# CHAPTER FOUR

# STUDY RESULTS

## 4.1 INTRODUCTION

This chapter presents the quantitative and qualitative results of the study. The quantitative results are presented first, because the qualitative data were used to augment the initial (quantitative) results.

## 4.2 QUANTITATIVE RESULTS

The quantitative part of the study focused on the first two research questions (section 1.5). In an attempt to answer the research questions, four hypotheses were tested to determine the significance of performance differences between the experimental and control groups, and the interactive influences of gender and cognitive preferences, if any, on the attainment of the following learning outcomes:

1. Genetics content knowledge (GCKT)
2. Science inquiry skills (TOSIS)
3. Decision-making ability (DMAT)
4. Problem-solving ability (PSAT)
5. Attitude towards the study of life sciences (LSAQ)

(The abbreviations in brackets are the codes that were used to represent the tests used to assess learner performance).

### 4.2.1 Comparison of learner performance in genetics, science inquiry skills, decision-making, problem-solving abilities and attitude towards the study of life sciences

**Research question 1**

*How would learners exposed to a context-based teaching approach differ from those exposed to traditional teaching approaches with respect to the attainment of genetics content knowledge, science inquiry skills, decision-making ability, problem-solving ability, and their attitude towards the study of life sciences?*

## Null hypothesis 1

*Ho 1 There is no significant difference between learners exposed to a context-based teaching approach and those exposed to traditional teaching approaches in the attainment of genetics content knowledge, science inquiry skills, decision-making ability, and problem-solving ability and their attitude towards the study of life sciences.*

The results for testing this hypothesis are organised by first presenting a summary of the pre-test and post-test statistics for all the learning outcomes (descriptive statistics: mean scores ($\bar{x}$) and standard deviations (SD), and inferential statistics: F values and *p*- values). Second, the results of the analysis of variance (ANOVA) of pre-test mean scores, which compare learner performances prior to the intervention, are given. This is followed by the results of an analysis of covariance (ANCOVA of post-test mean scores, which compare learner performances after the intervention.

**Table 4.1 Summary of pre-test and post-test descriptive and inferential statistics for the assessed learning outcomes (LSAS, GCKT, TOSIS, DMAT, PSAT)**

| Test | Treatment | Pre-test | | | | | Post-test | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | Mean ($\bar{x}$) | SD | F - value | *p*-value | N | Mean ($\bar{x}$) | SD | F value | *p*-value |
| **GCKT** | E | 87 | 10.21 | 5.15 | | | 85 | 26.68 | 11.14 | | |
| | C | 101 | 10.35 | 5.31 | | | 93 | 15.46 | 7.6 | | |
| | Difference | | -0.14 | | 0.03 | **0.861** | | 11.22 | 3.54 | 63.00 | **<0.0001*** |
| **TOSIS** | E | 86 | 23.95 | 11.61 | | | 80 | 28.92 | 10.74 | | |
| | C | 99 | 23.38 | 10.75 | | | 86 | 25.41 | 13.61 | | **0.0654** |
| | Difference | | 0.57 | | 0.12 | **0.7296** | | 3.51 | -2.87 | 3.44 | |
| **DMAT** | E | 87 | 58.32 | 23.62 | | | 85 | 68.3 | 18.85 | | |
| | C | 94 | 52.23 | 22.25 | | | 86 | 54.7 | 24.79 | | |
| | Difference | | 6.09 | | 3.19 | **0.0759** | | 13.6 | -5.94 | 17.22 | **<0.0001*** |
| **PSAT** | E | 88 | 29.69 | 21.31 | | | 86 | 48 | 25.8 | | |
| | C | 96 | 30.63 | 20.51 | | | 88 | 34.06 | 19.53 | | |
| | Difference | | -0.94 | | 0.09 | **0.7629** | | 13.94 | 6.27 | 16.57 | **<0.0001*** |
| **LSAQ** | E | 86 | 121.66 | 10.78 | | | 77 | 127.96 | 9.98 | | |
| | C | 99 | 122.37 | 10.49 | | | 82 | 117.16 | 17.73 | | |
| | Difference | | -0.71 | | 0.21 | **0.6504** | | 10.8 | -7.75 | 25.04 | **<0.0001*** |

KEY: * Indicates a significant treatment effect at α = 5% significance level.

| | | | |
|---|---|---|---|
| GCKT: | Genetics Content Knowledge Test | E: | Experimental group |
| TOSIS: | Test of Science Inquiry Skills | C: | Control group |
| DMAT: | Decision-Making Ability Test | SD: | Standard deviation |
| PSAT: | Problem-Solving Ability Test | | |
| LSAQ: | Life Sciences Attitude Questionnaire | | |

Table 4.1 shows that there were no significant differences between the mean scores and standard deviations (SD) of the experimental and control groups in all the learning outcomes prior to the intervention. However, after the intervention, there were significant differences between the mean scores and standard deviations of the experimental and control groups in all the learning outcomes, except in the attainment of overall science inquiry skills. Detailed pre-test and post-test results for each learning outcome are presented below.

#### *4.2.1.1 Attainment of genetics content knowledge*

*Ho 1.1* *There is no significant difference in their attainment of genetics content knowledge between learners exposed to the context-based teaching approach and those exposed to traditional teaching approaches.*

The results of testing this hypothesis showed that the pre-test mean score for the control group was 10.35 ± 5.31, and for the experimental group was 10.21 ± 5.15 (table 4.2(a)). ANOVA results (table 4.2(a)) showed no significant difference between the pre-test mean scores of the control and experimental groups (F [1,186] = 0.03 and a $p$ = 0.8610) at 5% significant level. Learners from the control and experimental groups could therefore be assumed to have had approximately the same genetics content knowledge prior to the intervention.

**Table 4.2(a) Pre-test mean scores ($\bar{x}$), standard deviations (SD) and ANOVA results for genetics content knowledge (GCKT)**

| Treatment | Pre-test | | | | |
|---|---|---|---|---|---|
| | N | Mean ($\bar{x}$) | SD | F -value | *p*-value |
| E | 87 | 10.21 | 5.15 | 0.03 | **0.861** |
| C | 101 | 10.35 | 5.31 | | |
| Difference | | -0.14 | | | |

The post-test mean scores of the control and experimental groups were 15.46 ± 7.6 and 26.68 ± 11.14 respectively (table 4.2(b)). The results of an ANCOVA to compare the post-test mean scores for the experimental and control groups are shown in table 4.2(b).

**Table 4.2(b)** **Post-test mean scores ($\bar{x}$), standard deviations and ANCOVA results for genetics content knowledge (GCKT)**

| Treatment | Post-test | | |
|---|---|---|---|
| | N | Mean ($\bar{x}$) | SD |
| Experiment | 85 | 26.68 | 11.14 |
| Control | 93 | 15.46 | 7.6 |
| Difference | | 11.22 | 3.54 |

| Source of variation | F | Sum of Squares | Mean Square | F Value | *p*-value |
|---|---|---|---|---|---|
| TREATMENT | 1 | 5579.741514 | 5579.741514 | 63.00 | <.0001 |
| GCKT_RG | 1 | 234.142064 | 234.142064 | 2.64 | 0.1058 |
| Error | 175 | 15498.182700 | 88.561040 | | |
| Corrected Total | 177 | 21258.818140 | | | |

These ANCOVA results show a significant difference at 5% significant level between the post-test mean scores of the control and experimental groups (F [1,175] = 63.00, *p* = <.0001; table 4.2(b)) in favour of the experimental group. According to these results, the experimental group performed significantly better than the control group in attaining genetics content knowledge. Therefore, the null hypothesis that there is no significant difference between learners exposed to context-based teaching approaches and those exposed to traditional teaching approaches in their attainment of genetics content knowledge was rejected.

