42, 3	29, 3	16, 3
47. My geography teacher organizes activities in which we **compare** objects using standardize units of measure and suitable measuring instruments.	12, 7	38, 3	38, 3	10, 7
48. My geography teacher organizes us to **observe** geographical phenomena such as the maximum and minimum air temperatures, wind direction and speed, atmospheric pressure, relative humidity, amount and type of rainfall.	10, 7	22, 8	40, 3	26, 2
49. My geography teacher encourages us to **predict** future geographical events based upon our observations.	11, 6	36, 6	41, 4	10, 4
50. My geography teacher encourages us to use various forms of data to determine the **correctness of geographical theory**.	7, 9	27, 9	47, 3	16, 9
51. My geography teacher encourages us to **describe** a geographical feature's position in relation to other geographical features.	8, 5	25, 6	49, 9	16, 0
52. My geography teacher gives us many opportunities to **observe** geographical important problems.	5, 9	25, 9	52, 1	16, 1
53. My geography teacher encourages us to use any means to **communicate** investigated information.	7, 9	32, 4	46, 5	13, 2
54. My geography teacher links the work in geography on **graphs** to our everyday life, i.e. getting us to bring examples from newspapers and magazines for discussion in class.	12, 7	43, 1	31, 0	13, 2
55. My geography teacher organizes activities in which we arrange geographical features in logical **order** according to their structures.	9, 9	40, 9	41, 7	7, 5

Learners' responses to items 43 to 55 also enabled the researcher to apply *The Means Procedure* to establish the extent to which they perceive their teachers' application of basic science process skills to the teaching of geography Table 6.12 indicates the means procedure for the application of basic science skills according to learners' responses.

Table 6.12 The Means Procedure for Teacher Application of Basic Science Process Skills According to Learners' Responses

Variable	N	Mean	Standard Deviation	Minimum	Maximum
SV59V71	355	2.7	0.5	1.0	4.0

Table 6.12 reveals that the arithmetic mean is 2.7. *This mean implies that learners "agree" that teachers apply basic science process skills to the teaching of geography.* Basic science process skills form the foundation for integrated science process skills. The following section presents data analysis on the perceived application of integrated science process skills to the teaching of geography.

6.2.3.3 Integrated Science Process Skills

Items 56 to 58 and 63 to 68 in Part Four of the learners' questionnaire, and items 64 to 72 of teachers' questionnaires were designed to establish teacher and learner perceptions of the application of integrated science process skills to the teaching of geography. Table 6.13 indicates teachers' perception of their application of integrated science process skills to the teaching of geography.

Table 6.13 Geography Teachers' Perception of their Application of Integrated Science Skills Expressed as Percentage Scores

N = 71

Questionnaire Items on Integrated Science Process Skills	Never	Sometimes	Often	Always
64. I encourage learners to **identify variables** that affect geographical phenomena, e.g. how variables such as air temperature, air pressure, humidity, and cloud cover influence the occurrence of rainfall.	2, 8	25, 4	45, 0	26. 8
65. I devise exercises in which my learners have to **construct tables of data.**	22, 5	46, 5	22, 5	8, 5
66. I devise exercises in which learners have to **construct graphs**.	12, 7	59, 1	19, 7	8, 5
67. I devise exercises in which my learners **conduct investigations**.	14, 1	54, 9	23. 9	7. 1
68. I devise exercises in which my learners **identify the variables** understudy.	19, 7	42, 3	28, 0	10. 0
69. I give my learners geographical problems in which they are encouraged to **construct hypotheses**.	19, 7	43, 7	29, 6	7. 0
70. I give exercises in which my learners **define** geographical features by using observable characteristics of the features.	16, 9	25,4	45, 0	12. 7
71. I give my learners hypotheses and request them to **design investigations** to test the given hypotheses.	25, 4	42, 2	25, 4	7. 0
72. I devise exercises in which learners have to **describe the relationship between variables** on a graph.	14, 0	46, 5	31. 1	8. 5

Teacher responses to items 64 to 72 of the questionnaire enabled the researcher to apply *the Means Procedure* to establish the extent to which they perceived their application of integrated science process skills to the teaching of geography. Following is Table 6.14 which shows the means procedure for the application of integrated science process skills.

