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ENHANCING STATISTICAL LITERACY THROUGH STATISTICAL REASONING LEARNING ENVIRONMENT (SRLE) APPROACH IN JUNIOR HIGH SCHOOL

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ABSTRACT

The study investigated the efficiency of a statistical reasoning learning environment focusing on the four stages of handling data (collecting, organizing, representing, and interpreting) in augmenting junior high school students' performance and statistical literacy in handling data. Using a quantitative descriptive–experimental design, two Grade 7 classes (control and experimental, 30 students each group) were exposed to different instructional approaches: the control group received the usual teacher-centered instruction, while the experimental group experienced a structured handling-of-data intervention aligned with principles of the Statistical Reasoning Learning Environment. Pretests and post tests, developed and validated by the researcher, were administered to both groups, and data were analyzed using weighted means and dependent and independent t-tests at a 5% level of significance. Results showed substantial gains from pretest to posttest in both groups, with mean scores increasing from 4.00 to 9.27 in the control group and from 3.07 to 8.87 in the experimental group, and all computed t-values were significant, leading to the rejection of the null hypotheses. These findings indicate that clear instruction grounded in the four stages of handling data significantly improves students' achievement and supports the development of statistical reasoning, suggesting that integrating structured data-handling learning processes in mathematics instruction can serve as a practical framework or trajectory for teachers, school leaders, and curriculum designers in promoting statistical literacy at the secondary level.

Keywords: *Statistical Reasoning, Statistical Data, Statistical Literacy, Data Management*

INTRODUCTION

The importance of statistics in everyday life and workplace has led to calls for increased attention to statistical literacy in the mathematics curriculum. Statistical reasoning is and should be a clear goal of statistical instruction.

Essentially there are four stages involved in handling data: collecting it, organizing it, representing it, and interpreting it.

This type of learning requires much more effort to develop and assess. The use of effective teaching practices that incorporate technology, curriculum, and assessment as learning tools can increase students' statistical reasoning and thinking. Garfield and Ben-Zvi (2018) have described this integration of teaching, technology, curriculum, and assessment that in the statistics education literature as the Statistical Reasoning Learning Environment (SRLE).

This study aimed to enhance the teaching of statistical handling of data to students and the desired outcome is to develop statistical thinking and reasoning.

Students should be taught to : select and use handling data skills when solving problems in other areas of the curriculum, in particular science, decide how best to organize and present findings; use the precise mathematical language and vocabulary for handling data; solve problems involving data; interpret tables; lists and charts used in everyday life; construct and interpret frequency tables, including tables for grouped discrete data; represent and interpret discrete data using graphs and diagrams, including pictograms, using ICT (information communication technology) where appropriate; recognize the difference between discrete an continuous data; draw conclusions from statistics and graphs and recognize when information in a misleading way.

Students should learn how to collect data as part of a purposeful enquiry, setting out to answer specific questions that they might raise. This might involve the skills associated with designing simple questionnaires. For example, as part of a geography – focused project on transport, they might decide to collect data about how students travel to school and seek to make comparisons between, say, students, in a rural school and those in a city school. A useful technique is that of tallying based on counting in fives. Data should then be organized in a frequency table which shows both these processes for the information collected from a Year 5 class in a rural school.

Various skills of graphs and diagrams can then be used to represent the data, before the final step of interpreting it.

While not exactly data collected in the classroom, student records provide useful information. Taking the time to review student files and counseling records, the teacher will have some reference points from which to compare the data from within the class.

Students can be engaged in various ways to produce a lot of helpful information. By creating fun projects for students to report their own progress, teachers can gain more insight into how the student perceives their own accomplishments and ability.

If teaching the Common Core curriculum, create bar charts that students can color in to indicate their own level of understanding of the material. Create a chart to post on the wall that students will sign when they feel they have mastered a particular problem. Use this with smaller, discreet assignments so students will see their own accomplishment. Place a large, lined sheet on the wall to capture student questions about a certain topic. Address the questions at the beginning of each presentation.

Similarly, create a place where students can make comments on the material and topic presented. For K-6, this could be the sheet of paper on the wall or a binder placed in the classroom. For 7-12, this could be an online blog or comment section on a classroom website. Help students create their own learning goals and track them. Students will also learn about goal setting as they decide their individual targets.

In the (post-) pandemic world, it is important for students to learn this skill. They will use it in their future mathematics and research subjects. Moreover, in a research-driven world, students will find themselves using this skill to determine certain aspects of the world.

Garfield (2018) stated that statistical thinking and reasoning should be the desired outcomes for a course; however, “no one has yet demonstrated that a particular set of teaching techniques or methods will lead to the desired outcomes” (p. 10). Since Garfield’s discussion, the limited number of studies that have attempted to measure outcomes in statistics education based on teaching methods have had mixed outcomes according to Loveland (2014).

