CHAPTER-4

DATA ANALYSIS AND INTERPRETATION

4. DATA ANALYSIS AND INTERPRETATION

4.1. INTRODUCTION

This chapter presents the analysis and interpretation of data collected for the study titled, *"A Study on the Effect of Metacognitive Instructional Strategy in Promoting Problem-Solving Skills among Secondary Stage Students."* The study adopted a quasi-experimental design with a control and an experimental group, each comprising 30 students.

The purpose of this chapter is to systematically analyze the data to determine the effectiveness of metacognitive instructional strategies in improving students' problem-solving skills and metacognitive awareness using appropriate statistical techniques.

4.2. ORGANIZATION OF THE DATA

The data were organized according to the two key assessment tools used:

- A Biology Problem-Solving Test (Pre-test and Post-test)
- The Metacognitive Awareness Inventory (MAI) (Pre-test and Post-test)

Each tool was administered to both the experimental and control groups before and after the intervention. The data have been presented in tabular form with corresponding statistical interpretations.

4.3. OBJECTIVE-WISE ANALYSIS, INTERPRETATION AND DISCUSSION OF RESULTS

4.3.1. Objective 1: To assess the awareness level of Metacognitive Instructional Strategies among secondary stage students before and after the intervention of the independent variable.

Analysis Method: A qualitative analysis was conducted using bar graphs to visualize the pre-test and post-test Metacognitive Awareness Inventory (MAI) scores of both the experimental and control groups.

Findings: The experimental group showed a marked increase in MAI scores from M = 14.00 (pre-test) to M = 22.00 (post-test) while the control group scores increased slightly from M= 14.07 (pre-test) to M = 15.03 (post-test).

Table 4.1. Mean Scores of Metacognitive Awareness Inventory (MAI) in Pre-test and Post-test for Experimental and Control Groups

Group	MAI Test	N	Mean
Experimental Group	Pre-Test	30	14
	Post-Test	30	22
Control Group	Pre-Test	30	14.07
	Post-Test	30	15.03

