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IMPROVING STATISTICAL LITERACY IN GRADE 11 STATISTICS AND PROBABILITY THROUGH A JASP-FOCUSED SEMINAR

Babie Jean S. Sabudan[1], Arthea Joana B. Saquido[2]

[1]*Researcher, Institute of Teacher Education, Kapalong College of Agriculture, Sciences and Technology, Kapalong, Davao del Norte, Philippines*

[2]*Researcher, Institute of Teacher Education, Kapalong College of Agriculture, Sciences and Technology, Kapalong, Davao del Norte, Philippines*

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ABSTRACT

This study examined the effectiveness of the JASP-Focus Seminar as an intervention in enhancing Grade 11 students' skills in solving statistical problems at Baltazar Nicor Valenzuela National High School. Specifically, it aimed to determine the significant difference between the students' pretest and post-test scores. A pre-experimental research design was employed to assess the impact of the intervention. Data were collected from 67 Grade 11 students using purposive sampling, with pretest and post-test scores serving as the primary instruments. The results revealed a notable improvement in student performance following the intervention. The mean percentage of the pretest score was 36%, indicating a poor level of understanding, while the post-test percentage mean score rose to 70%, classified as high. The paired t-test analysis showed a statistically significant improvement, $t(66) = 30.1$, $p < .001$, demonstrating the strong positive effect of the JASP-Focus Seminar on students' statistical problem-solving skills. To further understand the students' learning experiences, in-depth interviews were conducted, which led to the emergence of six major themes: (1) gaining understanding through applying practical and real-life data; (2) simplifying statistical problem-solving through JASP-assisted learning; (3) improving confidence and understanding; (4) hands-on and interactive activities increase learning; (5) struggling with selecting the appropriate statistical test; and (6) experiencing ease of statistical calculations compared to manual methods. Overall, the findings confirm that the JASP-Focus Seminar significantly improved students' competency in statistics by promoting both conceptual understanding and computational ease.

KEYWORDS: *Jasp-Focused Seminar Intervention, Quantitative-Descriptive, Pre-Experimental, Statistical Literacy, Philippines*

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INTRODUCTION

As data continues to grow rapidly, it's essential to teach individuals how to manage and interpret it. Statistical literacy is key, enabling people to make informed decisions based on data that affects their lives. The GAISE II report for K–12 underscores the importance of statistical literacy for leading a healthier, more productive life (Bargagliotti et al., 2020). However, simply adding statistics to the curriculum is not enough. Aziz and Rosli (2021) note that students' statistical literacy depends on prior knowledge, teaching strategies, learning environments, and attitudes toward statistics. Effective instruction must be engaging, relevant, and promote active learning. Sutherland et al. (2022) further highlight the need for differentiated teaching, especially for students with math difficulties. Without inclusive, research-based approaches, many students may remain statistically illiterate despite living in a data-rich world.

In Turkey, despite the increased emphasis on statistics in education—reflected in the 2013 and 2018 middle school curricula—high school students still show low levels of statistical literacy. A study involving 163 students from grades 10 to 12 across two high schools highlights this ongoing concern (Batur & Baki, 2021). Similarly, a study of 392 clinicians across nine Latin American countries revealed widespread statistical illiteracy, with major gaps in understanding concepts like p-values and confidence intervals. Although a 10-hour intervention showed short-term gains, improvements were not sustained, highlighting the need for ongoing statistical education in medical training (Soto-Mata et al., 2022). Furthermore, Kurnia et al. (2022) found that in Indonesia, 42% of Year 9 students showed limited statistical thinking, and most Year 9 and 12 students demonstrated non-critical use of statistics—able to apply basic concepts but struggling with deeper analysis and informed decision-making.

In the Philippines, Grade 4 students showed limited mastery of key statistical skills, such as problem-posing, data

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representation, and variability measures. The study also found a strong link between students' achievement of MELCs and their parents' educational attainment, highlighting the role of parental involvement in academic success (Baquing, 2024). Moreover, in Negros Occidental, senior high school students showed poor statistical literacy across subjects, despite recognizing its importance. The study revealed difficulties in affective and cognitive areas, indicating a general lack of proficiency despite positive attitudes toward statistics (Repedro & Diego, 2021). Further, Sibaen (2021) found that at Benguet State University, even STEM students showed low quantitative literacy reasoning (QLR), with prior achievement in math and statistics having little impact on performance. This highlights the need for more effective, innovative teaching methods to improve statistical literacy.