Based on this fact and the need to understand how students reasoning ability in statistics is developed holistically, peer reviewed research articles that dealt with teaching practice and outcomes related to reasoning were reviewed. In addition, teaching principles and standards were reviewed to determine what composes effective teaching in statistics. The following two subsections highlight some of the recent work in these two areas as they relate to statistics education.

Slauson (2018) investigated the difference between student learning of variation from a standard lecture-based format and a format emphasizing experimentation in two different sections of an introductory statistics course at the tertiary level. To measure outcomes of the experiment, they used a pre and post multiple-choice assessment that focused on statistical reasoning. Results were also gathered through student interview questions related to variation. In analyzing results from the reasoning assessment, they found improvement in students’ statistical reasoning about standard deviation in the hands-on experiment group but not in the lecture-based group. There was no statistically significant improvement found in students’ reasoning about sampling distributions. The effect size, however, was minimal with approximately only one more question being answered correctly. For this reason, there were no statistically significant differences

found between differences in pretest and posttest the hands-on experiment learning and lecture-based classes.

In her study, Loveland (2014) subdivided one section of an introductory statistics course at the university level into two sections taught by the same teacher. One section was taught with entirely lecture-based teaching methods and the other with largely active learning methods that included group work, hands on activities to gather data, and teacher facilitation with minimal amount of lecture. She investigated whether students developed more conceptually, procedurally, or both using active learning environments. After completing the courses, she found no difference between students' ability to comprehend statistics or complete statistical procedures in the traditional lecture based and active learning-based course. She used stepwise selection to determine the most significant effects in her study. This procedure found that previous GPA, pretest points, and attendance were the most contributive predictors of student achievement whether classes were lecture based or activity based being insignificant.

Given this phenomenon, Baglin (2013) and Loveland (2014) both looked at promoting reasoning and thinking holistically, but in one class being taught by the same instructor in two different ways. Based on this gap in the research literature, this study began by looking for answers to the broad question, "What instructional practices promote statistical reasoning most effectively?" Thus, this study exists to help explore the impact of effective teaching practices to the development of statistical reasoning. Though teaching methods promote reasoning, other factors such as technology, curriculum, and assessment could promote statistical reasoning as well. For this reason, attention to teaching, technology, curriculum, and assessment are also potentially important components to consider in answering this broad question.

For students to learn statistics at deeper levels, they must learn statistics in ways that develop conceptual understanding of important statistical ideas at all levels of education (Pesek and Kirshner, 2018). National Council of Teachers of Mathematics (NCTM) (2014) stated that effective teaching and learning is composed of eight major practices related to learning mathematics and statistics: Establish mathematics goals to focus learning, implement tasks that promote reasoning and problem solving, use and connection mathematical representations, facilitate meaningful mathematical discourse, pose purposeful questions, build procedural fluency from conceptual understanding, support productive struggle in learning mathematics, and elicit and use evidence of student thinking (NCTM 2014).

Teaching that promotes statistical reasoning also incorporates the use of curriculum, technology, and assessment that is aligned with learning goals to promote in-depth learning (Garfield & Ben-Zvi, 2019). Curricula should provide progressions that allow students to build upon and develop their own knowledge through high-level tasks (NCTM 2014). Teachers should use technology to build students' conceptual understanding of statistics and not just as a means for computing statistics or presenting presentations (Chance & Rossman, 2016). Teachers should use assessments as an instructional tool. This provides a way for students to gain understanding while at the same time allows the teacher to gage student understanding (Petit et.al, 2016). Teachers who align their curriculum to in-depth learning goals, use technology to build conceptual

understanding, and use assessment as a learning tool are more likely to promote statistical reasoning and thinking.

Statistical reasoning is and should be a clear goal of statistical instruction. This type of learning requires much more effort to develop and assess. The use of effective teaching practices that incorporate technology, curriculum, and assessment as learning tools can increase students' statistical reasoning and thinking. Garfield and Ben-Zvi (2019) have described this integration of teaching, technology, curriculum, and assessment that in the statistics education literature as the Statistical Reasoning Learning Environment (SRLE).

Statistics that requires to organizing and interpreting data and inferring from numerical data for problem situations, permeates our lives and sorts out many sciences including mathematics is one of the important subjects of mathematics education. In literature, the importance and role of statistics upon our lives is frequently emphasized (Ben-Zvi & Garfield, 2018). In GAISE (2015) report it was stated that our lives are surrounded with quantitative and qualitative contexts. And it was suggested that "every high-school graduate should be equipped with statistical literacy to cope with the requirements of citizenship and to be prepared for a healthy, happy, and productive life" (p. 1). Ben-Zvi and Garfield (2018) stressed that when it was compared with the past, statistics instruction included more students from different educational levels and researchers, educators, adults started to draw attention to statistics mostly. As a result of the importance of statistics and emphasis about the necessity of the statistics education, individuals are expected to be aware and interpret the situations about their lives, and to be statistically equipped and statistically literate (Mittag, 2016). In this sense, statistical literacy, having a decisive role on daily life choices, preferences at supermarkets, decisions in our health, every field from media to politics (GAISE, 2015) is among the important areas of mathematics education too.