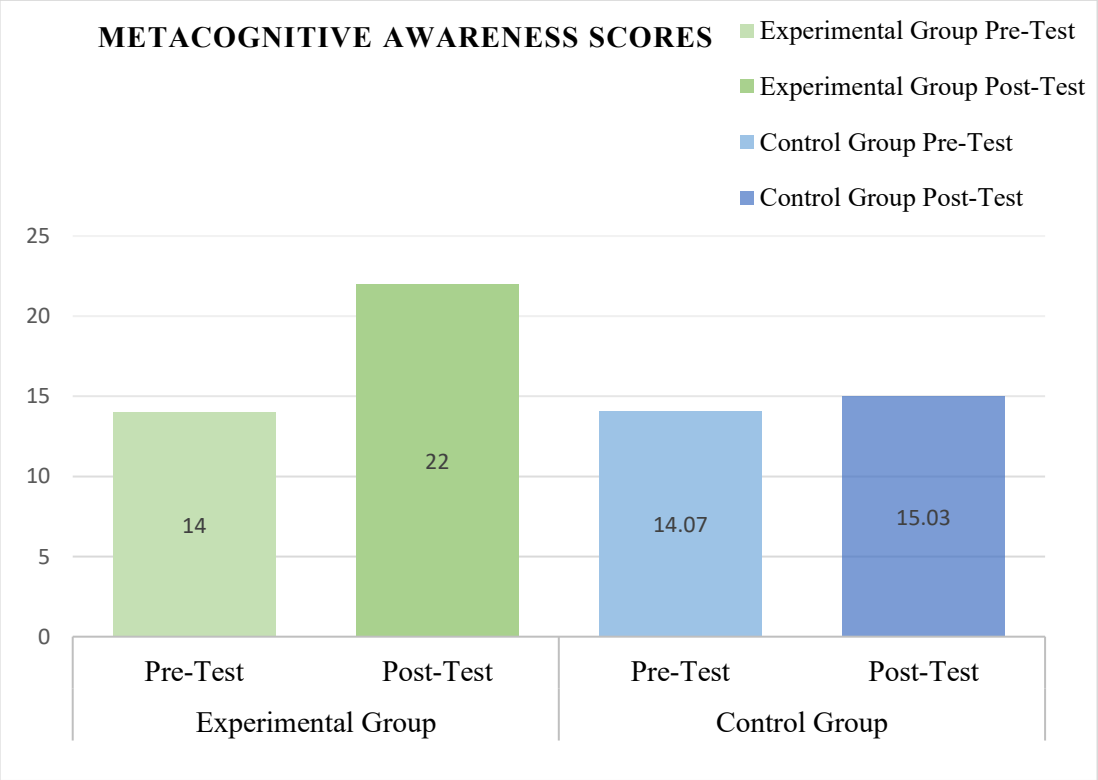

***Figure 4.1.**: Bar Graph Showing Pre-test and Post-test Metacognitive Awareness Scores of Experimental and Control Groups*

Interpretation: There was a clear and meaningful increase in the metacognitive awareness of students who were exposed to metacognitive instructional strategies. In contrast, the control group exhibited only a minimal change in their MAI scores. This suggests that the intervention significantly enhanced students' metacognitive self-awareness and self-regulation skills.

4.3.2. Objective 2: To compare the difference between the mean scores of problem-solving skills between students taught through metacognitive instructional strategies and those taught through traditional teaching methods.

H_0: There is no significant difference in the mean scores of problem-solving skills between students taught through metacognitive instructional strategies and those taught through traditional teaching methods.

H_1: There is a significant difference in the mean scores of problem-solving skills between students taught through metacognitive instructional strategies and those taught through traditional teaching methods.

Analysis Method: An Independent Samples two-tailed t-test was conducted on post-test Biology scores at a significance level of 0.05.

Table 4.2: Independent t-test Results Comparing Post-Test MAI Scores between Experimental and Control Groups

Group	N	Mean	SD	Df	t-value	Critical t- value	Remarks
Experimental Post-Test	30	27	0.74	58	13.81	2.002	Significant
Control Post-Test	30	21.93	1.87				

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where:

$\bar{x}_1$ = Mean of Experimental Group

$\bar{x}_2$ = Mean of Control Group

S_1 = Standard Deviation of Experimental Group

S_2 = Standard Deviation of Control Group

$n_1 = n_2 = 30$

$$\boldsymbol{t} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{27 - 21.93}{\sqrt{\frac{0.74^2}{30} + \frac{1.87^2}{30}}} = \frac{5.07}{\sqrt{0.0183 + 0.1166}} = \frac{5.07}{\sqrt{0.1349}} = \frac{5.07}{0.3673} \approx \mathbf{13.81}$$

Degrees of Freedom (Df): $Df = n_1 + n_2 - 2 = 30 + 30 - 2 = 58$

The calculated t-value is 13.81. At a significance level of 0.05 (α=0.05) and degrees of freedom (Df = 58), the critical t-value (two-tailed) is approximately 2.002.

Since the calculated t-value (13.81) is much greater than the critical t-value (2.002), at the 0.05 significance level (two-tailed) with the 58 degrees of freedom, the difference in means is statistically highly significant and therefore, the null hypothesis is rejected.