Table 6.14 The Means Procedure for the Application of Integrated Science Process Skills According to Teacher Responses

Variable	N	Mean	Standard Deviation	Minimum	Maximum
SV85V93	71	2.3	0.7	1.1	4.0

Data in Table 6.14 indicate that the arithmetic mean is 2,3. *This mean implies that teachers perceive that they sometimes apply integrated science process skills to the teaching of geography.*

Items 56 to 68 in Part four of the learners' questionnaire were to establish learners' perception of their teachers' application of integrated science process skills to the teaching of geography. Following is Table 6.15 which indicates learners' perception.

Table 6.15 Geography Teacher Application of Integrated Science Skills According Learners' Responses Expressed as Percentage Scores

N = 355

Questionnaire Items on Integrated Science Process Skills	Never	Sometimes	Often	Always
56. My geography teacher encourages us to **identify variables** that affect geographical phenomena, e.g. how variables such as air temperature, air pressure, humidity, and cloud cover influence the occurrence of rainfall.	7, 0	18, 0	50,2	24, 8
57. My geography teacher devises exercises in which we have to **construct tables of data**.	14, 1	30, 1	41, 7	14, 1
58. My geography teacher devises exercises in which we have to **construct graphs**.	9, 6	34, 1	44, 2	12, 1
63. My geography teacher devises exercises in which we **conduct investigations**.	9, 9	38, 5	46, 8	4, 8
64. My geography teacher devises exercises in which we **identify the variables** understudy.	8, 4	31,0	52, 7	7, 9
65. My geography teacher gives geographical problems in which we are encouraged to **construct hypotheses**.	13, 5	31, 6	45, 4	9, 6
66. My geography teacher gives us exercises in which we are encouraged to **define** geographical features by using observable characteristics of the features.	11, 3	24, 8	47, 6	16, 3
67. My geography teacher gives us hypotheses and request us to **design investigations** to test the given hypotheses.	13, 5	49,9	29, 9	6, 7
68. My geography teacher devises exercises in which we have to **describe the relationship between variables** on a graph.	7, 6	37, 8	42, 2	12, 4

The Means Procedure derived from learners' responses could also be used to establish the degree to which learners perceived their teachers' application of integrated science process skills to the teaching of geography. Table 6.16 shows the means procedure for the application of integrated science process skills.

Table 6.16 The Means Procedure for Teacher Application of Integrated Science Process Skills according to Learners' Responses

Variable	N	Mean	Standard Deviation	Minimum	Maximum
SV72V84	355	2.6	0.5	1.1	4.0

A review of Table 6.16 indicates that the arithmetic mean is 2,6. *This implies that learners "agree" that their teachers apply integrated science process skills to the teaching of geography*

The results of descriptive statistics in Tables 6.10 and 6.12 indicate that geography teachers and learners are in agreement with regard to the application of basic science process skills to the teaching of geography. The results in these tables reveal that teachers and learners perceive that basic science process skills are applied to the teaching of geography.

Further examinations of the results of descriptive statistics divulge interesting information regarding the application of integrated science process skill to the teaching of geography. *Table 6.14 show that teachers are of the opinion that they "sometimes" apply integrated science process skills to the teaching of geography whilst Table 6.16 that learners "agree" that their teachers apply integrated science process skills to the teaching of geography.*

The differences of teacher and learner perceptions of the application of integrated science process skills to the teaching of geography could be attributed to the respondents' misunderstanding of questionnaires' items. This assertion is confirmed by the researcher's experience who had to explain during interviews to both teachers and learners the meaning of science process skills (cf. 6.4.2.5 and 6.4.2.6). The following paragraphs present inferential

statistics results.

6.3 INFERENTIAL STATISTICS

This section deals with inferences made from the sample of this study to the geography teacher and learner population in the Free State province. The results of the one-way ANOVAs were computed to determine if there were statistically significant differences among the sampled members of the twelve education districts.

The education districts were combined into three districts as individual districts had few respondents. Districts 1, 2, 3 and 4 were combined to form *Education District 1*; districts 5, 6, 7 and 8 were combined to form *Education District 2*; and districts 9,10,11 and 12 were combined to form *Education District 3*.