As statistics has a wide work area in mathematics education in recent years, statistical literacy emerges as a subject being mostly investigated and mostly stated about its' importance (Watson, 2016). Although statistical literacy is seen one of the important learning outcomes for the statistics field by many researchers (Garfield & delMas, 2016), it is underlined that statistical literacy has any widely accepted definition and extent yet (Whetstone, 2014). Therefore, there are many definitions based on different aspects of statistical literacy. Wallman (2019) defined statistical literacy as "an ability to understand and critically evaluate statistical results that permeate daily life, coupled with the ability to appreciate the contributions that statistical thinking can make in public and private, professional and personal decisions" (p. 1). Garfield (2019) emphasized 3 points in his statistical literacy definition (as cited in Rumsey, 2018):

1) Understanding statistics language: words, symbols, and terms.

2) Being able to interpret graphs and tables.

3) Read, interpret and make sense of different contexts in the news, media and daily lives.

Gal (2018) defined statistical literacy as an ability of discussing about statistical information or interpreting the possible situations, evaluating critically, and expressing their opinions; with this definition he drew attention to the fact that statistical literacy required critical stance and interpreting skills. Hovermill et.al. (2014) stressed the importance of the understanding of statistics within the relevant for statistical literacy. In GAISE (2016) report statistical literacy defined as to know what statistical terms and symbols mean, to understand the basic language or fundamental ideas of statistics, to be able to interpret statistical graphs. From these definitions; we could define statistical literacy to interpret table and graphs, to infer from data, to make effective decisions, to critically evaluate, to know the basic language of statistics, to adopt the terminology of statistics, and to interpret the relevant contexts

In GAISE (2015) report, it was noted that statistical literacy is essential for personal lives and important for our daily personal choices, and it provides us to make decision about the quality of foods and their effect on our shopping in this direction. Also, Ramirez et.al. (2017) noted that raising statistical literate individuals should be an ultimate goal of statistics education. Chick and Pierce (2017) stressed that statistical literacy is a basic requirement to raise students as being able to make sense of data and to take efficient decisions related daily life situations. Wallman (2019) emphasized promoting the statistical literacy level for all citizens whatever their level of education in the nineties and stressed that one of the aims of the teachers in elementary and secondary schools to raising their students as statistical literate. Mittag (2016) stressed the importance of statistical literacy as a key qualification for employers and policy makers in educational institutions and remarked on promoting it. Biggeri and Zuliani (2019) pointed out that statistical literacy is an essential for democratic life and has an important role on keeping pace within the age of information and computers in real sense and making decision on daily life situations independently and effectively. Packer (2017) stressed the increasing need for statistical literate people in many workplaces, and the importance of understanding statistical information through these needs for workers to promote quality of processes. In GAISE (2015) report; statistical literacy is called as an ultimate goal. Also this goal is explained in report with the idea that “people are surrounded with statistical information on topics ranging from the economy to education, from movies to sports, from food to medicine, and from public opinion to social behavior in either newspaper or other media reports”(p. 1). Also, it is stressed that individuals could cope with statistical information at work, and teachers may engage in statistics concerning their students’ performance or own responsibilities. Therefore, report points out the importance of statistical knowledge on many disciplines as understanding and making sense of statistical results such experiments as testing the drugs in medical sciences or determining crime statistics and getting results in law enforcement field (GAISE, 2015). So, the importance of statistics and its surrounding our lives is understood. Since job groups are differed, it is seen that statistical literacy is an essential quality to maintain more successful and productive professional lives. At this point, as future individuals, for undergraduate students the importance of being statistical literate has arisen. And the question that “to what extent statistics courses contribute to this aim” is revealed.

Ben-Zvi and Garfield (2014) stressed to focus more on statistical literacy, reasoning, and thinking rather than teaching based on skills, procedures, and

computations in statistics courses. Chance (2018) noted that statistics courses should aim to teach individuals through "what is needed for an informed consumer of statistical information". Rumsey (2018) stated that "any introductory statistics course should raise students' awareness of real-life data and prepare them for a career for information age in today". Hassad (2017) referred to give a place on concepts and their applications rather than calculations, procedures and rules as underlining the importance of reform-based (concepts based) teaching of statistics to develop statistical literacy. Reston (2015) suggested that challenges emerging in the statistics courses should be overcome by incorporating statistical literacy in the statistics course's contents in undergraduate education and studies should be carried out in this way considering the multidimensional and dynamic nature of statistical literacy. Parallel with these emphasizes, the importance of inquiring to what extent statistics courses focused on statistical literacy in statistics courses practices emerged.