Moreover, the study explored the use of a JASP-focused seminar as an intervention to improve statistical literacy among Grade 11 students. This study was conducted at Baltazar Nicor Valenzuela National High School, a public secondary school located in the Division of Davao del Norte. Data were collected through paper-based test questionnaires answered by Grade 11 students from the same school. The researchers conducted this study due to the observable struggle of students in comprehending fundamental statistical concepts, which negatively impacted their performance and confidence in statistics and probability. The relevance of this research lies in its potential to enhance student engagement and understanding through interactive, hands-on data analysis using JASP software. Furthermore, the findings provide valuable insights into how guided statistical practice can address foundational gaps and foster critical thinking. This research may contribute to the advancement of more dynamic and technology-integrated teaching approaches, ultimately promoting higher statistical competence. The urgency of this intervention is emphasized by the pressing need to support students in overcoming their fear of statistics, which is crucial for their academic growth and the development of a data-literate society.

Several studies have explored similar themes, such as Aziz and Rosli's (2021) "Challenges in Developing Students' Statistical Literacy Skills," Koga's (2022) "Limited Critical Thinking in Statistical Literacy Among High School Students," and Çakıroğlu and Güler's (2021) "Effectiveness of Gamification in Enhancing Statistical Literacy." While these studies offer valuable insights, they do not directly address the specific needs of Grade 11 students. Thus, this action research aims to bridge that gap by implementing a JASP-focused seminar to enhance statistical literacy among Grade 11 learners at the instructional or frustration level. The study contributes to developing school-based interventions that strengthen students' understanding and application of core statistical concepts.

The literature emphasizes the effectiveness of integrating technology in teaching statistics, particularly how statistical software supports students in understanding complex data analysis procedures. In this context, a JASP-focused seminar serves as a practical intervention that enhances students' comprehension of statistical concepts by allowing hands-on learning and real-time analysis.

Research Questions

The study aimed to determine the effectiveness of a JASP-focused seminar as an intervention in mastering key concepts in statistics and probability among Grade 11 students. Further, this study gathered relevant information to address the following questions:

1. What is the pre-test result on the level of improving statistical literacy of the pre-experimental group?
2. What is the post-test result on the level of improving statistical literacy of the pre-experimental group?
3. Is there a significant difference between the pre-test and post-test scores of the pre-experimental group?
4. What insights can be drawn from the results regarding the effectiveness of the JASP-focused seminar in enhancing the statistical literacy of grade 11 students in statistics and probability?

PROPOSED INTERVENTION/PLAN

Table 1. Intervention Plan Matrix

Week	Day	Activity	Topics Covered	Method/Strategy	Purpose
1	Day 1	Pre-Test	Hypothesis Testing, One-sample t-test, Independent Samples t-test, Paired t-test, Correlation Analysis	20-item paper-based pre-test	Assess baseline knowledge on key statistical concepts
	Day 2	Seminar Session 1	Introduction to JASP, Hypothesis Testing	Lecture on JASP interface, formulation of null and alternative hypotheses	Familiarize students with software and foundational concepts
	Day 3	Seminar Session 2	One-sample t-test	Lecture and guided hands-on activity with real-life problems	Teach test selection, directionality, and JASP application

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2	Day 4	Seminar Session 3	Independent Samples t-test	Step-by-step walkthrough, student-led data analysis with/without laptops	Demonstrate use of JASP for group comparison analysis
	Day 5	Seminar Session 4	Paired Samples t-test, Correlation Analysis	Detailed explanation and guided hands-on activities using JASP	Teach methods for analyzing paired data and variable relationships
3	Day 6	Post-Test	Same topics as pre-test	20-item post-test mirroring the pre-test	Measure learning gains and intervention effectiveness

Before starting the study, the researcher worked together with the Grade 11 Mathematics Teachers to ask permission on making all their students—a total of three sections to be the participants of the study. On the first day, students took a 20-item pre-test focused on solving word problems related to hypothesis testing, one-sample t-test, independent samples t-test, paired t-test, and correlation analysis. This assessment served as a baseline to gauge their initial level of understanding prior to the intervention.