6.3.1 Sample Mean Differences

ANOVAs were conducted to determine if there were any mean differences among the sampled members of the education districts. Three ANOVAs were computed on the three factors, namely, *inquiry teaching methods*, *basic science process skills* and *integrated science process skills*. The researcher, maintained an overall significance level of 0,05 and set the excedance probability at 0.05 ÷ 3. The probability level was 0.0167.

6.3.1.1 One-way ANOVA for Inquiry Teaching Methods

☐ *Teacher Responses*

A series of one-way ANOVAs were conducted on teachers' responses and statistically significant differences were found among *Gender, Teachers with(out) Matriculation Geography, Grade and Location of the school* as independent variables with respect to *inquiry teaching methods* as a dependent variable. The mean statistics for each group of combined education districts were: 1 = 2.72, 2 = 72 and 2.72 and 3 = 2.73 (The names of the combined education districts are deliberately withheld in compliance with the terms of agreement on confidentiality). The F ratio using $p < 0{,}0167$ was 0.0396

The *F-value* for *gender* was 6.12 and Pr > F was 0.158. This indicates that a significant difference exists between males and female teachers with respect to their perceived inquiry methods they apply to the teaching of geography. A comparison of the means of male and female teachers indicates that male teachers (mean = 2.82) perceive that they apply inquiry methods to the teaching of geography more than female teachers (mean = 2.60).

The *F-value* for *teachers with or without matriculation geography* was 3.48 and Pr > F was 0.0663. This indicates that a significant difference exists between *teachers with or without matriculation geography* with respect to their perceived inquiry methods they apply to the teaching of geography. A further review of the ANOVA reveal that teachers who took geography as a subject to matric perceive that they have a higher application of inquiry methods to the teaching of geography (mean = 2.78) than those teachers who did not take

geography as a subject to matric (mean = 2.60).

The *F-value* for *Grade* was 2.35 and Pr > F was 0.0807. This indicates that a significant difference exists between *teachers who teach different Grades* with respect to their perceived inquiry methods they apply to the teaching of geography. A comparison of the means of Grades 9, 10, 11 and 12 teachers indicates that Grade 10 teachers (mean = 2.94) perceive that they apply inquiry methods to the teaching of geography more than other teachers. Grade 10 teachers are followed by Grade 12 teachers (mean = 2.75), Grade 9 teachers (mean = 2.57 and lastly, by Grade 11 teachers (mean = 2.50).

The *F-value* for *the Location of the school* was 0.96 and Pr > F was 0.3312. This indicates that a significant difference exists between *teachers who teach at rural schools and those who teach at urban schools* with respect to their perceived inquiry methods they apply to the teaching of geography. Quite interestingly, teachers in urban schools (mean 2.80) show a higher perception of their application of inquiry methods than teachers in rural schools (mean = 2.50).

☐ *Learner Responses*

A series of one-way ANOVAs were conducted on learners' responses and statistically significant differences were found among *Gender, Grade and Type of the school* as independent variables with respect to *inquiry teaching methods* as a dependent variable. The mean statistics for each group of combined education districts were: 1 = 2.60; 2 = 2.60 and 3= 2.60 (The names of the combined education districts are also deliberately with held in

compliance with the terms of agreement on confidentiality). The F ratio using $p < 0,0167$ was 0,1127.

The *F-value* for *gender* was 1.19 and Pr > F was 0.2768. This indicates that a significant difference exists between males and female learners. An analysis of the means reveals that female learners have a higher score of perception (mean = 2.61) of their teachers' application of inquiry methods to the teaching of geography than male learners (mean = 2.58).

The *F-value* for *Grade* was 9.26 and Pr > F was 0.001. This indicates that a significant difference exists between learners of different Grades. Further examination of the results, divulges interesting information according to Grades regarding the application of inquiry methods to the teaching of geography. Although it is important to note that learners in all Grades agree (all means are 2.5 or above) that their teachers apply inquiry methods, Grade 11 learners indicate a higher score of perception (mean = 2.82) followed by Grade 9 learners (mean = 2.64); Grade 12 (mean = 2.59); Grade 10 learners (mean = 2.57) and lastly, Grade 8 learners (mean = 2.50).

The *F-value* for *Type of the school* was 3.52 and Pr > F was 0.0613. This indicates that a significant difference exists between learners at public schools and independent schools. A further review of the results show that learners at independent schools have a higher score (mean = 2.65) on their teachers' application of inquiry methods to the teaching of geography than learners at public schools (mean = 2.58).

