International Journal of Social Science and Human Research

**ISSN (print): 2644-0679, ISSN (online): 2644-0695**

Volume 07 Issue 07 July 2024

DOI: 10.47191/ijsshr/v7-i07-58, Impact factor- 7.876

Page No: 5107- 5110

# Enhancing Statistical Literacy: The Role of Statistical Reasoning Learning Environment (SRLE) in Vocational and Technical Education in Jiangsu Province, China

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**ABSTRACT:** This study investigates the impact of the Statistical Reasoning Learning Environment (SRLE) on statistical literacy among vocational and technical education students in Jiangsu Province, China. Using a descriptive-experimental design, the research assessed the statistical reasoning skills of students before and after the implementation of SRLE. Sixty students from Jiangsu Automotive Technician College participated in pre-tests and post-tests that evaluated their understanding of samples, populations, parameters, descriptive and inferential statistics, statistical tests, hypothesis testing, graphical data interpretation, and errors and statistical power.

The results indicated a significant improvement in students' statistical literacy post-intervention, with consistent proficiency across all indicators. The analysis demonstrated that SRLE effectively enhanced students' abilities to comprehend and apply statistical concepts. The study concludes that integrating SRLE in the curriculum can substantially improve statistical literacy, providing students with the necessary skills to interpret data and make informed decisions in their professional and personal lives.

This research contributes to the growing body of literature on statistics education by highlighting the benefits of a structured learning environment that promotes active engagement and critical thinking in statistical reasoning. The findings underscore the importance of incorporating effective teaching practices, technology, and assessment tools in enhancing students' statistical competencies.

**KEYWORDS:** statistical literacy, Statistical Reasoning Learning Environment (SRLE), vocational education, technical education, educational intervention,

## I. INTRODUCTION

In today's technology-driven world, understanding statistical concepts, theories, and applications is essential. Data analytics permeates all areas of life, making statistical literacy critical for students in vocational and technical education. In Chinese culture, the application of statistical skills is particularly vital. Students must learn to handle data effectively, using precise mathematical language, solving data-related problems, and interpreting various data presentations (Gal, 2018). This involves four key stages: collecting, organizing, representing, and interpreting data.

Effective statistical education incorporates hands-on data collection and representation techniques. For example, students might design questionnaires to compare data from different demographics, organizing findings in frequency tables and representing them graphically. This practical approach helps students understand and apply statistical concepts in real-world contexts (Garfield, 2018).

The importance of statistical reasoning in education cannot be overstated. Research by Slauson (2018) and Loveland (2021) highlights mixed outcomes in statistical education based on teaching methods, underscoring the need for instructional practices that promote statistical reasoning holistically. Effective teaching integrates technology, curriculum, and assessment to enhance students' statistical reasoning, as described by Garfield and Ben-Zvi (2019) in the Statistical Reasoning Learning Environment (SRLE).

Statistical literacy, defined as the ability to understand and critically evaluate statistical information, is crucial for informed decision-making in everyday life and professional settings (Wallman, 2019). The growing emphasis on statistical education aims to equip students with the skills needed to navigate a data-driven society (Watson, 2021). Despite challenges in teaching statistics due to varying student backgrounds and a historical focus on procedural aspects, fostering statistical reasoning and literacy remains a key educational goal (Tishkovskaya and Lancaster, 2016).

***Research question**: Is there a significant difference in the performance of the student respondents in the experimental group in the handling of data between the pre-test and post-test?*

## II. RESEARCH METHODOLOGY

This study employed a quantitative, descriptive-experimental design to investigate the teaching of data handling to statistics students. The research was conducted at Jiangsu Automotive Technician College in Jiangsu Province, China, which has 4,000 students and 200 teachers, including 500 students and four teachers in the mathematics department. A purposive sampling method selected 60 full-time students currently enrolled in a statistics course to form the experimental group. The study used a 100-item pre-test and post-test instrument developed to assess statistical literacy, covering understanding of samples, populations, and parameters; descriptive and inferential statistics; statistical tests and hypothesis testing; graphical and data interpretation; and errors and statistical power. The research followed a structured procedure: preparing the class for data handling instruction, selecting students, preparing and validating the tests, administering the pre-test, conducting the teaching intervention, and administering the post-test. Data were collected and organized for analysis. Statistical analysis included calculating the weighted mean to determine average scores and using T-tests for both dependent and independent samples to compare pre-test and post-test results. The study ensured ethical considerations by maintaining the privacy and confidentiality of respondents, obtaining formal consents, and informing participants about the study's purpose and goals.