#### *4.2.1.2 Attainment of science inquiry skills*

*Ho 1.2* *There is no significant difference between learners exposed to context-based teaching approach and those exposed to traditional teaching approaches, in their attainment of science inquiry skills.*

The analysis of learner performance on science inquiry skills was divided into two parts: overall attainment of science inquiry skills; and attainment of specific components of science inquiry skills (discussed below).

#### (i) Attainment of overall science inquiry skills

Table 4.3(a) shows the pre-test mean scores ($\bar{x}$), standard deviations (SD) and the inferential statistics for learners' attainment of overall science inquiry skills.

**Table 4.3(a) Pre-test mean scores ($\bar{x}$), standard deviations (SD) and ANOVA results for science inquiry skills (TOSIS)**

| **Treatment** | **Pre-test** | | | | |
|---|---|---|---|---|---|
| | **N** | **Mean ($\bar{x}$)** | **SD** | **F - value** | ***p*-value** |
| Experiment | 86 | 23.95 | 11.61 | 0.12 | **0.7296** |
| Control | 99 | 23.38 | 10.75 | | |
| Difference | | 0.57 | | | |

According to the results in table 4.3(a) above, the ANOVA showed no significant difference between the competence of the control and experimental groups in overall science inquiry skills prior to the intervention (F [1,183] = 0.12 and $p$ = 0.7296; table 4.3(a)). The overall science inquiry skills competence of the two groups was therefore assumed to be approximately the same before the intervention.

The post-test mean scores and standard deviations were 25.41 $\pm$ 13.61 for the control group, and 28.92 $\pm$ 10.74 for the experimental group, with a mean difference of 3.51 (table 4.3(b)). ANCOVA results for these mean scores showed no significant difference at 5% significance level (F= 3.44, $p$ = 0.0654; table 4.3(b)). This result means that the competence of the control and experimental groups in overall science inquiry skills was approximately the same after the intervention.

**Table 4.3(b) Post-test mean scores ($\bar{x}$), standard deviations and ANCOVA results for overall science inquiry skills (TOSIS)**

| **Treatment** | **Post-test** | | |
|---|---|---|---|
| | **N** | **Mean ($\bar{x}$)** | **SD** |
| Experiment | 80 | 28.92 | 10.74 |
| Control | 86 | 25.41 | 13.61 |
| Difference | | 3.51 | -2.87 |

| **Source of variation** | **DF** | **Sum of Squares** | **Mean Square** | **F Value** | ***p* - value** |
|---|---|---|---|---|---|
| TREATMENT | 1 | 511.1988710 | 511.1988710 | 3.44 | 0.0654 |
| RTOT | 1 | 627.1296884 | 627.1296884 | 4.22 | 0.0415 |
| Error | 163 | 24221.3927000 | 148.5975000 | | |
| Corrected Total | 165 | 25397.2590400 | | | |

Based on this result, the hypothesis that there is no significant difference in their attainment of science inquiry skills between learners exposed to context-based teaching approaches and those exposed to traditional teaching approaches was not rejected.

### (ii) Attainment of specific components of science inquiry skills (OT1–OT5)

A summary of the pre-test and post-test mean scores, standard deviations and inferential statistics for specific components of TOSIS is shown in table 4.4 below.

**Table 4.4 Summary of pre-test and post-test statistics for the components of the Test of Science Inquiry Skills (TOSIS; T1 to T5)**

| Category of inquiry skills | Treatment | PRE-TEST SCORES | | | | | POST-TEST SCORES | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | mean($\bar{x}$) | SD | F-value | *p*-value | N | Adjusted mean ($\bar{x}$) | SD | F-value | *p*-value |
| OT1 | E | 86 | 3.6046 | 4.5930 | 2.80 | 0.0962 | 80 | 5.8971 | 2.3639 | 33.21 | <.0001* |
| | C | 98 | 4.2857 | 2.7806 | | | 85 | 3.9085 | 2.0549 | | |
| OT2 | E | 86 | 3.61492 | 3.6149 | 0.13 | 0.7222 | 80 | 4.1317 | 3.7123 | 0.00 | 0.9866 |
| | C | 98 | 4.79591 | 4.0562 | | | 86 | 4.1216 | 3.9994 | | |
| OT3 | E | 86 | 5.6395 | 4.5242 | 1.94 | 0.1657 | 80 | 7.7157 | 6.8410 | 0.05 | 0.8273 |
| | C | 98 | 6.5816 | 4.6305 | | | 86 | 7.4736 | 7.3063 | | |
| OT4 | E | 86 | 7.3255 | 6.0729 | 4.29 | 0.0398* | 80 | 5.8380 | 4.1643 | 0.54 | 0.4642 |
| | C | 98 | 5.3061 | 7.0277 | | | 86 | 6.5459 | 7.5401 | | |
| OT5 | E | 86 | 2.7906 | 3.8043 | 0.06 | 0.8034 | 86 | 5.3860 | 4.7212 | 7.70 | 0.0062* |
| | C | 98 | 2.6530 | 3.6752 | | | 79 | 3.4244 | 4.4233 | | |

KEY: * Indicates a significant treatment effect at α = 5% significance level.

OT1: Ability to formulate hypotheses
OT2: Ability to identify variables
OT3: Ability to design experiments
OT4: Graphing skills
OT5: Ability to draw conclusions from results

SD: Standard deviation
E: Experimental group
C: Control group

The results in table 4.4 show that an ANOVA of pre-test scores for the components of TOSIS showed no significant difference between the performances of the control and experimental groups (OT1- F [1,182] = 2.80, *p*=0.096; OT2 - F [1,182] = 0.13, *p*=0.722; OT3 - F [1,182] = 1.94, *p*=0.166; and OT5 - F [1,182] = 0.06, *p*=0.803), except for graphing skills, where a significant difference was observed between the performances of the experimental and control group (OT4 - F [1,182] = 4.29, *p*=0.040; table 4.4) in favour of the experimental group.

The post-test ANCOVA results showed a significant difference in the ability to formulate hypotheses (OT1 - F [1,162] = 33.21, *p*=<0.0001; table 4.4) and to draw conclusions from results (OT5 - F[1.162] = 7.70, *p*=0.006; table 4.4) at 5% significant level, in favour of the experimental group. No significant differences were observed between the performances of the two groups for the science inquiry skills of identification of variables, experimental design, and graphing skills (OT2 - F [1,163] = 0.00, *p*=0.9866; OT3 - F [1,163] = 0.05, *p*=0.827; and OT4 - F [1,163] = 0.54, *p*=0.464; table 4.4).

#### *4.2.1.3 Attainment of decision-making ability*

*Ho 1.3 There is no significant difference in their attainment of decision-making ability between learners exposed to context-based teaching approaches and those exposed to traditional teaching approaches.*

Comparison of the pre-test mean scores of the control and experimental groups using an ANOVA showed no significant differences between the performances of the two groups on decision-making ability (F [1,179] = 3.19, *p*=0.0759; table 4.5(a)).

