



Background

This research was conducted at Salisbury Composite High School, in Sherwood Park, Alberta, Canada. The goal of my action research was to test a teaching strategy that could positively impact student’s attitudes toward chemistry laboratory work, and chemistry in general, as well as affecting student levels of metacognition and academic achievement. I implemented a treatment that consisted of direct instruction in five basic lab skills, and conducted performance assessments of the students in my treatment group. The promotion of hope, effort and optimism in students about their learning by using performance assessments, and student self-assessments as a metacognitive strategy, ideally will influence student attitudes about science and their own learning (Stiggins, 2005).

Methodology

- This study was conducted on grade 11 chemistry students divided into a treatment group (N=27) and a non-treatment group (N=31).
- The treatment was a series of five laboratory skills performance assessments: using an electronic balance, using a graduated cylinder lighting a Bunsen Burner, pipetting, and performing a titration.
- Before and after the unit of study both groups completed a survey, a lab skills self-assessment, and a chemistry skills exam.
- Both groups wrote three formative quizzes and a summative unit exam.



Figure 1. Laboratory Skill Performance Assessments: the Electronic Balance, the Graduated Cylinder, the Bunsen Burner, Pipetting and a Titration.

| Research Questions                                                                                        | Data Source 1                | Data Source 2                             | Data Source 3      |
|-----------------------------------------------------------------------------------------------------------|------------------------------|-------------------------------------------|--------------------|
| What effect do laboratory skills performance assessments have on student attitudes toward the laboratory? | Science Attitudes Survey     | Chemistry Lab Skills Self-Assessment      | Student Interviews |
| What effect do laboratory skills performance assessments have on student attitudes toward chemistry?      | Science Attitudes Survey     | Student Interviews                        |                    |
| What effect do laboratory skills performance assessments have on student metacognition?                   | Science Attitudes Survey     | Chemistry Lab Skills Self-Assessment      | Student Interviews |
| What effect do laboratory skills performance assessments have on student academic achievement?            | Chemistry Skills Review Exam | Formative Quizzes and Summative Unit Exam | Student Interviews |

Data Analysis

- The treatment group’s average pre-treatment score on the Chemistry Skills Review Exam was 64% with a range of 69%; post-treatment the average was 83% with a range of 35% (Figure 2).
- The average normalized gain on the Chemistry Lab Skills Self-Assessment for the treatment group was 100% for using the electronic balance, 63% for using graduated cylinders, 91% for lighting Bunsen Burners, 65% for pipetting volumes, and 73% for performing a titration (Figure 3).
- The Science Attitudes Survey revealed that the treatment group perceptions of their ability to use basic lab equipment, and their metacognitive activity showed significant change.
- The average score on the Summative Unit Exam was 76 %, with a range of 69 % for the treatment group, and the average was 74 % with a range of 64% for the non-treatment group (Figure 4).