6.3.1.2 One-way ANOVA for Basic Science Process Skills

☐ *Teacher Responses*

A series of one-way ANOVAs were conducted on teachers' responses and statistically significant differences were found among *Gender, Teachers with(out) Matriculation Geography, Grade and Location of the school* as independent variables with respect to *Basic Science Process Skills* as a dependent variable. The mean statistics for each group of combined education districts were: 1 = 2.65; 2 = 2.68 and 3 = 2.65. The F ratio using $p < 0,0167$ was 0,0221.

The *F-value* for *gender* was 5.46 and Pr > F was 0.0224. This indicates that a significant difference exists between males and female teachers with respect to their perceived basic science process skills they apply to the teaching of geography. A comparison of the means of male and female teachers indicates that male teachers (mean = 2.82) have a higher perception of their application of basic science process skills to the teaching of geography than female teachers (mean = 2. 46).

The *F-value* for *teachers with or without matriculation geography* was 8.98 and Pr > F was 0.0038. This indicates that a significant difference exists between *teachers with or without matriculation geography* with respect to their perceived basic science process skills they apply to the teaching of geography. Further analysis shows that teachers who took geography as a school subject to matric (mean = 2.80) perceive that they apply basic science process skills to the teaching of geography more than teachers without matriculation geography (mean = 2.31).

The *F-value* for *Grade* was 2.90 and Pr > F was 0.0414. This indicates that a significant difference exists between *teachers who teach different Grades* with respect to their perceived basic science process skills they apply to the teaching of geography. It is also interesting to note that Grade 10 teachers (mean = 2.89) perceive that they apply basic science process skills to the teaching of geography more than teachers who teach other Grades. The means for other teachers are as follows: Grade 12 (mean = 2.77), Grade 11 (mean = 2.29) and Grade 9 (mean = 2.23).

The *F-value* for *the Location of the school* was 4.38 and Pr > F was 0.0400. This indicates that a significant difference exists between *teachers who teach at rural schools and those who teach at urban schools* with respect to their perceived basic science process skills they apply to the teaching of geography. Further analysis reveals that teachers in urban schools (mean = 2.80) have a higher perception of their application of basic science process skills to the teaching of geography than teachers in rural schools (mean 2 = 2.48).

☐ *Learner Responses*

A series of one-way ANOVAs were conducted on learners' responses and statistically significant differences were found among *Gender, Grade and Type of the school* as independent variables with respect to *Basic Science Process Skills* as a dependent variable. The mean statistics for each group of combined education districts were: 1 = 2.70; 2 = 2.70 and 3 = 2.70. The F ratio using p < 0,0167 was 0,0258.

The *F-value* for *gender* was 1.22 and Pr > F was 0.2705. This indicates that a significant

difference exists between males and female learners. The results of the analyses indicate that female learners have a higher perception score (mean = 2.69) on their teachers' application of basic science process skills to the teaching of geography than male learners (mean = 2.62).

The *F-value* for *Grade* was 9.27 and Pr > F was 0.001. This indicates that a significant difference exists between learners of different Grades. Further examination of the results, divulge interesting information regarding learners in different Grades with respect to their teachers' application of basic science process skills to the teaching of geography. Grade 11 learners have a higher perception score (2.97), followed by Grade 9 learners (2.70), Grade 12 learners (2.64), Grade 10 learners (2.58) and Grade 8 learners (2.56).

The *F-value* for *Type of the school* was 3.14and Pr > F was 0.0770. This indicates that a significant difference exists between learners at public schools and independent schools. Learners in independent schools have a higher perception score (2.74) than learners in public schools (2.64) with respect to their teachers' application of basic science process skills to the teaching of geography.

6.3.1.3 One-way ANOVA for Integrated Science Process Skills

□ *Teacher Responses*

A series of one-way ANOVAs were conducted on teachers' responses and statistically significant differences were found among *Gender, Teachers with (out) Matriculation Geography, Grade and Location of the school* as independent variables with respect to

Integrated Science Process Skills as a dependent variable. The mean statistics for each group of combined education districts were: 1 = 2.35; 2 = 2.35 and 3 = 2.38. The F ratio using $p < 0,0167$ was 0,0743.