**Table 4.5(a) Pre-test mean scores ($\bar{x}$), standard deviations (SD) and ANOVA results for decision-making ability (DMAT)**

| **Treatment** | **Pre-test** | | | | |
|---|---|---|---|---|---|
| | **N** | **Mean ($\bar{x}$)** | **SD** | **F - value** | ***p*-value** |
| Experiment | 87 | 58.32 | 23.62 | | |
| Control | 94 | 52.23 | 22.25 | | |
| Difference | | 6.09 | | 3.19 | **0.0759** |

The ANCOVA results on learner performance in the decision-making ability test (DMAT) showed a significant difference between the performances of the control and experimental groups (F [1,168] = 17.22, *p* = <0.0001; table 4.5(b)) in favour of the experimental group. This result suggests that learners from the experimental group showed a higher decision-making ability than those from the control group after the intervention.

**Table 4.5(b) Post-test mean scores ($\bar{x}$), standard deviations and ANCOVA results for decision-making ability (DMAT)**

| Treatment | Post-test | | |
|---|---|---|---|
| | N | Mean ($\bar{x}$) | SD |
| Experiment | 85 | 68.3 | 18.85 |
| Control | 86 | 54.7 | 24.79 |
| Difference | | 13.6 | -5.94 |

| Source of variation | DF | Sum of Squares | Mean Square | F Value | *p* – value |
|---|---|---|---|---|---|
| TREATMENT | 1 | 7748.441415 | 7748.441415 | 17.22 | <.0001 |
| DMAT_RD | 1 | 6488.142102 | 6488.142102 | 14.42 | 0.0002 |
| Error | 168 | 75587.931770 | 449.92817 | | |
| Corrected Total | 170 | 92134.502920 | | | |

Therefore, the null hypothesis that there is no significant difference in their attainment of decision-making ability between learners exposed to context-based teaching approaches and those exposed to traditional teaching approaches was rejected.

### *4.2.1.4 Attainment of problem-solving-ability*

*Ho 1.4* *There is no significant difference between learners exposed to context-based teaching approaches and those exposed to traditional teaching approaches, in their attainment of problem-solving ability.*

Comparison of the pre-test mean scores of the experimental and control groups, using an ANOVA, revealed a non-significant difference between the performances of the two groups before the intervention (F [1,182] = 0.09, *p* = 0.7629; table 4.6(a)).

**Table 4.6(a) Pre-test mean scores ($\bar{x}$), standard deviations (SD) and ANOVA results for problem-solving ability (PSAT)**

| Treatment | Pre-test | | | | |
|---|---|---|---|---|---|
| | N | Mean ($\bar{x}$) | SD | F - value | *P*-value |
| Experiment | 88 | 29.69 | 21.31 | 0.09 | **0.7629** |
| Control | 96 | 30.63 | 20.51 | | |
| Difference | | -0.94 | | | |

An ANCOVA of the experimental and control post-test mean scores showed that learner performance on the problem-solving ability test (PSAT) differed significantly at 5% significant level in favour of the experimental group (F [1,171] = 16.57, *p*=<0.0001; table 4.6(b)).

**Table 4.6(b) Post-test mean scores ($\bar{x}$), standard deviations and ANCOVA results for problem-solving ability (PSAT)**

| Treatment | Post-test | | |
|---|---|---|---|
| | N | Mean ($\bar{x}$) | SD |
| Experiment | 86 | 48 | 25.8 |
| Control | 88 | 34.06 | 19.53 |
| Difference | | 13.94 | 6.27 |

| Source of variation | DF | Sum of Squares | Mean Square | F Value | *p* - value |
|---|---|---|---|---|---|
| TREATMENT | 1 | 8452.76672 | 8452.766720 | 16.57 | <.0001 |
| PSAT_RP | 1 | 2537.65115 | 2537.651151 | 4.98 | 0.0270 |
| Error | 171 | 87219.20006 | 510.05380 | | |
| Corrected Total | 173 | 98268.53448 | | | |

According to these results, learners from the experimental group showed higher problem-solving ability than those from the control group after the intervention. The null hypothesis that there is no significant difference in their attainment of problem-solving ability between learners exposed to context-based teaching approaches and those exposed to traditional teaching approaches was therefore rejected.

### *4.2.1.5 Learners' attitude towards the study of life sciences*

*Ho 1.5 There is no significant difference in their attitude towards the study of life sciences between learners exposed to context-based teaching approach and those exposed to traditional teaching approaches.*

#### (i) Overall learner attitude towards the study of life sciences

The maximum possible score (most positive attitude) for LSAQ was 150. A score of 75 (150/2) represented a neutral attitude, and the minimum possible score (most negative attitude) was 30. Thus a score of more than 75 represented a positive attitude, while a score of less than 75 represented a negative attitude (see section 3.10.1.2).

The pre-test mean scores and standard deviations ($\bar{x}\pm$ SD) of the control and experimental groups were 122.37 ± 10.49 and 121.66 ± 10.78 respectively, (table

4.7(a)). The mean scores of both groups were above the 75 score, which implies that both groups had a relatively positive attitude towards the study of life sciences before the intervention. An ANOVA of pre-test LSAQ mean scores showed no significant difference between the pre-test mean scores of the control and experimental groups (F[1,183] = 0.21 *p*=0.6504; table. 4.7a), at the 5% significance level.

**Table 4.7(a)** **Pre-test mean scores ($\bar{x}$), standard deviations (SD) and ANOVA results for attitude towards life sciences (LSAQ)**

| Treatment | Pre-test | | | | |
|---|---|---|---|---|---|
| | N | Mean ($\bar{x}$) | SD | F - value | *P*- value |
| Experiment | 86 | 121.66 | 10.78 | | |
| Control | 99 | 122.37 | 10.49 | | |
| Difference | | -0.71 | | 0.21 | **0.6504** |

The post-test mean scores and standard deviations of the control and experimental groups were (117.16 ± 17.73) and (127.96 ± 9.98) respectively (table 4.7(b)). ANCOVA results revealed a significant difference between attitudes of the two groups towards the study of life sciences (F [1,156] = 25.04, *p*=<0.0001), at 5% significant level (table 4.7(b)). The experimental group had a more positive overall attitude towards the study of life sciences than the control group.

**Table 4.7(b)** **Post-test mean scores ($\bar{x}$), standard deviations and ANCOVA results for attitude towards life sciences (LSAQ)**

| Treatment | Post-test | | |
|---|---|---|---|
| | N | Mean ($\bar{x}$) | SD |
| Experiment | 77 | 127.96 | 9.98 |
| Control | 82 | 117.16 | 17.73 |
| Difference | | 10.8 | -7.75 |

| Source of variation | DF | Sum of squares | Mean square | F Value | *p*-value |
|---|---|---|---|---|---|
| TREATMENT | 1 | 4609.062600 | 4609.062600 | 25.04 | <.0001 |
| RATOT | 1 | 4316.766395 | 4316.766395 | 23.45 | <.0001 |
| Error | 156 | 28719.442030 | 184.098990 | | |
| Corrected Total | 158 | 37145.823900 | | | |

Therefore the null hypothesis that there is no significant difference in their overall attitude towards the study of life sciences between learners exposed to the context-based teaching approach and those exposed to traditional teaching approaches was rejected.