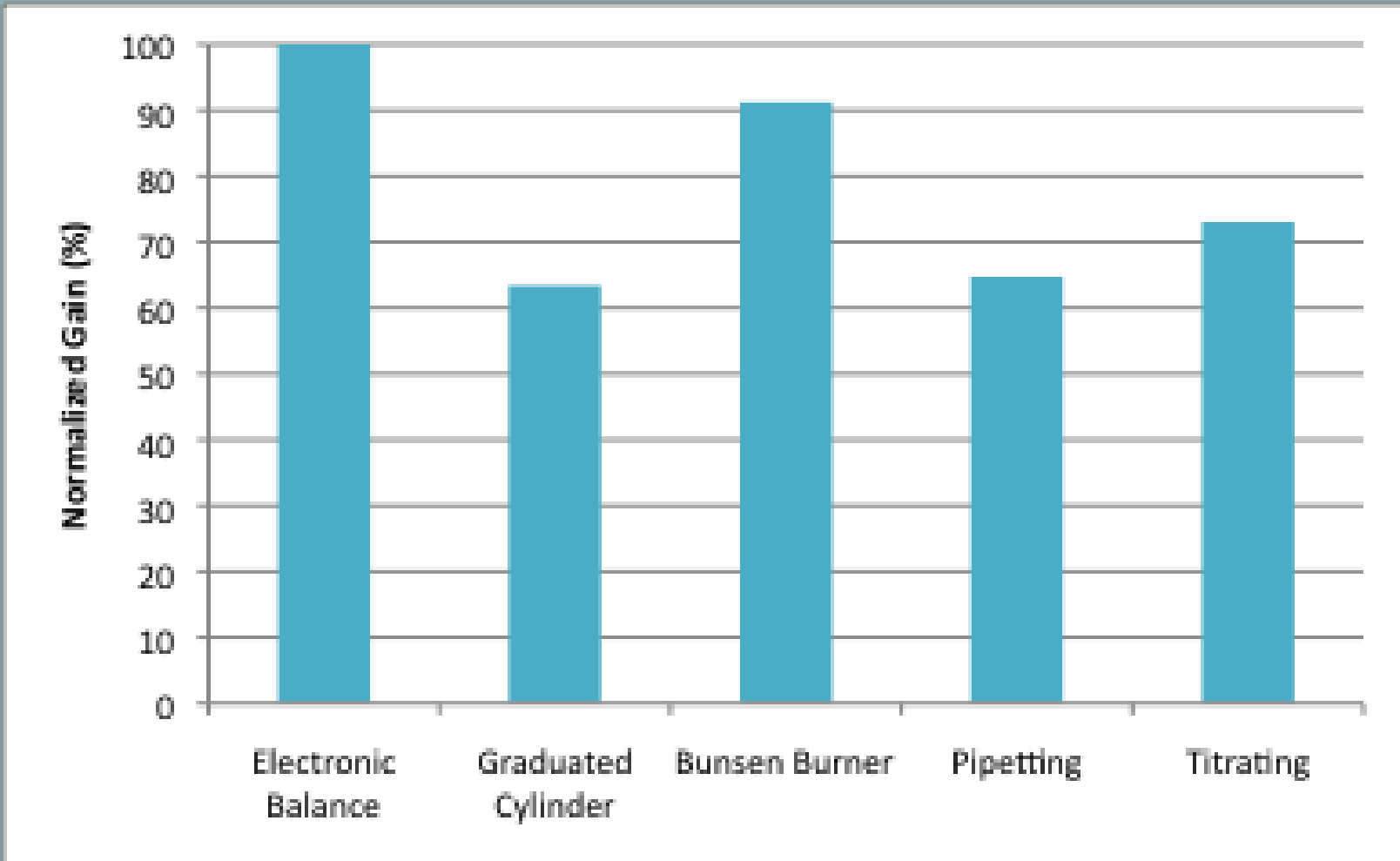


Figure 3. Treatment Group Average Normalized Gain on the Chemistry Lab Skills Self-Assessment, (N=27).