The *F-value* for *gender* was 5.95 and Pr > F was 0.0173. This indicates that a significant difference exists between males and female teachers with respect to their perceived integrated science process skills they apply to the teaching of geography. The results of the ANOVA reveal that male teachers (mean = 2.53) perceive that they apply integrated science process skills to the teaching of geography more than female teachers (mean = 2.15).

The *F-value* for *teachers with or without matriculation geography* was 6.12 and Pr > F was 0.0158. This indicates that a significant difference exists between *teachers with or without matriculation geography* with respect to their perceived integrated science process skills they apply to the teaching of geography. Teachers who took geography as a school subject to matric (mean = 2.48) perceive that they apply integrated science process skills to the teaching of geography more than those teachers who did not study geography to matric (mean = 2.07).

The *F-value* for *Grade* was 2.35 and Pr > F was 0.0807. This indicates that a significant difference exists between *teachers who teach different Grades* with respect to their perceived integrated science process skills they apply to the teaching of geography. Further examination of the results indicates that Grade 10 teachers (mean = 2.62) perceive that they apply integrated science process skills to the teaching of geography more than other teachers. The mean for Grade 12 teachers, is 2.41; for Grade 11 teachers, the mean is 2.26 whilst for Grade 9 teachers the mean is 1.99.

The *F-value* for *the Location of the school* was 0.73 and Pr > F was 0.3943. This indicates that *a* significant difference exists between *teachers who teach at rural schools and those who teach at urban schools* with respect to their perceived integrated science process skills they apply to the teaching of geography. Furthermore, the results indicate that teachers in urban schools (mean = 2.41) perceive that they apply integrated science process skills more than teachers in rural schools (mean = 2.28).

□ *Learner Responses*

A series of one-way ANOVAs were conducted on learners' responses and statistically significant differences were found among *Gender, Grade and Type of the school* as independent variables with respect to *Integrated Science Process Skills* as a dependent variable. The mean statistics for each group of combined education districts were: 1 = 2.58; 2 = 2.58 and 3 = 2.58. The F ratio using $p < 0,0167$ was 0,1982.

The *F-value* for *gender* was 2.68 and Pr > F was 0.1024. This indicates that a significant statistical difference exists between males and female learners. The results of the analyses indicate that female learners have a higher perception score (mean = 2.61) than male learners (mean = 2.51) with regard to their teachers' application of integrated science process skills to the teaching of geography.

The *F-value* for *Grade* was 5.41 and Pr > F was 0.0003. This indicates that a significant statistical difference exists between learners of different Grades. Further review of the results, reveal that Grade 9 learners have a higher perception score (2.73) than learners at other

Grades with respect to their teachers' application of integrated science process skills to the teaching of geography. Means for learners at other Grades are as follows: Grade 11 = 2.64; Grade 10 = 2.57; Grade 8 = 2.48 and Grade 12 = 2.33.

The *F-value* for *Type of the school* was 0.47and Pr > F was 0.4918. This indicates that a significant statistical difference exists between learners at public schools and learners at independent schools. Further examination of the results divulges interesting information regarding learners at independent and learners at public schools with regard to their teachers' application of integrated science process skills to the teaching of geography. Learners at public secondary school have a higher perception score (2.59) than learners at independent schools (mean = 2.55). The following paragraphs present data gathered through interviews.

6.4 INTERVIEWS

As indicated earlier, (cf. 5.2) the interviews allowed the researcher to explore problems geography teachers and learners experienced when they were engaged in inquiry teaching and inquiry learning respectively. Interviews also allowed the researcher to establish problems geography teachers and learners experienced when science process skills were applied to the teaching of geography. Furthermore, interviews revealed possible solutions to the identified problems.

6.4.1 Interview Data Analyses

The researcher reviewed the entire set of interviews once initially. Then, the researcher

reviewed the data again and induced categories of responses for each research question. Finally, interpretative summaries for each question were noted. The researcher validated the interpretations, inferences and categories by discussing the analyses with five colleagues. Following are the results of the interview.

6.4.2 Interview Results

This section presents the results and conclusions about the interviews. The results are likely to serve as valuable guides to further study in other areas of research such as inquiry learning and learner application of science process skills to the learning of geography.

6.4.2.1 Difficulties Geography Teachers Experience When Developing Inquiry Teaching

The following questions were asked to elicit information on problems teachers experience when they develop inquiry teaching (**objective 2**).