Undergraduate education is an important stage for individuals to embark on life and to be successful at their works in the future. In this stage, education related students' professions are given through course contents which specific for faculties and their departments, practices about the professions, total credits, theoretical, laboratory, and practice lessons. The aim is raising individuals as equipped with requirements of their professions. Lessons and the content of these lessons are differed depending on students' professions. However, work groups are different, statistics has emerged as one of the common lessons in undergraduate programs. For statistics being a common lesson at undergraduate programs indicates that statistical knowledge is a common requirement for professional lives of individuals. Considering the importance of being statistical literate individuals, determining to what extent practices in statistics courses contents focus on statistical literacy is important. Also subjects and information in statistics courses may vary in different profession groups. And this situation reveals the question as "What kind of practices related statistical literacy take part in statistics courses in profession groups?". Also, in which aspects practices are being differed or similar is gained importance. Thus, it would be seen that how statistics course practices change depending on professions as revealing different and similar aspects of profession groups in terms of statistical literacy.

Statistical reasoning is and should be a clear goal of statistical instruction. This type of learning requires much more effort to develop and assess. The use of effective teaching practices that incorporate technology, curriculum, and assessment as learning tools can increase students' statistical reasoning and thinking. Garfield and Ben-Zvi (2018) have described this integration of teaching, technology, curriculum, and assessment that in the statistics education literature as the Statistical Reasoning Learning Environment (SRLE).

Garfield and Ben-Zvi's (2019) description of the SRLE is a socio-constructivist approach to instruction. The SRLE falls in close alignment with NCTM teaching principles (2016) and teaching practices (2014) that foster student engagement and classroom discourse between students and the teacher, NCTM professional teaching standards to promote discourse (2016), and other educational research on promoting discourse (Smith and Stein 2011). The SRLE also includes components of assessment that include

students in the assessment process and use assessment to advance student reasoning and thinking. The SRLE has six principles of instructional design that are aligned with Cobb and McClain (as cited by Garfield and Ben-Zvi (2019)).

1. Focus on developing central statistical ideas rather than on presenting set of tools and procedures.
2. Promote classroom discourse that includes statistical arguments and sustained exchanges that focus on significant statistical ideas.
3. Use assessment to learn what students know and to monitor the development of their statistical learning as well as to evaluate instructional plans and progress.
4. Integrate the use of appropriate technological tools that allow students to test their conjectures, explore and analyze data, and develop their statistical reasoning.
5. Use real and motivating datasets to engage students in making and testing conjectures.
6. Use classroom activities to support the development of students' reasoning

Garfield and Ben-Zvi's (2018) six elements provided a framework in which to monitor effective teaching practices in statistics. Previous study designs did little to attempt to integrate each of these elements into their methods for monitoring teacher effect on students' development of statistical reasoning. Given the previous research on socio-constructivist learning environments and their effects, a study looking at the six principles of the SRLE concurrently is needed. In addition, a careful design that includes each of the SRLE components may also change the findings in which effects were previously not found. The literature review thus imposes key research questions in which to explore.

In our data-driven technological society, the need to understand and to apply statistical literacy is paramount across all walks of life (Watson, 2014). Challenging statements and research reports such as above regularly appear in media reports and the basis for decision-making should be statistics rather than feelings and beliefs (Ingram, 2015). For instance, citizens need to understand that headlines such as above were determined from a sample of the population under study and the conclusions may be subject to confounding variables and sampling error. Indeed, citizens without statistical literacy may not be able to discriminate between credible and incredible information and will have difficulty in interpreting, critically evaluating and communicating reactions to such messages (English & Watson,2016).

The importance of statistics in everyday life and workplace has led to calls for an increased attention to statistical literacy in the mathematics curriculum. Professional organizations such as the National Council of Teachers of Mathematics (2016) in the United States and the New Zealand curriculum document (Ministry of Education, 2017) promote a critical perspective towards statistics. Franklin et al. (2017, p. 1) write that 'Every high school with the requirements of citizenship, employment, and family and to be prepared for a healthy, happy, and productive life'. Additionally, schools are being asked to prepare students to be flexible thinkers, to be lifelong learners, and to manage complexities of an uncertain world (Ministry of Education, 2017; Watson, 2016). Having a good grasp of social statistics can help citizens deal with a complex array of issues and participate actively in public debates and assert their rights (English & Watson, 2016).

Statistical literacy is especially important in a digital age where students are constantly presented with statistics from a variety of competing sources (Frost, 2013).