### (ii) Learner attitude according to categories of the study of life sciences

To further explore the significance of the treatment effect on learners' attitude towards the study of life sciences, individual LSAQ items were grouped according to these attitude categories: the application of life sciences to everyday life (ATT1); life science lessons/classes (ATT2); life science-related career prospects (ATT3); genetics as a topic (ATT4), and life sciences as a school subject (ATT5).

ANOVA of the LSAQ pre-test mean scores showed no significant differences between the attitudes of the control and experimental groups for all LSAQ items, except item RA5 (I admire people who are knowledgeable in life sciences), in which the control group showed a more positive attitude than the experimental group (p= 0.037; appendix XVI).

Statistical comparisons (ANCOVA) of post-test mean scores on specific attitude statements showed significant differences between the experimental and control groups on a number of items in favour of the experimental group (table 4.8).

**Table 4.8 Comparison of post-test control and experimental mean scores ($\bar{x}$) for LSAQ items according to LSAQ categories**

| Item Code | Item statement | N | Control MEAN ($\bar{x}$) ± SD | N | Experiment MEAN ($\bar{x}$) ± SD | p-value |
|---|---|---|---|---|---|---|
| **CATEGORY (ATT 1): APPLICATION OF LIFE SCIENCES / GENETICS TO EVERY DAY LIFE** | | | | | | |
| **OA2** | Without the study of life sciences, it would be difficult to understand life. | 81 | 3.936 ± 1.065 | 77 | 3.951 ± 0.857 | 0.9225 |
| **OA6** | I like studying life sciences because of its importance in understanding the environment. | 80 | 4.046 ± 1.168 | 77 | 4.289 ± 1.049 | 0.1740 |
| **OA8** | What is taught in genetics cannot be used in everyday life. | 81 | 4.285 ± 0.746 | 77 | 4.441 ± 0.639 | 0.1623 |
| **OA17** | Ideas in genetics are not related to human needs. | 82 | 4.284 ± 0.933 | 76 | 4.312 ± 0.867 | 0.8486 |
| **OA24** | What is learnt in life sciences can be applied to our daily lives. | 80 | 4.350 ± 0.969 | 77 | 4.584 ± 0.767 | 0.0983 |
| **OA27** | Discoveries in life sciences and genetics have improved human life. | 80 | 3.899 ± 1.023 | 77 | 4.391 ± 0.566 | 0.0003* |
| **CATEGORY (ATT 2): LEARNERS' PERCEPTION OF LIFE SCIENCE/GENETICS LESSONS / CLASSES** | | | | | | |
| **OA3** | Performing practical activities in genetics helps me to understand genetics concepts and ideas better. | 80 | 4.388 ± 0.665 | 77 | 4.545 ± 0.597 | 0.1228 |
| **OA11** | There are too many concepts (ideas) to learn in genetics, as a result, I have lost interest in the topic. | 81 | 3.518 ± 1.352 | 76 | 3.881 ± 1.222 | 0.0809 |
| **OA12** | I do not bother about what we learn in genetics because I do not understand them. | 81 | 4.356 ± 0.899 | 77 | 4.587 ± 0.784 | 0.0857 |
| **OA14** | I usually feel like running out of the class during life science lessons. | 81 | 4.151 ± 1.188 | 77 | 4.512± 0.883 | 0.0304* |
| **OA18** | I do not understand genetics lessons. | 82 | 3.865 ± 1.124 | 77 | 4.391 ± 0.712 | 0.0004* |
| **OA20** | I feel quite happy when it is time for genetics lessons. | 81 | 3.727 ± 1.109 | 77 | 4.040 ± 0.857 | 0.0456* |
| **OA22** | I really enjoy the life science lessons which deal with my daily life experiences. | 80 | 4.310 ± 1.003 | 77 | 4.496 ± 0.883 | 0.2152 |

Table 4.8 Cont. Comparison of post-test control and experimental mean scores ($\bar{x}$) for LSAQ items according to LSAQ categories

| Item Code | Item statement | N | Control MEAN ($\bar{x}$) $\pm$ SD | N | Experiment MEAN ($\bar{x}$) $\pm$ SD | p-value |
|---|---|---|---|---|---|---|
| **CATEGORY (ATT 3): LEARNERS' PERCEPTION OF LIFE SCIENCE CAREER PROSPECTS** | | | | | | |
| **OA10** | My future career/profession has nothing to do with genetics, so I don't study it a lot. | 80 | 4.004 $\pm$ 1.169 | 77 | 4.217 $\pm$ 0.995 | 0.2237 |
| **OA13** | Genetics will be very useful in my future career/ profession. I therefore want to study it very well. | 81 | 3.879 $\pm$ 1.187 | 77 | 4.100 $\pm$ 1.021 | 0.2087 |
| **OA21** | I hope to study genetics and life sciences further, because I want to take up a career in medicine. | 82 | 3.511 $\pm$ 1.219 | 77 | 3.780 $\pm$ 1.096 | 0.1472 |
| **OA25** | I will have fewer job opportunities if I study genetics and life sciences. | 81 | 4.133 $\pm$ 1.081 | 77 | 4.211 $\pm$ 0.864 | 0.6213 |
| **CATEGORY (ATT 4): LEARNERS' OPINION OF GENETICS AS A TOPIC** | | | | | | |
| **OA1** | Genetics is an interesting topic to study. | 81 | 4.301 $\pm$ 1.008 | 77 | 4.683 $\pm$ 0.471 | 0.0026* |
| **OA7** | Genetics is a difficult topic. | 81 | 3.409 $\pm$ 1.034 | 77 | 3.713 $\pm$ 0.092 | 0.0530 |
| **OA9** | I enjoy studying genetics. | 78 | 4.196 $\pm$ 1.106 | 77 | 4.359 $\pm$ 0.826 | 0.3041 |
| **OA23** | I don't like studying genetics. | 81 | 4.202 $\pm$ 0.993 | 77 | 4.437 $\pm$ 0.805 | 0.0950 |
| **OA30** | I like setting difficult tasks for myself when studying genetics. | 82 | 3.652 $\pm$ 1.280 | 77 | 3.968 $\pm$ 1.224 | 0.1180 |
| **CATEGORY (ATT 5): LEARNERS' OPINION OF LIFE SCIENCE AS A SUBJECT** | | | | | | |
| **OA4** | Life sciences is more difficult than other science subjects. | 81 | 3.779 $\pm$ 1.084 | 77 | 4.194 $\pm$ 0.904 | 0.0102* |
| **OA5** | I admire people who are knowledgeable about life sciences. | 80 | 4.120 $\pm$ 0.882 | 77 | 3.979 $\pm$ 0.938 | 0.3388 |
| **OA15** | I enjoy studying life sciences. | 82 | 4.160 $\pm$ 0.975 | 77 | 4.453 $\pm$ 0.787 | 0.0373* |
| **OA16** | Studying life sciences is a waste of time. | 81 | 4.311 $\pm$ 1.169 | 77 | 4.803 $\pm$ 0.539 | 0.0010* |
| **OA19** | I do not agree with many ideas (concepts) in life sciences. | 81 | 3.734 $\pm$ 1.049 | 77 | 4.111 $\pm$ 0.932 | 0.0171* |
| **OA26** | Life sciences is an easy subject. | 82 | 3.248 $\pm$ 1.277 | 77 | 3.827 $\pm$ 0.812 | 0.0008* |
| **OA28** | Life sciences is not my favourite subject. | 79 | 3.913 $\pm$ 1.194 | 77 | 4.258 $\pm$0.772 | 0.0335* |
| **OA29** | I sometimes avoid studying life sciences. | 82 | 3.555 $\pm$1.187 | 76 | 4.099 $\pm$0.982 | 0.0020* |

* Indicates a significant treatment effect at α = 5% significance level.