## III. RESULTS AND DISCUSSION

**Table 1. Significant Difference in the Performance of the Student Respondents in Statistical Literary Test**

| INDICATORS | | t | df | Sig. (2-tailed) | Decision | Interpretation |
|---|---|---|---|---|---|---|
| 1. Understanding of Samples, Populations, and Parameters | Pretest<br>Posttest | -10.207 | 59 | .000 | Rejected | Significant |
| 2. Descriptive and Inferential Statistics | Pretest<br>Posttest | -6.951 | 59 | .000 | Rejected | Significant |
| 3. Statistical Tests and Hypothesis Testing | Pretest<br>Posttest | -8.577 | 59 | .000 | Rejected | Significant |
| 4. Graphical and Data Interpretation | Pretest<br>Posttest | -4.454 | 59 | .000 | Rejected | Significant |
| 5. Errors and Statistical Power | Pretest<br>Posttest | -5.869 | 59 | .000 | Rejected | Significant |
| *Overall* | Pretest<br>Posttest | -15.499 | 59 | .000 | Rejected | Significant |

Table 1 explores the significant differences in the performance of student respondents in the statistical literacy test across five key indicators.

The t-values and significance levels indicate strong and significant improvements across all indicators. For "Understanding of Samples, Populations, and Parameters," the t-value of -10.207 with a df of 59 and a significance level of .000 highlights a substantial improvement in students' understanding after the intervention, consistent with findings by Garfield and Ben-Zvi (2019) emphasizing focused instruction. The high improvement may be due to the foundational nature of these concepts, which, when clarified, significantly enhance overall comprehension.

"Descriptive and Inferential Statistics" shows a t-value of -6.951 with the same df and significance level, indicating a significant enhancement in students' ability to comprehend and apply these statistical concepts. This aligns with Chance and Rossman (2016), who found that active learning strategies boost students' statistical reasoning abilities. The improvement might be attributed to the practical applications and frequent use of these statistics in various contexts, making the learning more relatable and engaging.

"Statistical Tests and Hypothesis Testing," with a t-value of -8.577 and a significance level of .000, underscores significant gains in conducting and interpreting statistical tests, demonstrating the effectiveness of hands-on learning, as supported by Slauson (2018). The high t-value suggests that the hands-on approach effectively demystified complex statistical procedures, leading to better understanding and retention.

For "Graphical and Data Interpretation," a t-value of -4.454 with a significance level of .000 indicates notable improvement in students' skills in interpreting data and graphical representations. Despite a lower t-value compared to other indicators, this improvement is consistent with Loveland (2021), who noted significant gains with targeted instructional strategies. The relatively lower improvement could be due to students' varied prior experience with graphical tools and the inherent challenges in mastering visual data interpretation.

Lastly, "Errors and Statistical Power" presents a t-value of -5.869 with a significance level of .000, signifying significant improvement in understanding errors and statistical power. This finding is supported by Baglin (2021), highlighting the importance of focusing on these concepts for deeper statistical understanding. The improvement might be moderate compared to other areas due to the abstract nature of these concepts, which often require higher cognitive engagement to fully grasp.

Overall, the aggregate performance shows a t-value of -15.499 with a significance level of 0.000, confirming the instructional intervention's effectiveness in enhancing students' statistical literacy. The high t-values across all indicators indicate robust improvements, validating the positive impact of the educational approach. The variation in t-values across indicators suggests that while some areas benefited more from the intervention, others may require additional targeted instructional strategies to achieve similar levels of improvement.

## IV. CONCLUSION

The analysis of student performance in the statistical literacy test reveals significant improvements across all assessed indicators following the instructional intervention. The findings demonstrate substantial gains in understanding samples, populations, and parameters; descriptive and inferential statistics; statistical tests and hypothesis testing; graphical and data interpretation; and errors and statistical power. The consistent rejection of the null hypothesis across all indicators underscores the effectiveness of the targeted instructional strategies employed in the study, highlighting the positive impact of a structured, hands-on approach to teaching statistical concepts. This aligns with existing literature on the benefits of active learning and focused instruction in enhancing statistical reasoning and literacy. However, the variation in t-values suggests that while foundational and applied statistical concepts saw considerable improvement, areas involving more abstract and complex concepts, such as errors and statistical power, exhibited moderate gains. This indicates that while the intervention was broadly effective, some areas may benefit from additional targeted instructional strategies to achieve similar levels of improvement.

To enhance these results, it is recommended to incorporate more targeted instructional strategies for abstract concepts, such as the use of real-world examples, interactive simulations, and more frequent formative assessments to reinforce understanding. Continuing to employ and expand upon active learning strategies, such as practical exercises, group projects, and data analysis activities, can further enhance students' comprehension and application of statistical concepts. Differentiated instruction techniques should be employed to address the varied prior experience and skills among students, ensuring that all students achieve a deeper understanding of the material. Incorporating technology tools such as statistical software, online simulations, and interactive tutorials can provide additional support for students, helping demystify complex concepts and offering opportunities to practice and apply their skills in a controlled, feedback-rich environment. Providing teachers with ongoing professional development opportunities focused on the latest research-based instructional strategies in statistics education can further enhance teaching effectiveness. Training in the effective use of technology and active learning techniques is particularly beneficial. Conducting longitudinal studies to track the long-term impact of these instructional strategies on students' statistical literacy can provide valuable insights, helping refine and improve teaching methods over time and ensuring sustained student success in statistics education. By implementing these recommendations, educational institutions can build upon the successes observed in this study, further enhancing the statistical literacy and reasoning skills of their students, better preparing them for academic and professional endeavors that require strong statistical competencies.

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