Leading statistics educators such as Garfield and Ben-Zvi (2019) claim that despite the widespread emphasis on reform in the learning and teaching of statistics, statistics education is still viewed as an emerging and challenging discipline, when compared to other learning areas. Tishkovskaya and Lancaster (2016) argue that teaching statistics is challenging because it serves students with varying backgrounds and abilities, some of whom may have had negative experiences with statistics. Another reason could be that statistics education in schools focuses on the procedural and computational aspects of statistics rather than on developing conceptual understanding (Shaughnessy, 2017).

The traditional emphasis on skills development has resulted in many students not being able to think or reason statistically and led to the call for statistics education to focus on statistical thinking and literacy (Moore, 2017). According to Jacobe, Foti, and Whitaker (2014), with increased expectation for teaching statistics comes the demand for tools to properly assess the conceptual understanding of learners of statistics. However, most large-scale assessments still emphasize procedures. There is a need to measure current understanding in relation to expectations set forth by curriculum documents.

Moreover, there is a lack of a clear definition of statistical literacy. Statistics educators, statisticians and researchers around the world have not reached a consensus (English, 2013) and hence numerous definitions of statistical literacy abound.

This study uses the Three-Tiered Statistical Literacy Hierarchy by Watson (2017). Statistical literacy models were developed to evaluate statistical literacy in a wider framework and to approach statistical literacy theoretically. When we analyzed statistical literacy models in the literature (Gal, 2018), it was focused on specific components in the models. Watson (2017) presented a three-tiered Statistical Literacy Hierarchy. These tiers are (a) an understanding of statistical terminology, (b) an understanding terminology in social contexts, and (c) the ability to question claims made without proper statistical justification (p. 2). Gal (2018) identified knowledge and dispositional elements that were essential for the development of statistical literacy. Knowledge elements (literacy, statistical knowledge, mathematical knowledge, context, critical questions) are the ability to use statistical and mathematical knowledge, critically evaluate and reason statistical information in a variety of contexts. Dispositional elements (beliefs, attitudes, and critical stance) consist of beliefs, concern, and willingness about the competence of applying current knowledge and skills (p. 4).

In her statistical literacy model Watson (2016) presented context, task format, task motivation, data collection-representation-data analyses-inference, variation, literacy skills, and mathematical/statistical skills components. When we analyzed models, it was seen that Gal (2018) and Watson (2016) models show more resemblance. At the same time one component is more restricted in one of the models could be discussed in a wider extent in other models. Also components which are emphasized in all three models draw attention. However, they are called with different names; context and understanding the concepts and terminology components take place in all three models. It was realized that it could be very difficult to distinguish different components in models. Therefore, it was

planned to adopt a model which includes components in all these models in the literature and help us to distinguish differences between components. Although critical approach is taken part in Gal (2018) and Watson (2017) models separately, this component is not represented in Watson (2016) model. But statements related critical approach and questioning could be seen in the component of mathematical-statistical skills in this model. And also the importance to develop critical stance and critically evaluate skills is emphasized (Gal, 2018). So, it seems necessary to provide critical approach component in our statistical literacy model.

As determining the components of statistical literacy model both literature and possible situations that could be observed at instruction are considered. However, dispositional factors such as motivation, concern are considered besides knowledge elements in the literature, it is thought that it would be difficult to observe this factor in the statistics classroom environment. Therefore, dispositional factors are not addressed within the scope of this study. Since statistical process component, including sampling, data collection and representation, and interpreting and inference stages was presented only in Watson (2016) model separately, these stages were seen in the statistical knowledge component of Gal (2018) model. Also, Newton et.al. (2011) highlighted statistical process stages as important for statistical knowledge.

Weiland (2017) referred a statistical process to explain statistical literacy as underlining some competencies as formulating statistical questions, collecting data for these problems, analyzing data with proper methods and displaying data in graphs, interpreting the data as addressing the questions and discussing about the meaning of the statistical information. In this way it is important to address statistical process basing on the efforts of individuals on statistical phenomena in statistical literacy model. As synthesizing statistical literacy models given in the literature in her model Özmen (2015) addressed Statistical process, Reasoning, Basic Concepts, and Context components.

The aim of this paper is the teaching of handling of data to students. And it tried to find answers to the profile of the students' respondents in terms of age and sex; performance of the experimental group in the handling of data for pre-test; performance of the students in the experimental in the post test; the mean gains of the experimental; and this led to the feedback generated from the students in the experimental group who used the four stages in handling data.

The interplay between and among these variables is seen in the paradigm.