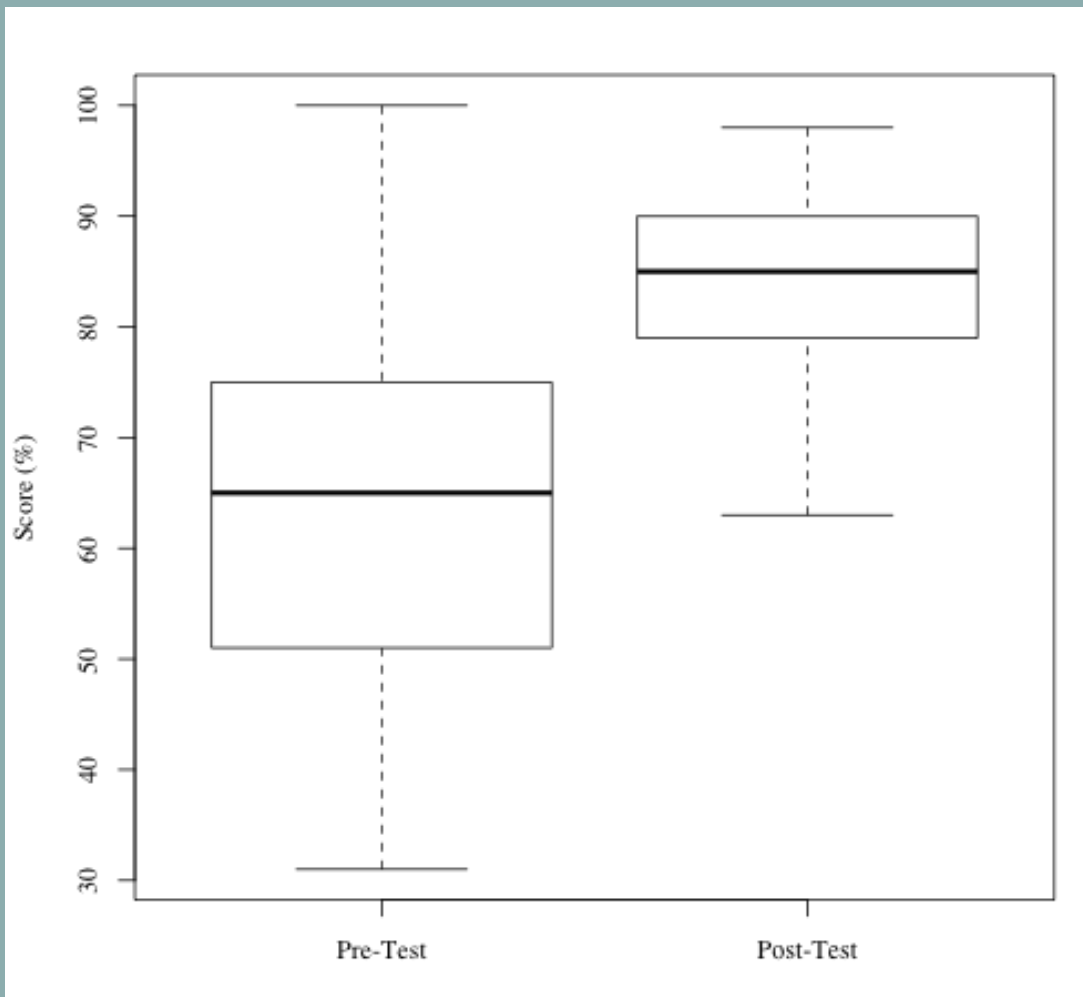


Figure 2. Treatment Group Chemistry Skills Review Exam Score Distribution, (N=27) .

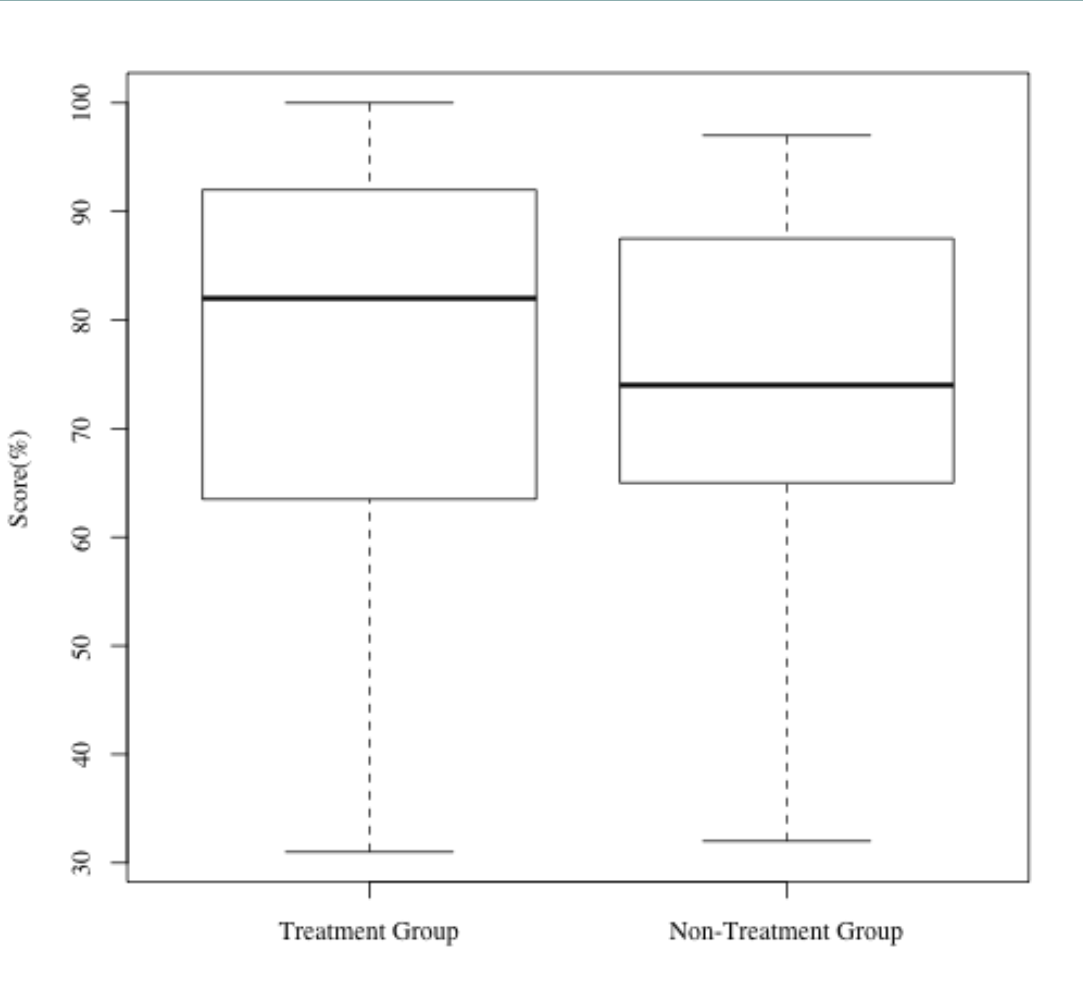


Figure 4. Summative Unit Exam Scores for the Treatment Group, (N=27), and for the Non-Treatment Group, (N=31).

Conclusion

The results of this study show that conducting performance assessments of students laboratory skills had a positive effect on student’s attitudes toward laboratory work and toward chemistry in general. A more reflective attitude toward their self-assessment was also displayed. Finally, the treatment group made real progress on both the theoretical and practical aspects of chemistry.