The items in which the experimental group showed a more positive attitude than the control group included these statements:

- OA1: Genetics is an interesting topic to study
- OA4: Life sciences is more difficult than other science subjects
- OA14: I usually feel like running out of the class during life science lessons;
- OA15: I enjoy studying life sciences
- OA16: Studying life sciences is a waste of time
- OA18: I do not understand genetics lessons
- OA19: I do not agree with many ideas (concepts) in life sciences
- OA20: I feel quite happy when it is time for genetics lessons
- OA26: Life sciences is an easy subject
- OA27: Discoveries in life sciences and genetics have improved human life
- OA28: Life sciences is not my favourite subject
- OA29: I sometimes avoid studying life sciences (table 4.8).

Of these 12 items, eight (OA1, OA4, OA15, OA16, OA19, OA26, OA28 & OA29, table 4.8) are about learner attitudes towards the study of genetics as a topic and life sciences as a subject. This result suggests that after the intervention, learners from the experimental group appreciated the study of genetics and life sciences more than those from the control group. Three of the twelve items (OA14, OA18& OA20) are about learner perceptions of life science lessons/classes. It appears that after the intervention, learners from the experimental group appreciated and enjoyed life science lessons more than their counterparts from the control group, and had a better understanding of genetics lessons.

The ANCOVA results showed non-significant treatment effects for items that associated the study of life sciences with career prospects. Similarly, there was no significant treatment effect on items linking the study of life sciences and genetics with everyday life (table 4.8). Item OA5 (I admire people who are knowledgeable about life sciences), in which the control group had a more positive attitude than the experimental group in the pre-test (appendix XVI), showed a non-significant difference between the mean scores of the two groups in the post-test (table 4.8).

In summary, before the intervention the attitudes of the experimental and control groups towards the study of life sciences were positive and approximately the same. However, after the intervention, learners from the experimental group showed a more positive attitude towards the study of life sciences than those from the control group.

**Research question 2**

*Would there be any interactive influences of gender and cognitive preferences, on learner attainment of the learning outcomes?*

In an attempt to answer this research question, three hypotheses were tested in relation to the interactive influences of gender, cognitive preferences, and the collective interactive influence gender and cognitive preferences on the acquisition of the learning outcomes.

### 4.2.2 Interactive influence of gender and treatment

**NULL HYPOTHESIS 2**

Ho.2 *There is no significant interactive influence of gender on learners' attainment of genetics content knowledge, science inquiry, problem-solving, decision-making abilities, and their attitude towards the study of life sciences.*

The results of a 2 x 2 factorial ANCOVA showed no significant interactive influence of gender on learner performance on all the learning outcomes assessed: ([GCKT: F (1,173) = 0.360,*p*=0.5497], [TOSIS: F(1,161) =2.64, *p*=0.1059], [DMAT: F(1,166) = 0.38, *p*=0.5372], [PSAT: F(1.169) = 0.61, *p*=0.4353], and [LSAQ: F(1, 154) = 0.16,*p*=0.6859], table 4.9).

**Table 4.9 Summary of post-test statistics for the interactive influence of gender on the learning outcomes (GCKT, TOSIS, DMAT, PSAT, LSAQ)**

| **Dependant Variable** | **Treatment** | **Gender** | **N** | **Mean ± SD** | **F- value** | ***p*-value** |
|---|---|---|---|---|---|---|
| **GCKT** | C | F | 49 | 16.499 ± 8.639 | **0.36** | **0.5497** |
| | | M | 44 | 14.370 ± 6.154 | | |
| | E | F | 55 | 26.736 ± 10.749 | | |
| | | M | 30 | 26.485 ± 12.001 | | |
| **TOSIS** | C | F | 45 | 28.444 ± 14.453 | **2.64** | **0.1059** |
| | | M | 41 | 21.951 ± 11.878 | | |
| | E | F | 50 | 28.980 ± 10.389 | | |
| | | M | 30 | 29.000 ± 11.477 | | |
| **DMAT** | C | F | 45 | 56.444 ± 26.038 | **0.38** | **0.5372** |
| | | M | 41 | 50.976 ± 23.324 | | |
| | E | F | 54 | 69.444 ± 19.074 | | |
| | | M | 31 | 68.710 ± 18.751 | | |
| **PSAT** | C | F | 47 | 32.660 ± 20.848 | **0.61** | **0.4353** |
| | | M | 41 | 35.610 ± 18.034 | | |
| | E | F | 55 | 49.273 ± 26.095 | | |
| | | M | 31 | 45.806 ± 25.531 | | |
| **LSAQ** | C | F | 42 | 116.833 ± 20.376 | **0.16** | **0.6859** |
| | | M | 40 | 118.125 ± 14.678 | | |
| | E | F | 46 | 127.261 ± 9.715 | | |
| | | M | 31 | 128.194 ± 10.512 | | |

KEY:
GCKT: Genetics Content Knowledge Test; E: Experimental group
TOSIS: Test of Science Inquiry Skills; C: Control group
DMAT: Decision-Making Ability Test; M: Male learners
PSAT: Problem-Solving Ability Test; F: Female learner
LSAQ: Life Sciences Attitude Questionnaire; SD: Standard deviation

Analysis of the interactive influence of gender on the acquisition of the specific components of science inquiry skills showed no significant effect on learner ability to formulate hypotheses (F= 0.00; *p*=0.9989), identify variables (F= 2.59; *p*=0.0552), design experiments (F= 0.90; *p*=0.3440), draw and interpret graphs (F= 1.22; *p*=0.2703), and draw conclusions from results (F= 0.03; p=0.8595) (appendix XVII).

Based on these results the hypothesis that there is no significant interactive influence of gender on learners' attainment of genetics content knowledge, science inquiry, problem-solving, decision-making abilities, and their attitude towards the study of life sciences was accepted.

### 4.2.3 Interactive influence of cognitive preferences and treatment

**Null hypothesis 3**

*Ho 3* *There is no significant interactive influence of learners' cognitive preferences on their attainment of genetics content knowledge, science inquiry skills, decision-making ability, problem-solving ability, and their attitude towards the study of life sciences*

A 2 x 4 factorial ANCOVA showed no significant interactive influence of cognitive preferences on learner performance on all the learning outcomes at 5% level of significance: ([GCKT: F(3,148) =1.57, *p*=0.2001], [TOSIS: F(3,137) = 0.36, *p*=0.7831], [DMAT: F(3, 142) = 0.03, *p*=0.9922], [PSAT: F(3,144) = 0.43, *p*=0.7291] and [LSAQ: F(3,130) = 0.90, *p*=0.4419], table 4.10). Analysis of the interactive influence of learner cognitive preferences on the acquisition of the various components of science inquiry skills showed no significant influence either. Therefore, learners' cognitive preferences did not significantly interact with the materials used to teach the experimental and the control groups in the attainment of the assessed learning outcomes.