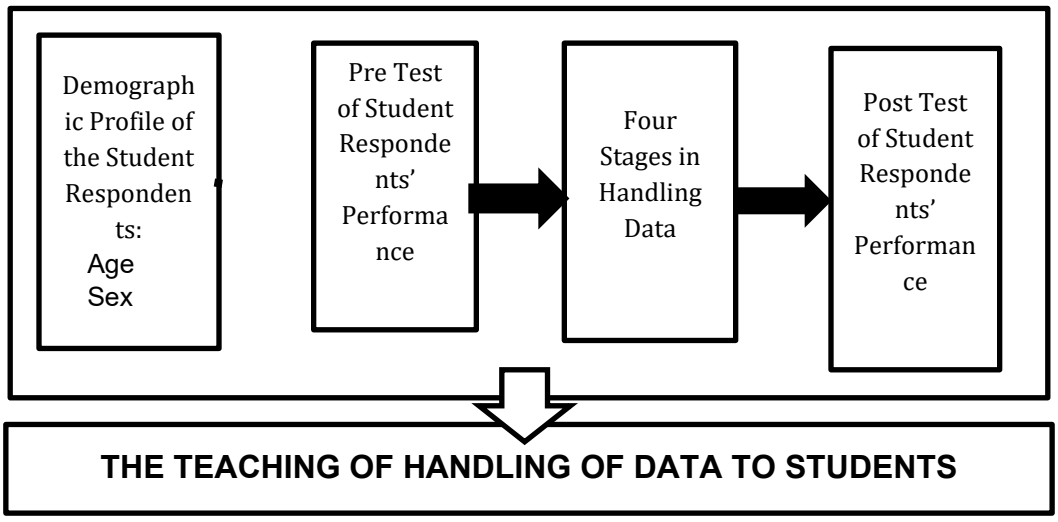

Figure 1. *Conceptual and/or Theoretical Framework for the Teaching of Handling of Data to Students*

As shown in the figure, the researcher first gathered data on the demographic profile of the student respondents, specifically, the student respondents' age and sex.

Then, the researchers investigated the pre-test performance of the experimental group in the handling of data. Afterward, the researchers looked into the performance of the students in the experimental with the performance of students in the post test. It was followed by the mean gains of the experimental.

Finally, the researchers led to the feedback generated from the students in the experimental group who used the four stages in handling data.

The following will benefit from the results of this study: *Teachers* – The study will serve as the teachers' guidelines on how to assess students' statistical reasoning and the the teaching of handling of data to students. This is one of the goals of the teachers in teaching statistics; to assess how the students fare in the subject. The study will aid them on how to teach statistical skills in the classroom. *Supervisors and School Heads* – This study is also beneficial to supervisors and school heads, specifically on areas for teacher evaluation. It allows them to determine how the teacher teaches statistical reasoning and the teaching of handling of data to students. It can also serve as avenues for further action research by the teachers and administrators regarding the topic. *DepEd Officials* – This study may also be beneficial for DepEd Officials in terms of refining the evaluation of how the teacher teaches statistical reasoning inside the Statistics classroom. Furthermore, the study can serve as a precursor on further studies about the topic. They can then disseminate results to schools to help teachers about strategies in teaching Statistics.

Research Questions

This study aimed to evaluate the effectiveness of the intervention by comparing the performance of learners under different conditions. Specifically, it sought to answer the following questions:

1. What is the performance of the control group in the handling of data for pre-test and post-test?
2. What is the performance of the experimental group in the handling of data for pre-test and post-test?
3. Is there a significant difference between the performance of the experimental and control group in the handling of data for pre-test and post-test?

METHODOLOGY

The study adopted quantitative research design particularly the descriptive-experimental design format with the two sections in the junior high of the researcher's Grade 7 class. This is to represent the experimental group. Since the major problem is centered on the teaching of handling of data to students, the treatment varied in terms of the exposure of the two groups of respondents. The teacher presented the lesson undergoing the usual process. Motivation was presented, followed by illustrative examples. Practice exercises were provided. At the end of each lesson, the students were evaluated.

The experimental group was exposed to the rigid prescription of the teaching of handling of data to students. In this approach, the teacher's role is to clarify questions that arise and his /her guide for activities provided in the teacher's package. The same motivation, illustrative examples, and exercises were provided.

The descriptive-experimental approach was the basic pattern employed. The experimental group was separated as described based on the results of the pre – test, post - test and their feedback to similar activities to which they were subjected.
Comparison between the two groups was made in terms of their scores on the pre and posttests.

The study underwent the following stages:

1. Preparation of class for the teaching of handling of data to students.
2. Selection of class.
3. Preparation and validation of pre and post-tests.
4. Pre – treatment administration of pre-test.
5. Treatment commented by the control group being exposed to the experimental group to the class using the teaching of handling of data to students.
6. Treatment continued until the post test was administered
7. Collection and organization of data for statistic testing and analysis.

The strengths and weaknesses along each area covered are also identified based on test results. After the post test, results were further analyzed to determine whether there are improvements in the strengths and weaknesses observed in the pre- test.

The Grade 7 junior high school students of the researcher under his classes were considered part of this experimental paper of Junior High School which has been in operation.