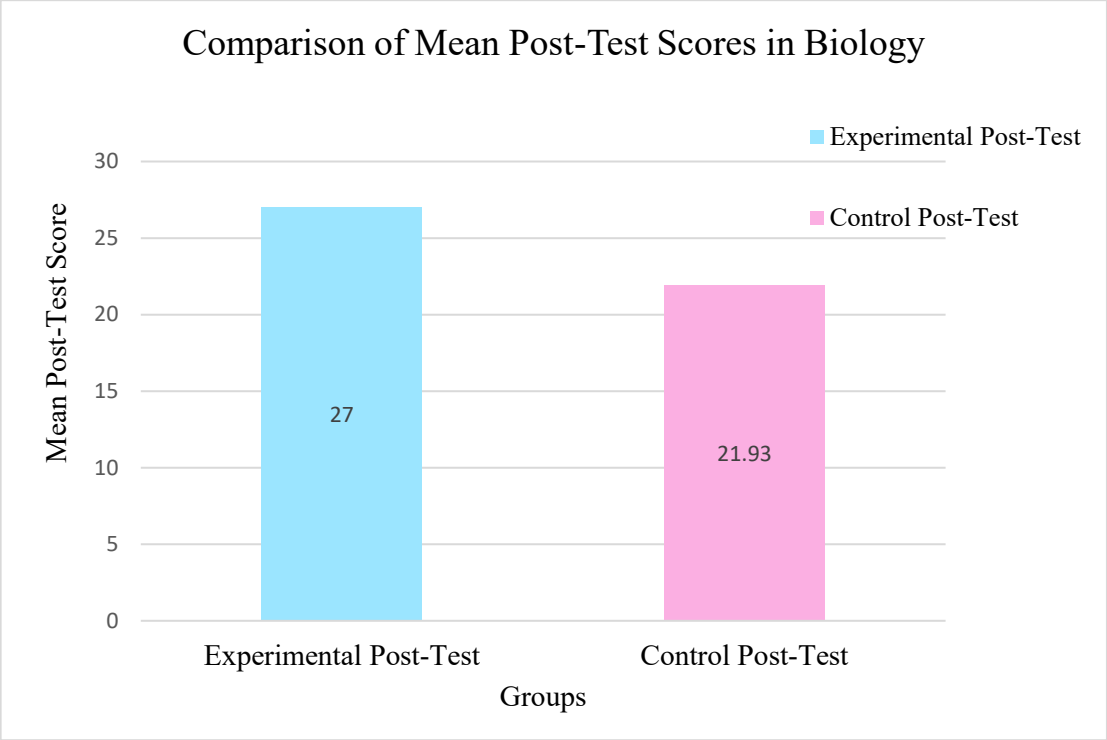

Figure 4.2.: *Bar graph showing the mean post-test scores in Biology for the experimental group (M = 27.00, SD = 0.74) and the control group (M = 21.93, SD = 1.87). The experimental group was taught using metacognitive instructional strategies, while the control group received traditional instruction. Error bars represent standard deviation. The significant difference between groups (t = 13.81, p < 0.05) indicates a positive impact of metacognitive strategies on students' problem-solving skills.*

Interpretation: There is a significant difference between the post-test scores of Biology of students taught through metacognitive instructional strategies (experimental group) and those taught through traditional methods (control group). This indicates that the use of metacognitive instructional strategies had a positive impact on students' learning outcomes and problem-solving skills.

4.3.3. Objective 3: To study the correlation between awareness level of metacognitive instructional strategies and the problem-solving skills.

H_2: There is a positive correlation between awareness level of metacognitive instructional strategies and the problem-solving skills.

Analysis Method: To examine the relationship between students' metacognitive awareness and their problem-solving performance, the Pearson correlation coefficient (r) was calculated.

In this study, Pearson's r was computed using the MAI post-test scores (representing metacognitive awareness) and the Biology post-test scores (representing problem-solving skills) of students from the experimental group.

Table 4.3 Pearson Correlation Coefficients between MAI Post-Test & Biology Post-Test Scores

Group	Score Comparison	r	Strength of Relationship	Interpretation
Experimental	MAI vs. Biology post-test	**0.94**	Strong positive association	Students with higher metacognitive awareness tended to achieve higher Biology scores.
Control	MAI vs. Biology post-test	**0.11**	Very weak relationship	Minimal association between awareness and Biology scores; changes likely due to uncontrolled factors.

Note: r = Pearson correlation coefficient; critical r at $p < 0.01$ (two-tailed, $df = 28$) ≈ 0.463.

Interpretation: Pearson's correlation analysis was conducted to determine the linear relationship between students' metacognitive awareness (MAI post-test scores) and their problem-solving performance in Biology (post-test scores).

- **Experimental group:** The analysis produced an r -value of 0.94 ($p < 0.01$), indicating a strong, statistically significant positive correlation. This result confirms that students who developed higher levels of metacognitive awareness after explicit

strategy instruction were also the ones who achieved the highest scores on the Biology problem-solving test. In practical terms, the intervention through metacognitive instructional strategies not only raised average performance but also aligned individual gains in awareness with corresponding gains in problem-solving skills.

- **Control group:** In contrast, the control group yielded an r -value of 0.11, which represents a very weak and non-significant relationship between MAI scores and Biology achievement. This minimal association suggests that, without targeted metacognitive instruction, improvements in Biology performance were largely independent of students' self-reported awareness levels and may have been influenced by random variation or uncontrolled classroom factors.

Overall, these findings support Hypothesis H_2 and underscore the critical role of metacognitive instructional strategies in enhancing students' capacity to regulate their thinking and apply effective problem-solving skills in science learning contexts.