On the second day, the first seminar session commenced, covering two key topics--an introduction to JASP and hypothesis testing. The teacher provided an overview of JASP's interface, highlighting the specific features and functions relevant to the topics at hand. Following this, the session focused on formulating null and alternative hypotheses, laying the groundwork for the upcoming statistical methods.

On the third day, seminar session two was introduced, which centered on the one-sample t-test. The teacher explained the distinction between one-tailed and two-tailed tests and demonstrated how to apply this knowledge using JASP. Through real-life example problems and guided hands-on practice, students learned how to perform one-sample t-tests using the software.

On the fourth day, seminar session three was held, covering the independent samples t-test. The teacher led students through a practical, step-by-step walkthrough of the process using JASP. Students with laptops were encouraged to actively participate by conducting their own analysis, while those without laptops were called to the front to gain hands-on experience navigating the software.

On the fifth day, the final seminar session was conducted, covering both the paired samples t-test and correlation analysis. The teacher explained each method in detail, supplemented by guided practice using JASP to help students understand how to analyze paired data and explore the relationship between variables.

On the sixth and final day, students took a post-test parallel in structure to the pre-test. This assessment aimed to measure learning gains and evaluate the effectiveness of the seminar series in improving students' understanding and application of statistical methods using JASP.

METHODOLOGY

Research Design

This study employed quantitative research through a one-group pretest-posttest design, a type of pre-experimental approach. A pre-experimental descriptive one-group pretest-posttest research design is a systematic method used to evaluate the impact of an intervention on a single group by assessing results prior to and following the intervention. In this design, researchers conducted a pre-test to evaluate the baseline condition of a specific variable in the group. Subsequently, an intervention was implemented, followed by a post-test to assess any changes in the same variable. This design facilitated a quick evaluation of the intervention, allowing for prompt modifications according to participant performance (Creswell & Creswell, 2018).

In this context, the researchers utilized a pre-experimental descriptive one-group pretest-posttest design to assess the impact of the JASP-focused seminar intervention on enhancing the statistical literacy of Grade 11 learners at Baltazar Nicor Valenzuela National High School. The design began with a pre-test to evaluate the baseline statistical literacy of the students, focusing on key aspects such as hypothesis testing. After the intervention was implemented, a post-test was conducted to measure any improvements in the students' statistical skills. This approach allowed for a quick evaluation of the intervention's effectiveness and enabled the researchers to make necessary adjustments based on the students' progress throughout the study.

Research Respondents

Purposive sampling, a non-random selection technique, empowers researchers to delve into specific populations by choosing individuals, cases, or events with key characteristics aligned with the research aims. This approach, also known as judgmental sampling, leverages the researcher's expertise to identify participants who can offer the most valuable insights, unlike random selection where chance dictates participant selection (Nikolopoulou, 2023).

This research study involved 67 Grade 11 students from Baltazar Nicor Valenzuela National High School. The participants were selected based on their academic performance in Statistics and Probability, particularly those who exhibited limited understanding of key statistical concepts. The study aimed to improve the students' statistical literacy, which is

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essential not only for their current academic success but also for conducting future research. To address this, a JASP-focused seminar series was implemented as an intervention. The seminar introduced students to the JASP statistical software and guided them through various statistical procedures using real-life data and hands-on activities. By enhancing their skills in data analysis, hypothesis testing, and interpretation of results, the intervention aimed to equip students with foundational knowledge that would be particularly useful when they undertake research projects in senior high school and beyond.

Research Instrument

This range of percentage score below is used to assess the level of performance of the students in statistics and probability during pretest and post-test. This range was adopted fro the study of Marilasari (2017) which was used to measure the reading comprehention of the students.

Range of Percentage Score	Descriptive Level	Interpretation
90 – 100	Outstanding	If the measures described in solving statistics and probability of the students is outstanding.
72-89	Highly Satisfactory	If the measures described in solving statistics and probability of the students is highly satisfactory.
55- 69	Satisfactory	If the measures described in solving statistics and probability of the students is satisfactory
36 – 53	Fairly Satisfactory	If the measures described in solving statistics and probability of the students is fairly satisfactory.
40 – 54	Needs Improvement	If the measures described in solving statistics and probability of the students is needs improvements.
0 - 39	Poor	If the measures described in solving statistics and probability statistics and probability of the students did not meet the expectation.