Teacher Question: *What difficulties do you experience when developing inquiry teaching?*

Learner Question: *What problems does your geography teacher experience when (s)he develops inquiry teaching?*

Eight teachers and three groups of learners who were interviewed responded that there was a lack of learner involvement as small numbers of learners were willing to participate in inquiry. It was mentioned that learners who attempted to participate were scorned by their peers if their ideas or questions were irrelevant to the problems or issues under investigation. Hence.

learners were discouraged from participating in discussions.

One teacher mentioned that *"very few students participate in inquiry tasks. They do not want to speak in class because other students laugh at them if the make language mistakes."*

According to one group of learners *"Some learners laugh at us if we make mistakes."*

This implies that learners' command of English as a medium of instruction was inadequate and as a result, they were not willing to speak in class because their peers laughed at their English.

It was further indicated by thirteen teachers that learners lacked independent thinking as they were used to teacher domination in the classroom. This problem was also aggravated by a shortage of library facilities. Furthermore, learners did not read widely as some of the schools did not have functioning libraries. It was difficult to develop inquiry teaching if learners were not exposed to a wide variety of reading material. Hence, learners could not be frequently engaged in individual or group inquiry as there were no learning materials.

This is further illustrated by a teacher who stated the following:

"They are lazy to think, they do not exercise their thinking skills. They always want me to do everything for them"

Another teacher says, *"I cannot engage my students in inquiry because our library does not have any other geography textbook except the textbook we use."*

Two teachers indicated that Grade 12 geography syllabus was too lengthy to finish on schedule and teachers resorted to survival teaching methods which enabled them to finish the syllabus as quickly as possible. For instance, according to one teacher, *"it is difficult to use inquiry teaching methods because Grade 12 syllabus is very long. I teach in such a way that I finish it as quickly as possible."*

6.4.2.2 Suggested Solutions to Difficulties Geography Teachers' Experience When Developing Inquiry Teaching

The following question was formulated to examine how the problems identified above could be alleviated (**objective 4**).

Teacher and Learner Question: *How can one solve these difficulties?*

Four teachers and five groups of learners interviewed indicated that teachers should involve learners by giving them individual or group tasks which encourage inquiry learning. At the end of each task, all learners should be requested to present reports on the investigated issue or problem. Teachers should encourage learners to present their reports orally as well as in writing. Teachers noted that this process was likely to improve learners' communication skills.

Three groups of learners also suggested that teachers should discourage learners from scorning their peers when they give ideas or ask questions that are irrelevant. Teachers should also help learners who ask senseless questions or give irrelevant ideas by prompting them to formulate questions correctly. They should point out to the learners what is wrong with

their questions. Hence, this could help learners to formulate questions or ideas properly.

Eleven teachers were of the opinion that because outcomes-based education requires teachers to be creative and design learning materials, it could alleviate the problem of the shortage of learning materials at their schools if it is implemented properly. Teacher invention of learning materials could also alleviate the lack of these in the library. However, the teachers also indicated that they were not trained in OBE, hence once they were equipped with OBE's teaching skills they might be able to design and create learning materials for their learners.

6.4.2.3 Difficulties Learners Experience When They are Involved in Inquiry Learning

The following questions were formulated to establish difficulties that learners experienced when they were involved in inquiry learning (**objective 3**).

Teacher Question: *What difficulties do your learners experience when they are involved in inquiring learning?*

Learner Question: *What problems do you experience when you are involved in inquiry learning?*

Six groups of learners indicated that they found it difficult to generate their own questions. One group said, *"We cannot ask our own questions. We wait for the teacher to ask us questions or to teach us. The teacher always tells us what to do in class."*. They mentioned that this was intensified by the fact that the resources, content and problems were still selected

by their geography teachers. Learners were expected to use these to interpret and evaluate an issue or a problem because they failed to understand the processes and techniques involved in geographical inquiry.

Furthermore, seven teachers and one group of learners indicated that most learners were unable to identify an issue or a problem that they might use to generate questions that would guide their inquiry individually or in groups. Learners also indicated that their teachers failed to provide them with guidance about the methods and sequence of inquiry which made it difficult to collect and analyse data related to a problem on their own. For instance, a group of learners mentioned that, *"the teacher gives us a project and expects us to do it without his guidance. If we ask him a question he says "I do not know, go and look for the information on your own. Do you want me to do the project for you?"*

Four groups of learners further indicated that their teachers did not indicate to them suitable sources of information which they might use when involved in inquiry learning. Hence learners sometimes collected and analysed inaccurate data which did not relate to the investigated issue or problem.