**Table 4.10 Summary of post-test ANCOVA statistics for the interactive influence of cognitive preferences on the learning outcomes**

| Dependant variable | Cognitive preference | CONTROL | | | EXPERIMENTAL | | | F Value | *p*-value |
|---|---|---|---|---|---|---|---|---|---|
| | | N | Mean | SD | N | Mean | SD | | |
| GCKT | A | 15 | 15.7575758 | 6.7565759 | 16 | 28.0681818 | 9.2463976 | 1.57 | 0.2001 |
| | P | 26 | 15.3146853 | 7.6307005 | 27 | 29.3602694 | 9.7221894 | | |
| | Q | 15 | 18.1515152 | 10.0478000 | 19 | 28.9952153 | 13.2292589 | | |
| | R | 28 | 14.1331169 | 6.1629481 | 11 | 19.6694215 | 9.2287077 | | |
| TOSIS | A | 14 | 28.9285714 | 18.3112588 | 15 | 28.3333333 | 9.7590007 | 0.36 | 0.7831 |
| | P | 25 | 27.6000000 | 12.0000000 | 26 | 31.1538462 | 10.7058575 | | |
| | Q | 15 | 24.0000000 | 11.9821296 | 18 | 29.1666667 | 10.0366974 | | |
| | R | 23 | 21.3043478 | 13.9167485 | 10 | 27.0000000 | 13.9841180 | | |
| DMAT | A | 15 | 55.3333333 | 23.5634907 | 16 | 73.1250000 | 21.2033802 | 0.03 | 0.9922 |
| | P | 26 | 51.5384615 | 23.9486630 | 27 | 68.8888889 | 19.0814717 | | |
| | Q | 14 | 56.4285714 | 28.1772256 | 20 | 73.5000000 | 16.3111199 | | |
| | R | 22 | 51.8181818 | 26.1199365 | 11 | 68.1818182 | 16.6241883 | | |
| PSAT | A | 15 | 34.6666667 | 20.9988662 | 16 | 42.5000000 | 24.3584345 | 0.43 | 0.7291 |
| | P | 26 | 38.0769231 | 19.2912894 | 27 | 52.2222222 | 25.0128172 | | |
| | Q | 15 | 32.3333333 | 21.2860339 | 20 | 48.0000000 | 26.6754372 | | |
| | R | 23 | 29.5652174 | 18.8241288 | 11 | 51.8181818 | 30.2714987 | | |
| LSAQ | A | 13 | 117.692308 | 21.6347892 | 16 | 130.187500 | 10.3808718 | 0.90 | 0.4419 |
| | P | 22 | 123.409091 | 16.2822108 | 24 | 128.500000 | 8.6727960 | | |
| | Q | 15 | 112.333333 | 16.2905173 | 16 | 128.125000 | 6.7515430 | | |
| | R | 24 | 114.208333 | 19.0308198 | 9 | 125.222222 | 14.7120510 | | |

KEY:
GCKT: Genetics Content Knowledge Test
TOSIS: Test of Science Inquiry Skills
DMAT: Decision-Making Ability Test
PSAT: Problem-Solving Ability Test
LSAQ: Life Sciences Attitude Questionnaire
A: Application mode
P: Principle mode
Q: Questioning mode
R: Recall mode
SD: Standard deviation

Based on these results, the hypothesis that there is no significant interactive influence of learner cognitive preferences on their attitude towards the study of life sciences, and their attainment of genetics content knowledge, science inquiry skills, decision-making ability, and problem-solving ability was not rejected.

### 4.2.4 Interactive influence of gender, cognitive preferences and treatment

**Null hypothesis 4**

*Ho 4 There is no significant interactive influence of gender and cognitive preference on learners' attainment of genetics content knowledge, science inquiry skills, decision-making ability, problem-solving ability, and attitude towards the study of life sciences.*

A 2 x 2 x 4 factorial ANCOVA showed no significant interactive influence of gender and learners' cognitive preferences on the performance of learners on all the assessed learning outcomes ([GCKT: F (3,140) = 1.98, *p*=0.1199], [TOSIS: F (3,129)=0.74, *p*=0.5278], [DMAT: F (3,134)=0.96, *p*=0.4122], [PSAT: F( 3,122) = 0.49, *p*=0.6905] and [LSAQ: F (1,154) = 0.38, *p*=0.7659) (appendix XIX). The implication of these results is that learners' gender and cognitive preference did not have a significant combined interactive influence on the attainment of the learning outcomes when using the context-based approach or the traditional teaching approaches.

### 4.2.5 Comparison of pre-test and post-test cognitive preferences of the experimental group

Some researchers (Tamir, 1975) have suggested a possible influence of instructional approaches on learners' cognitive preferences. It therefore became necessary to find out whether the context-based materials and approach affected learners' cognitive preferences. A Fisher exact test (Stokes, et al., 2000) was used to determine the significance of the relationship, if any, between pre-and post-intervention cognitive preferences of the experimental group. The test results showed a strong correlation between the pre-test and post-test cognitive preferences of the learners (*p*=0.0003), at 5% level of significance (appendix XX). It was therefore assumed that learners' cognitive preferences were not significantly altered by the use of the context-based teaching approach.

## 4.3 QUALITATIVE RESULTS

**Research question 3**

*What are learners' and educators' views that could account for differences in learner performance, if any?*

This research question was explored by collecting qualitative data from participating learners and educators using focus group and one-to-one interviews respectively. The texts below present some of the data obtained from the interviews. (Detailed interview protocols are presented in appendix XXI).

### 4.3.1 Learners' opinions of the study of genetics

Codes were used to associate the interview transcripts with the respondents. The codes consist of the letters ES (for experimental group learners) and CS (for control group learners) and the identity numbers of the individual learners.

#### *4.3.1.1 Learners' views on performance in genetics*

Focus group interview protocols showed that the experimental group perceived the study of genetics to be more accessible and fun, and they thought that they had performed well in the post-test (ref. table 4.11(a)).

**Table 4.11(a) Experimental group's perception of performance in genetics**

| | |
|---|---|
| ES9 | The stories made the study of genetics easy, because we managed to understand what was happening, and we were able to explain the situations. |
| ES68 | It was fun to learn genetics by using our own experiences. It just makes genetics so easy. I am sure I have passed the test. |
| ES3 | When I wrote the first test (pre-test), it was difficult, but after studying genetics, I felt more excited, and it became easy. I think I passed the second test (post-test). |

In contrast, most of the learners from the control group found the study of genetics inaccessible, challenging and confusing, even though it was interesting, as shown below (table 4.11(b)).

**Table 4.11(b) Control group's perception of performance in genetics**

| | |
|---|---|
| CS181 | Some educators start teaching genetics without us knowing where it comes from, where it is situated and how it affects us. |
| CS112 | Genetics is challenging because some of us do not understand what it is based on. |
| CS97 | I found the study of genetics to be difficult, because some of the terms, I cannot put them in my mind, especially the definitions. They are very confusing. |
| CS120 | Genetics was interesting, but when it comes to tests and examinations, we get scared or panic and fail, or we don't pass the way we expect to pass. |

#### *4.3.1.2 Learners' views on the approaches used to teach genetics*

The experimental group appeared to appreciate the teaching methods used, citing the use of hands-on activities, linkage of content with daily life experiences, small group class discussions, frequent interactions among themselves and the educators, and the use of stories, as the reasons for their appreciation (table 4.12 (a)).