Participants were the Grade 7 of 60 students where 30 were traditional and 30 were intervention coming from the researcher's classes from her institution.

The gathered data were subjected to statistical treatment using the following: (1) weighted mean, which was used to determine the mean scores of the respondents on their pretest and posttest results, and (2) t-test for both dependent and independent samples, which was used to analyze the comparison of the pretest and posttest results for the dependent t-test and between the experimental and control groups for the independent t-test.

Furthermore, this study made use of the 5% level of significance in all the statistical analysis thereby providing 95% level of confidence in the rejection or acceptance of the stated hypothesis. Using the SPSS software, any value of Sig found lower than 0.05 level was rejected.

RESULTS

Table 1 presents the performance of the pupil respondents in the pre-test and post test of the control group.

Table 1
Performance of the Control Group in the Pre-Test and Post Test

	Mean	SD
Pre-Test	4.00	1.49
Post Test	9.27	0.78

Table 1 shows that the pupil respondents of the control group obtained a mean of 4.00, with a standard deviation of 9.27 in the pre-test. Moreover, they obtained a mean of 1.49, with a standard deviation of 9.78 in the post test.

This shows that the pretest score for the control group is lower (M=4.00, SD=1.49) than the post test score (M=9.27, SD=0.78).

Table 2 presents the performance of the pupil respondents in the pre-test and post test of the experimental group.

Table 2
Performance of the Experimental Group in the Pre-Test and Post Test

	Mean	SD
Pre-Test	3.07	1.17
Post Test	8.87	1.20

Table 2 shows that the respondents of the experimental group obtained a mean of 3.07, with a standard deviation of 1.17 in the pre-test. Moreover, they obtained a mean of 8.87, with a standard deviation of 1.20 in the post test.

This shows that the pretest score for the experimental group is lower (M=3.07, SD=1.17) than the post test score (M=8.87, SD=1.20).

Table 3 shows the effectiveness of the four stages in handling data.

Table 3 shows that the student respondents in the control and experimental groups' pretest and post-test have computed t-values of -18.585 and -23.110, respectively, with a significance value of 0. Since the significance value is lower than the set significance value of 0.05, the null hypothesis is rejected. This shows that the four stages in handling data are effective; wherein, the pupil respondents in the control obtained a higher score in the post test than those in the experimental group.

Table 3
Effectiveness of Four Stages in Handling Data

	Mean	SD	Computed T-value	Sig	Decision on Ho	Interpretation
Control Group Pre-Test	4.00	1.49	-18.585	0	Rejected	Significant
Control Group Post Test	21.10	2.26				

Experimental Group Pre-Test	3.07	1.17	-23.110			
Experimental Group Post Test	8.87	1.20				

In many academic programs, courses on research methods are obligatory (Parker et al., 1999). The reason for this is sound; making sense of data is an essential skill in both academia and in many roles in society (Bridges et al.1998; Markham, 1991). However, previous research highlights that this enthusiasm for skills in research methods is not shared by all students. Instead, students in several disciplines have been reported to want to delay or avoid research method courses in general, and particularly quantitative method courses are often seen as negative by students in the social sciences (Paxton, 2006; Sankowsky, 2006).

Among teachers of quantitative methods, who must deal with students who have negative attitudes toward the topic, both anxiety and a lack of motivation has been observed in the student population (Wilder, 2010). Onwuegbuzie and Wilson (2003) argue that “statistics anxiety” can seriously harm academic performance and found evidence that certain groups of students, such as women and older students, perceive a higher level of anxiety than younger male students. Anxiety often goes together with a lack of motivation to learn (Onwuegbuzie and Wilson, 2003; Sundt, 2010). Here, research methods in general, and quantitative methods in particular, are often described as unpleasant, uninteresting or boring (Markham, 1991). As personal interest is a strong motivational factor for learning, the lack of interest is a serious inhibitor of learning (Sundt, 2010).

Several factors have been suggested to be the root causes of anxiety and lacking motivation. One such, which has received considerable attention, is that of self-confidence or self-efficacy (Paxton, 2006; Sundt, 2010). Self-confidence has in previous psychologically oriented studies been related to various cognitive capabilities, such as problem solving (Metcalfe, 1986) and recognition (Schachter, 1983). Low levels of perceived competence have further been shown to have an impact on behavioral outcomes within the educational system, such as choice of specialization of college majors (Hackett and Betz, 1989). The connection to anxiety is highlighted by Bridges et al. (1998), who argue that “Those who feel incapable of doing mathematical operations often experience extreme anxiety about the simplest statistical operations” (p. 15). This observation is confirmed in a study on determinants of anxiety where Onwuegbuzie (2000) highlight that the students with the lowest level of academic confidence also experience the highest levels of anxiety. As many students have low self-esteem when it

comes to mathematics (Lalayants, 2012), it is not thus surprising that anxiety is a widespread phenomenon among students.