Five teachers indicated that some learners failed to select appropriate methods for presenting, analysing and interpreting the data they have gathered. Hence they lacked the ability to give logical reasoned solutions and to justify their recommendations.

6.4.2.4 Suggested Solutions to Difficulties Learners Experience When They are Involved in Inquiry Learning

The following question was formulated to examine how the problems identified above could be alleviated (**objective 5**).

Teacher and Learner Question: *How can one solve these problems?*

Four groups of learners indicated that their geography teachers should teach them how to think. They argued that the teacher as a provider of structured learning experience should plan learning activities that stimulate their curiosity and make them ask questions.

Furthermore, ten teachers indicated that they should always ask learners to give reasons why certain geographical phenomena do or do not happen, i.e. ask probing questions. Two teachers further indicated that they should ask learners to construct ways of finding out answers to the questions. They assumed that these processes were likely to stimulate and motivate their learners.

Three teachers also indicated that they would encourage their learners to identify and state problems. A teacher even suggested one question which may invoke inquiry in their learners. He argued that inquiry might be developed by asking learners the following question:

- *What could be the cause of the problem*?

Three teachers felt that they should encourage learners to investigate the problem under their guidance and also suggested that learners should be assisted to finding suitable data from sources in and out of school. Teachers and learners should discuss methods of analysis and interpretation of data hand in hand. Learners should also be encouraged to present their findings and to speculate about the reasons for their findings.

If the solutions given above are implemented, it could promote the use of science process skills to the teaching of geography. Learners are likely to be engaged in activities that improve knowledge and understanding of the environment through research.

The following section analyses responses to questions that attempted to establish problems and solutions associated with science process skills applied to the teaching of geography.

6.4.2.5 Problems That Learners Experience When Science Process Skills are Applied to the Teaching of Geography

The following question was formulated to examine problems that learners experienced when science process skills are applied to the teaching of geography (**objective 7**).

Learner Question: *What problems do you experience when science process skills are applied to the teaching of geography?*

All groups of learners (100%) interviewed, indicated that they did not know the meaning of the term science process skills. The researcher explained to them that science process skills were

activities that geographers do when they investigated a problem, an issue or a phenomenon. Examples of basic science process skills such as *observing, communicating, measuring, prediction and inferring* were listed as well as examples of integrated science process skills such as *experimenting, designing investigations, conducting investigations and identifying variables.*

Learners indicated that difficulties were found in mapwork activities. Three groups of learners indicated that mapwork activities were not taught in their schools at all. These learners indicated that it seemed as if their teachers were not comfortable with this section of the syllabus. Those learners whose teachers taught this section of the syllabus, indicated that they found it difficult to measure and calculate distances between points on the map. They mentioned that it was difficult to measure the distance with a ruler in centimetres or millimetres and convert the measurement to metres or kilometres.

All groups of learners indicated that they were taught abstract concepts which were difficult to understand. Concepts such as atmospheric pressure, temperature, humidity and atmospheric air circulation, and they have never handled equipment which is used to observe these meteorological elements which are essential in weather forecasting . Instruments such as a wet and dry bulb thermometer, wind vanes, anemometer and a rain gauge are used to make surface observations of these elements. Hence they felt that this problem did not expose them to the process skills of making quantitative observations, recording data and interpreting data.

Four groups of learners indicated that their teachers had never demonstrated simple geographical experiments in their lessons. Hence integrated science process skills such as

experimenting, formulating hypotheses, identifying variables, defining variables operationally, designing investigations, analysing investigations and describing relationships between variables were not easily developed in their geography classrooms.

Learners also indicated that they were unable to observe phenomena and interpret what they have observed. They reported that making sense (*inferring*) of what they have observed was not easy because they were taught to reproduce facts rather than to show insight and understanding in their answers. They also indicated that they found it difficult to make accurate *predictions* or to give reasoned statements based on what they have observed.