**Table 4.12(a) Experimental group's opinions of the way in which they experienced the teaching of genetics and how they would like to be taught genetics**

| | |
|---|---|
| ES64 | The method used to teach genetics in this project was more practical, but other educators teach us theory only, which we don't understand. |
| ES15 | The way our educator taught us made it easy. We talked about things that happen to us, so it was easy to understand. I especially enjoyed the part on diseases and the inheritance of features from our parents. |
| ES65 | It was easy to understand the terms and ideas because we worked in groups and we learned from each other. If you are wrong, your friends explained the reasons to you. |
| ES82 | In other classes, there is no interaction between us and the educators, but in this programme we are allowed to say what we think, even to argue with others or disagree with the educator. |
| ES28 | The stories made the study of genetics easy because we managed to understand what was happening, and we were able to explain the situations. |

The control group seemed to suggest that the way genetics was taught was not facilitative, and resulted in learners' memorization of concepts. They indicated that they preferred more hands-on activities, field trips, greater interaction with their educators, and the use of real-life issues in the study of genetics. These perceptions are indicated in these quotations from learner interview protocols (table 4.12(b)).

**Table 4.12(b) Control group's opinions of the way in which they experienced the teaching of genetics and how they would like to be taught genetics**

| | |
|---|---|
| CS123 | The way our educators teach us makes us to fail, because we find it boring. They just read from textbooks, then they give us many exercises, so we just 'cram' *(memorize)* the work because we don't understand. |
| CS112 | The problem is that we do not do any practical activities in genetics. We would like to do practical activities so that we may understand genetics. |
| CS115 | Our educators should organize trips to places where we can see what we learn in class. |
| CS116 | Educators must be able to communicate with learners, not just get angry when we ask questions. |
| CS168 | Educators should always relate what we learn to real-life issues, and give more examples of how the things we learn can be applied in life. |

#### *4.3.1.3 Learners' views on the relevance of studying genetics*

The interview protocols revealed that learners from both groups perceived the study of genetics as relevant to their lives (tables 4.13 (a) & (b)). However, the two groups seemed to view the relevance of studying genetics from difference perspectives. The experimental group viewed relevance of the study of genetics mostly in terms of applications to everyday issues as well as their wellbeing, while the control group's appreciation of its relevance seemed to be confined to its importance in understanding their own body functions, as is evident in these comments (tables 4.13 (a) & (b)).

**Table 4.13(a) Experimental group's perception of the relevance of the study of genetics**

| | |
|---|---|
| ES51 | The study of genetics is good for us because we know how it (*genetics*) affects us, and we understand some of the issues we hear on TV. |
| ES70 | The study of genetics helps us improve our daily lives and deal with the challenges that we have in our lives. |
| ES39 | After studying genetics, I understand most of the things that happen in our societies, like why we have albinos. |

**Table 4.13(b) Control group's perception of the relevance of the study of genetics**

| | |
|---|---|
| CS132 | In genetics we study what happens in our bodies, so I think it is relevant. |
| CS105 | The study of genetics and life sciences helps us to know how to take care of ourselves. |
| CS97 | Genetics makes us to be aware of how gene mutations can cause disabilities and disorders in our bodies. |

#### *4.3.1.4 Learners' views on interest in the study of genetics*

The findings showed that learners from both groups expressed interest in the study of genetics (tables 4.14(a) & (b)). This observation is evident in these quotations.

**Table 4.14(a) Experimental group's opinions of their interest in the study of genetics**

| | |
|---|---|
| ES42 | Genetics was very interesting and fun. I used to look forward to the lessons. |
| ES65 | I enjoyed the practical activities because they were about things that we see and that we hear from people. |
| ES42 | The fact that we were dealing with things that happen in our lives made the study of genetics very interesting. |

**Table 4.14(b) Control group's opinions of their interest in the study of genetics**

| | |
|---|---|
| CS132 | Genetics was interesting because it deals with things that affect our lives. |
| CS106 | Genetics is interesting because we learn about ourselves, how we are made, and how certain characteristics come about. |
| CS145 | I found it (*genetics*) interesting because of the way the educator framed the question about genetics. |

In sum, the comments from learners show that learners taught with the developed materials and approach enjoyed the study of genetics and they found it to be relevant to their lives. They were confident about their performance in genetics and they were pleased with the way genetics was taught because they were able to interrogate their preconceptions and review them in light of new knowledge (tables 4.11(a), 4.12(a), 4.13(a) & 4.14(a). Learners from the control group showed interest in, and were of the view that genetics is relevant to their lives because the study of genetics deals with their own characteristics. However, they were of the view that the methods used to teach genetics were not facilitative enough for them to perform well in the post-tests (tables 4.11(b), 4.12(b), 4.13(b) & 4.14(b).

### 4.3.2 Educators' opinions on their learners' performance and the teaching approach

The subsequent passages show representative comments from educators' interview protocols. (Detailed interview protocols are contained in appendix XXI). The codes used to identify the educators are ET (experimental group educator) and CT (control group educator), followed by the identity number of the educator.

#### *4.3.2.1 Educators' views on learner performance in genetics*

Comments from the educators who taught the experimental group indicated that they were optimistic about their learners' performance in the post-tests. They attributed learners' enhanced performance to the use of authentic situations during lessons, ability of learners to relate with the teaching materials, and the linkage of content to contexts (table 4.15(a)).

**Table 4.15(a) Opinions of educators from the experimental group concerning their learners' performance in genetics**

| | |
|---|---|
| ET2 | The learners who were exposed to the new teaching approach performed much better when compared with my previous learners' performance. |
| ET3 | The use of real-life situations in the lessons helped learners to quickly remember things learned, because they can relate the concepts to situations which they are familiar with. |
| ET2 | Once you tell them [learners] what happens in real life, and then teach them the relevant genetics concepts, it becomes easier for them to understand. |

Educators from the control group expressed dissatisfaction with their learners' achievement in genetics. They were of the opinion that learners were unable to comprehend the processes and applications of genetics, partly because they are lazy to study the topic. Some educators felt that genetics is often taught as abstract concepts which is not facilitative, and that some learners believe that genetics is a difficult topic, and therefore do not put effort in studying it (table 4.15(b)).

**Table 4.15(b) Opinions of educators from the control group concerning their learners' performance in genetics**

| | |
|---|---|
| CT6 | What I notice with my classes is that they seem to understand the lessons when we start the study of genetics, but as we get deeper into the processes and applications of genetics, they get lost, and become bored. |
| CT4 | Probably learners are just lazy to study. |
| CT5 | At times what makes learners get lost during the study of genetics is the way educators present the lessons as abstract concepts. |
| CT4 | I would say they fail because they believe that genetics is very complex, so they just shut down. |

#### *4.3.2.2 Educators' views on their ability to identify learner preconceptions*

Educators from the experimental group indicated that they were able to note learners' preconceptions easily, and could address them at a later stage, as indicated in table 4.16(a)).

**Table 4.16(a) Educators from experimental group's opinions of their ability to identify and address learners' preconceptions**

| | |
|---|---|
| ET1 | When you listen to their arguments, you could easily pick out the wrong explanations and the correct ones, and during the content introduction, most learners corrected themselves, and I also emphasized the ideas which they misunderstood during the next stage of the lesson. |
| ET3 | If you start a lesson by saying to the learners, tell me something, then they feel free to tell you what they know, and then you can pick up misconceptions and correct them. |

Those from the control group commented that it was difficult to get the learners to express their views. As a result, it was not easy for them to know their learners' preconceptions. These opinions are expressed in the quotations below (table 4.16(b)).