DISCUSSION

The data show that the pupil respondents of the control group obtained a mean of 4.00, with a standard deviation of 9.27 in the pre-test. Moreover, they obtained a mean of 1.49, with a standard deviation of 9.78 in the post test.

Also, the pupil respondents of the experimental group obtained a mean of 3.07, with a standard deviation of 1.17 in the pre-test. Moreover, they obtained a mean of 8.87, with a standard deviation of 1.20 in the post test.

Additionally, the student respondents in the control and experimental groups' pretest and post-test have computed t-values of -18.585 and -23.110, respectively, with a significance value of 0. Since the significance value is lower than the set significance value of 0.05, the null hypothesis is rejected.

Conclusions

In conclusion, the pretest score for the control group is lower (M=4.00, SD=1.49) than the post test score (M=9.27, SD=0.78).
Furthermore, the pretest score for the experimental group is lower (M=3.07, SD=1.17) than the post test score (M=8.87, SD=1.20).

Finally, the four stages in handling data are effective; wherein, the pupil respondents in the control obtained a higher score in the post test than those in the experimental group.

Recommendations

It is recommended that administrators, school heads, supervisors, and teachers who use the four stages in handling data actively strengthen their competence in teaching research. They should design/propose seminars, trainings, and workshops focused on research instruction and regularly consult updated research textbooks to ensure that their content knowledge and examples reflect current developments. In addition, they need to stay informed about contemporary strategies and techniques in teaching research, conduct action research in their own classrooms to refine their practices, and participate in round table discussions with fellow research teachers to update and review topics and information related to the teaching of handling data.

The following is the recommended proposal crafted by the researchers to further apply the principles of statistical literacy both in the educators and the learners.

A PROPOSAL FOR THE STATISTICAL REASONING LEARNING ENVIRONMENT (SLRE) : THE TEACHING OF STATISTICAL LITERACY

I. Rationale

One of the important parts of the research paper, most especially if it is a quantitative one, is on how to organize, describe and interpret data. So, it is important that the research teacher knows how to teach handling data. In doing so, the research students would know how to handle data.

Slauson investigated the difference between student learning of variation from a standard lecture-based format and a format emphasizing experimentation in two different sections of an introductory statistics course at the tertiary level. To measure outcomes of the experiment, they used a pre and post multiple-choice assessment that focused on statistical reasoning. Results were also gathered through student interview questions related to variation. In analyzing results from the reasoning assessment, they found improvement in students' statistical reasoning about standard deviation in the hands-on experiment group but not in the lecture-based group. There was no statistically significant improvement found in students' reasoning about sampling distributions. The effect size, however, was minimal with approximately only one more question being answered correctly. For this reason, there were no statistically significant differences found between differences in pretest and posttest for the hands-on experiment learning and lecture-based classes (Slauson, 2008).

Target	Activity/ies	Persons Involved	Time Frame	Budget	Performance Indicators
Propose /Attend seminars/ trainings/ workshops in teaching research	Seminars/ Trainings/ Workshops in teaching research	Administrators School Heads Supervisors Teachers	School Year Beginning	Donations Sponsors Solicitation	Attended seminar/ training/ workshop on teaching research
Consult updated research textbooks	Acquiring complementary copies of research textbooks Selecting research textbooks	Administrators School Heads Supervisors Teachers	School Year Beginning	Donations Sponsors Solicitation	Acquired complementary copies of research textbooks Selected research textbooks
Be updated on	Create learning	Supervisors	Daily	Donations	Learning Plans

current strategies and techniques in teaching research	plans in research using current strategies and techniques	Teachers		Sponsors Solicitation	
Do action research in teaching research	Action research made by research teachers	Administrators School Heads Supervisors Teachers	Year End	Donations Sponsors Solicitation	Action research presentations
Do round table discussion with research teachers to update and review topics and information related to the teaching of handling data	Round table discussion on research teaching	Administrators School Heads Supervisors Teachers	Quarterly	Donations Sponsors Solicitation	Results of Round Table Discussions

II. Objectives

The following indicated techniques are intended for the administrators, school heads, supervisors, and teacher in the teaching of handling data to students.

Specifically, the following techniques should be implemented, monitored and evaluated in the teaching of handling data to students.

Compliance with Ethical Standards

As a researcher, considering several ethical considerations was mandatory to ensure the integrity of the research procedures and the protection of the rights of the participants. Informed consent clearly outlined the details of the research, questionnaires, and procedures was safeguarded or ensured in the conduct of the study. Formal communication letters from the district supervisors and the school heads of the participating schools were secured. The respondents, including teachers and school

heads, were fully informed about the purpose, procedure, and potential outcomes of the study. The respondents were provided with detailed information about the survey, and their participation was voluntary; they were given the right to withdraw at any point without negative consequences.

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