6.4.2.6 Suggested Solutions to Problems That Learners Experience When Science Process Skills are Applied to The Teaching of Geography

The following question was formulated to examine how the problems identified above could be alleviated (**objective 8**).

Learner Question: *How can one solve these problems?*

All groups of learners suggested that geography learning facilitators (subject advisors) or geography teachers from other schools should be incorporated in assisting them. Three groups suggested that learning facilitators should organize and conduct mapwork workshops annually, especially at the beginning of the year. These groups also suggested that geography learning facilitators should also visit schools under their guidance and present mapwork lessons a few weeks before final examination commence.

Seven groups of learners further suggested that Free State Department of Education should supply every secondary school which offered geography with meteorological instruments such as a barometer, a wet and dry bulb thermometer, a hygrometer, the Stephenson screen, a thermometer, a wind vane and a rain gauge. They believed that this equipment would enable them to participate in the recording of the information obtained from the instruments and observations which could enable them to apply science process skills to the learning of geography.

6.4.2.7 Problems That Teachers Experience When Applying Science Process Skills to The Teaching of Geography

The following question was formulated to examine difficulties that teachers experienced when they applied science process skills to the teaching of geography (**objective 9**).

Teacher Question: *What problems do you experience when you apply science process skills to the teaching of geography?*

Eighteen teachers indicated that they did not know the meaning of the term science process skills. The researcher explained what science process skills were and listed examples as indicated in section 6.4.2.5. All twenty teachers indicated that they did not specifically teach science process skills as a theme or topic in their lessons. They further indicated that most of the basic sciences process skills are developed when they teach other themes or topics of the syllabus.

Furthermore, they added that the skills were not examined in Grade 12 examinations and were regarded as a waste of time to teach because the geography syllabus was very long. They were expected to finish it by the end of June each year. Eight teachers also noted that examination questions sometimes did not test higher-order thinking skills of the learners.

Nineteen teachers also indicated that they would like to conduct some geographical experiments in their classrooms but they did not have the facilities and equipment to do so. They argued that experiments were likely to bring reality into the classroom which could enable learners to understand abstract concepts such as the water cycle, porosity, permeability, air pressure, evaporation, water vapour, convection currents, weathering, erosion and so on.

6.4.2.8 Suggested Solutions to Problems That Teachers Experience When Applying Science Process Skills to The Teaching of Geography

The following question was formulated to examine how the problems teachers experience when they applied science process skills to the teaching of geography could be alleviated (**objective 10**).

Teacher Question: *How can one solve these problems?*

Teachers answered this question, by suggesting some of the solutions given by their learners in section 6.4.2.6. Seven teachers further indicated that they would consider devoting much time to the teaching of the process skills of science if Grade 12 geography examiners could also include questions on the scientific method. They indicated that the scientific method

formed part of the syllabus but it was never examined, which influenced them to ignore this section of the syllabus. They indicated that they concentrated on sections which were important for the examination purposes. For instance, one teacher said, *"if science process are included in the exam then I will be forced to teach them."* He further went on, "*The syllabus has a section on the scientific method but examiners ignore this section."*

Five teachers also indicated that to compensate for time they might spend teaching the scientific method, other parts of the syllabus would have to be removed or the contents should be reduced. In short the syllabus was too extensive and it needed to be revised and reduced. One teacher indicated that the emphasis of the syllabus should also be shifted away from the content and concentrate on teaching skills which were useful in the modern economy.

It is interesting to note that all teachers were of the opinion that it was the duty of the Free State Department of Education to provide schools with facilities and equipment which would enable them to design and conduct experiments. One teacher sensed he was not trained to be creative, hence it was difficult for him to introduce programs that would make it possible for him to teach abstract geographical concepts effectively. Four teachers suggested that Free State Department of Education should organise workshops or short courses in which teachers would be trained to teach science process skills. Furthermore, these teachers also suggested that the Free State Department of Education should encourage them to improve their qualifications by linking teacher qualifications with salaries. They claimed that they were not keen on furthering their studies because a once-off merit payment is effected by the department when they have improved their qualifications.

6.5 CONCLUSION

This chapter presented teacher and learner perceptions of the application of science process skills to the teaching of geography. Finally, a synthesis of the views expressed by teachers and learners during interviews was furnished. Chapter seven elaborates on the findings stated in Chapter six by way of discussion, conclusion and recommendations.