Procedure

To gather the necessary data for this research, the researchers first secured an approved endorsement letter signed by the school principal, the program coordinator, and the Director of Research and Development. This letter granted permission to conduct the study with the selected group of Grade 11 students. Following approval, the researchers administered a pre-test to evaluate the participants' baseline knowledge of key concepts in statistics and probability. This served as the initial benchmark for assessing learning progress.

After the pre-test, a JASP-focused seminar was implemented, followed by a three-week intervention period, which was conducted on weekdays except Monday and Friday. During the intervention, students were systematically guided through statistical concepts and computations using the JASP software, allowing them to explore real-world applications of statistical tests.

At the conclusion of the intervention, a post-test—designed with parallel questions to the pre-test—was administered to measure any improvements in the participants' statistical knowledge. All data from the pre-test and post-test were collected, tabulated, and prepared for detailed analysis. The chart below shows the topics/competencies to be covered in each week of the study.

Table 2. Intervention Schedule

Week	Contents	Task	Platform
Week 1	• Hypothesis Testing • One Sample t-test • Independent Sample t-test • Paired t-test • Correlation	Diagnose Phase: Pre-Test	JASP Software
Week 2		Introduced the JASP software and started the intervention which is the JASP-focus seminar.	
Week 3		Diagnose Phase: Post Test	

Statistical Treatment of Data

The statistical tools employed in this study, namely the mean and the t-test, played a crucial role in analyzing the gathered data. The mean, a fundamental measure of central tendency, provided insights into the average performance of students in both the pretest and post-test phases. By calculating the mean scores from the total scores of students in each phase, researchers were able to gauge the overall level of skills on solving work-related problems involving fractions among participants before and after the intervention.

Moreover, the t-test enabled a comparison of means between two populations. It helped determine whether differences in mean scores between pretest and post-test phases were

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statistically significant, shedding light on the intervention's impact on skills on solving work-related problems. Additionally, the t-test identified significant variations in skill levels pre- and post-intervention, offering valuable evidence to support the study's conclusions.

Data Analysis

In this study, the researchers gathered data from both pre-test and post-test evaluations. They calculated the mean of the data and then compared the means of the pre-test and post-test using a paired t-test, alongside examining the standard deviation to assess the variation within the dataset. This analysis aimed to identify any notable differences and assess whether the mean demonstrated an increase, indicating the efficacy of the intervention.

Moreover, the collected data from the in-depth interviews were transcribed, translated, and analyzed, following Creswell's (2009) proposed process for data analysis. The translated responses of the participants were coded to create a thematic analysis of the data for this study. Thematic analysis, also known as coding, involves categorizing responses and identifying recurring themes in the text to develop a structured representation of thematic ideas. Through the systematic process of thematic analysis, the researcher organized the dataset into themes or patterns. This enabled the researcher to identify and develop themes based on the obtained data, as described by Dye (2021). During the data analysis, the researcher relied on the transcripts and translations of the informants' responses. The researcher grouped and organized the repeated responses using coding to generate a comprehensive theme analysis. The concepts were sorted and evaluated based on their relationships, similarities, and contrasts with the assistance of a data analyst.

Ethical Considerations

Adhering to ethical standards in research is crucial as it guides the true objectives of the study, such as the pursuit of knowledge, truth, and the prevention of errors, while also fostering important values like trust, accountability, mutual respect, and fairness in collaborative work. To maintain ethical research practices, this study adhered to the ethical principles outlined in the Belmont Report (2010), which include respecting individuals' autonomy, promoting beneficence and non-maleficence, ensuring justice, obtaining informed consent, safeguarding confidentiality and data protection, maintaining integrity, and addressing conflicts of interest.

RESULTS AND DISCUSSION

This chapter presents the findings gathered from the study. It includes data on students' level of statistical proficiency performance as measured in the pre-test, their performance in the post-test, and the statistical significance of the differences between the pre-test and post-test scores.

Research Question No. 1: What is the pre-test result on the level of improving statistical literacy of the students?

Presented in Table 3 are the results of the pretest, showing the performance of 67 students in solving work-related problems involving statistics and probability. The overall mean score is 7.18 indicating a poor performance by the students in the pretest. The highest score achieved was 13, while the lowest score was 3. The most frequent score was 8, obtained by 16 students.