**Table 4.16(b) Educators from the control group's opinions of their ability to identify and address learners' preconceptions**

| | |
|---|---|
| CT4 | Because they (learners) are usually quiet, it is difficult to know what they think, or what they know or don't know. |
| CT5 | At times when you ask them a question, they just stare at you without saying anything, so it is difficult to know what they are thinking. |

#### *4.3.2.3 Educators' views of the methods used to teach genetics*

Educators from the experimental group were of the view that the context-based approach to the teaching of genetics was facilitative, highlighting the use of authentic narratives, the interactive nature of the approach, ability to identify and address preconceptions, and the linkage of content and contexts as some of the features of the approach that could enhance learner performance. The educators recommended the approach for teaching other topics in life sciences (table, 4.17(a)).

**Table 4.17(a) Educators from the experimental group's views about appropriate and effective ways of teaching genetics**

| | |
|---|---|
| ET2 | To me, as an educator, the context based method, when followed correctly, will always achieve the expected objectives. All life sciences learning outcomes can be addressed, when you use the new teaching method. |
| ET1 | If you link real-life issues with the syllabus, they become more meaningful and clearer to the learners. |
| ET3 | The exploration of contexts stage allows for interaction and discussion, and it paves the way for the information (concept) stage where the content relating to that scenario, is presented by the educator. |
| ET1 | When you listen to their arguments, you could easily pick out the wrong explanations and the correct ones, and during the content introduction, most learners corrected themselves, and I also emphasized the ideas which they misunderstood. |
| ET1 | What made them understand genetics was the teaching method of starting the lesson with real-life issues (*narratives*), and then relating the concepts to those issues. Then the lessons made sense to them. |
| ET2 | I had the opportunity to use this technique to teach genetic topics and personally feel it can work very well in teaching other life science topics, especially controversial topics, like evolution, organ donation. |
| ET3 | It was time consuming. Adequate time is required to get information from learners and to correct their misconceptions. |
| ET2 | The educator needs to be well prepared and collect sufficient information for content, because there will be lots of questions to answer. |
| ET1 | The only problem with this method is that we cannot use it in our classes because we do not have enough resources for practical activities. |

Some of the educators from the experimental group surmised that the approach might present challenges in schools, with regard to time constraints, excessive work for educators, and lack of resources (table 4.17(a)).

There was lack of consensus among educators from the control group regarding their views on appropriate and effective ways of teaching genetics, and they seemed to be unsure of the causes of learners' poor performance in the topic. However, some of the educators identified learners' academic inability, incompetence of some educators, use of ineffective instructional approaches, and lack of resources as possible determinants of poor performance in genetics (table 4.17(b)).

**Table 4.17(b) Educators from the control group's views on appropriate and effective ways of teaching genetics**

| | |
|---|---|
| CT6 | I believe that the way I normally teach is the best way of teaching genetics, because I always strive to do the best in whatever I do. |
| CT4 | I think the way we teach genetics is limited to the sense of hearing. Our learners are not good at exploring issues on their own. They are very much reliant on the educator. |
| CT5 | At times what makes learners get lost during the study of genetics is the way educators present the lessons as abstract concepts. |
| CT4 | I can't pick up exactly where the problem lies; it's probably the way we teach genetics, or the type of resources that we use, because we normally use the chalk board, posters, textbooks, old models, and they don't seem to be effective in enhancing learners' achievement in genetics. |
| CT5 | Even some educators are not comfortable with some parts of genetics, so how can they arouse learners' interest and improve performance in those parts? |
| CT6 | I think practical activities can help to clarify the theory, but the problem is that, there are very few practical activities in genetics, and the materials are expensive, so we end up teaching theory only. |
| CT6 | Probably they are not just good at mastering the genetics concepts. I really don't know why they can't grasp the concepts. |

#### *4.3.2.4 Educators' views on the relevance to learners of studying genetics*

Educators from the experimental and control groups seemed to be in accord regarding the relevance to learners of the study of genetics. They appeared to believe that the study of genetics was meaningful in learners' lives and that the learners themselves viewed the study of genetics as important to their lives. These opinions are relayed in the quotations below (tables 4.18 (a) and (b)).

**Table 4.18(a) Opinions of educators from the experimental group on the relevance of the study of genetics to learners' lives**

| | |
|---|---|
| ET2 | Genetics is the basis of life itself. Without genes, there is no life, so the study of genetics is very relevant to the learners. |
| ET1 | And I know that the learners who were involved in this programme saw how genetics impacts on our lives. What they learned will be useful throughout their lives. |
| ET3 | The advantage of the way genetics was taught in this programme is that learners know that what is taught in class is actually happening in their own communities. |

**Table 4.18(b) Opinions of educators from the control group on the relevance of the study of genetics to learners' lives**

| | |
|---|---|
| CT4 | I believe that genetics is relevant and important to learners' lives, because it teaches them about the inheritance of diseases and certain abnormalities. |
| CT5 | Of course, genetics is very relevant to learners, but they need to understand it for them to appreciate it. |
| CT6 | Yes I think that learners realise the importance of genetics to their lives, although there are some topics which they think are not important to their lives, such as the study of plants. |

#### 4.3.2.5 *Educators' opinions on learners' interest in the study of genetics*

Comments from interviews showed that educators from both the experimental and control groups believed that their learners enjoyed the study of genetics. However, educators who taught the experimental group indicated that their learners were eager to take part in class discussions and express their views, while those from the control group expressed discontent with learner participation during lessons. These views are stated in the comments below (tables 4.19(a) & (b)).

**Table 4.19(a) Opinions of educators from the experimental group concerning their learners' interest and participation in genetics lessons**

| | |
|---|---|
| ET2 | Learners were very enthusiastic and motivated to learn more. |
| ET1 | The learners were very interested in the lessons, they all wanted to say something and convince the others about their views. |
| ET3 | For the first time, I did not have to force my learners to talk. In fact I had to control them at times. Everyone wanted to say something. |

**Table 4.19(b) Opinions of educators from the control group concerning their learners' interest and participation in genetics lessons**

| | |
|---|---|
| CT4 | Learners like genetics because it is an interesting topic. |
| CT5 | I would say learners generally like the study of genetics, but not all the different concepts of genetics. |
| CT4 | Our learners are scared or shy to express themselves and reveal what they think. I think they are also scared that their friends will laugh at them if they speak broken English, because as you know, English is not their mother tongue, and they are not good at it. |

Overall, the educators who taught the experimental group seemed to believe that their learners were interested in the study of genetics and that they performed well in the topic because of the teaching approach used. They also indicated that they were able to identify learners' alternative conceptions, which they addressed at a later stage. On the other hand, educators who taught the control group appeared to be discontent with their learners' performance in genetics, although they felt that their learners were interested in the study of the topic. The educators indicated that they could not easily identify learners' preconceptions because their learners were unwilling to participate in lessons.

## 4.4 CHAPTER SUMMARY

In summary, the results of this study showed that the use of the context-based teaching approach was more effective in improving learners' overall performance than traditional teaching approaches. The study results showed no significant interactive influences of gender and learners' cognitive preferences, and treatment on learner's attainment of all the learning outcomes. The qualitative data seems to corroborate the quantitative findings about the relative effectiveness of the two approaches in enhancing learner performance.