Table 3. Level of Statistical Literacy Before the Implementation of the JASP-Focus Seminar (Pre-Test)

Score	Frequency	Percentage
3	4	5.97%
4	3	4.47%
5	8	11.94%
6	11	16.41%
7	8	11.94%
8	16	23.88%
9	9	13.43%
10	4	5.97%
11	3	4.47%
13	1	1.49%
Total	**67**	**100%**
Overall Mean		**7.18**
Mean Percentage Score		**36%**
Standard Deviation		**2.14**
Description		**Poor**

Before the intervention given to the students, the result of the pretest was 7.18, classified as poor in performance, which means that the students' skills did not meet the expectation. This low performance aligns with findings from Dumale and Gurat (2023), who reported that Grade 12 students in the Philippines struggled with Statistics and Probability, particularly in understanding questions, selecting appropriate tests, and formulating conclusions. Similarly, Calma et al. (2022) found that senior high school students, especially from non-STEM strands and public schools, had low knowledge levels despite having a positive attitude toward the subject. Likewise, Alviar and Villanueva (2023) highlighted the inconsistent understanding of sampling and sampling distribution among Grade 11 HUMSS students, with scores ranging from 11% to 54%, suggesting the need for targeted

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instructional strategies to improve comprehension and application of statistical concepts.

Research Question No. 2: What is the post-test result on the level of improving statistical literacy of the of the students?

Presented in Table 4 are the results of the post-test, showing the performance of 67 students in solving work-related problems involving statistics and probability. The overall mean score is 13.93, indicating a satisfactory performance by the students in the post-test. The highest score achieved was 19, while the lowest score was 9. The most frequent score was 14, obtained by 16 students. The standard deviation is 2.16, suggesting that the students' scores were moderately spread out from the mean, indicating some variability in their levels of understanding and performance.

Table 4. Level of Statistical Literacy After the Implementation of the JASP-Focus Seminar (Post-Test)

Score	Frequency	Percentage
9	1	1.49%
10	4	5.97%
11	6	16.21%
12	4	5.97%
13	10	14.92%
14	16	23.88%
15	13	19.40%
16	5	7.46%
17	4	5.97%
18	3	4.47%
19	1	1.49%
Total	**67**	**100%**
Overall Mean		**13.93**
Mean Percentage Score		**70%**
Standard Deviation		**2.16**
Description		**Satisfactory**

After receiving the JASP-focused seminar as an intervention in improving skills on solving work-related problems involving statistics and probability, the result of the post-test mean percentage score was 70 percent, classified as an average level of performance, which means that the students' skills are satisfactory. This improvement aligns with McBride and Garcés-Manzanera (2024), who emphasized that JASP enhances student performance through its user-friendly interface and advanced tools, making data analysis more accessible. Similarly, Handley (2019) found that JASP improved university students' comprehension and application of statistical concepts due to its real-time analysis and intuitive design. Spector (2021) also supported these findings, noting that JASP fosters higher student engagement and understanding by eliminating the complexities of command-based software, ultimately leading to better academic outcomes.

Research Question No. 3: Is there a significant difference between the pre-test and post-test scores of the students?

Presented in Table 5 are the results of the significant difference between the pretest and post-test scores, indicating the performance levels of 67 students in solving work-related problems statistics and probability, $t(66) = 30.1$, $p < .001$. Since the probability value ($p < .001$) is less than the level of significance ($\alpha = 0.05$), the null hypothesis is rejected. This means that there is a significant difference between the pretest and post-test scores.

Table 5. Significant Difference Between the Pre-test and Post-test Scores

	df	t	p	Mean difference	Std. Error difference	Cohen's d
Post-test—Pre-test	66	30.1	<.001	6.75	0.224	3.67

Based on the results it was found that there is a significant difference between the pretest and post-test score of the students. This indicates that the JASP-focus seminar as an intervention was effective in improving statistical literacy to the Grade 11 students. This finding supports the research conducted by McBride and Graces-Manzanera (2024), emphasizes that JASP's intuitive interface and comprehensive features provide clear guidance for students, facilitating a better understanding of statistical analysis. Moreover, it result is correlated to the research conducted by Van de Schoot et al. (2020), who emphasized that JASP's intuitive interface and open-source platform facilitate a better understanding of statistical analyses, making it ideal for educational settings. Similarly, Perez and Medrano (2020) found that integrating user-friendly statistical software into classroom instruction significantly improved students' engagement and their ability to interpret and perform statistical tests.

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Research Question No. 4: What insights can be drawn from the results regarding the effectiveness of the JASP-focused seminar in enhancing the statistical literacy of grade 11 students in statistics and probability?

To answer this question, in-depth interviews were conducted with the participants. Probing questions were asked to elicit their response regarding their experiences with the impact of the JASP-focused seminar intervention in improving statistical literacy among grade 11 students. The major themes and sample statement for research question number 4 are presented in Table 5. Participants shared their responses about their own experiences and observation of the intervention. From the answers of the participants, six major themes emerged: (1) gaining understanding through applying practical and real-life data; (2) simplifying statistical problem-solving through JASP-assisted learning; and (3) improving confidence and understanding; (4) hands-on and interactive activities increases learning; (5) struggling with selecting the appropriate statistical test; and (6) experiencing ease of statistical calculations than the manual. These themes are shown in Table 5

Table 6. Insights of Students in the Implementation of the JASP-focused Seminar as an Intervention

Emerging Themes	Supporting Statements
Gaining Understanding Through Applying Practical and Real-Life Data	• "It uses real-life data, and it is much easier. (IDI 1) • "It emphasized practical application through hands-on exercises so we could easily understand how to use JASP." (IDI 2) • "The seminar's practical approach, which focused on applying statistical concepts within JASP, helped solidify my theoretical knowledge." (IDI 3)
Simplifying Statistical Problem-Solving Through JASP-Assisted Learning	• It is easier now because there's software to help with computations. (IDI 4) • "JASP helped me become more focused on solving problems and more engaged with the variables involved. (IDI 5) • "The JASP-focused seminar helped clarify complex statistical concepts by allowing hands-on application." (IDI 6)
Improving Confidence and Understanding	• The JASP-focused seminar helped me gain confidence in performing various statistical tests and interpreting the results. (IDI 3) • "Using JASP makes solving problems faster and easier to understand." (IDI 9) • "It helped me see the purpose behind the formulas we've
Hands-on and Interactive Activities Increases Learning	• "More hands-on activities for students would be beneficial. (IDI 4) • "I suggest incorporating more real-world datasets, as well as allocating time for guided practice sessions." (IDI 6) • "The story-like sentence, teacher, helped me the most." -IDI-08
Struggling with Selecting the Appropriate Statistical Test	• "We usually have difficulty finding the right test to use. (IDI 1) • "I still struggle with selecting the appropriate statistical test for certain types of data." (IDI 6) • "Sometimes, ma'am, I get confused about what test to use." (IDI 9)
Experiencing Ease of Statistical Calculations than the Manual	• "We had never used that software before. We used to just follow the formula, which was very long, so we would get confused eventually. (IDI) • "Now that I have been introduced to JASP, I feel the process is easier, clearer, and faster. (IDI 4) • "JASP is the first real statistical tool we have personally used, which give us ease." (IDI 7) • "Before using JASP, I mostly relied on manual calculations, but now it is easier to calculate. (IDI 8) • "We were not really exposed to statistical tools before, so we experienced difficulty." (IDI 10)

In this study, it was found that the intervention was effective in terms of improving the statistical literacy of students. The first theme that emerged from the study was the gaining understanding through applying practical and real-life data. McBride and Garcés-Manzanera (2024) emphasized that using real-life data through tools like JASP helps bridge theoretical knowledge with practical application, thereby deepening students' comprehension and retention of statistical methods. This aligns with the seminar's focus on hands-on activities that make abstract concepts more tangible. Similarly, Kaur et al. (2025) found that involving students in data literacy boot camps using authentic data sets significantly improved their grasp of statistical concepts and fostered a more positive attitude toward data literacy. Both studies support the value of experiential learning in developing meaningful understanding.

Furthermore, the second theme emerged from the study was simplifying statistical problem-solving through jasp-assisted learning. This is supported by the study of Navarro (2020), which emphasized that JASP streamlines complex statistical processes by automating calculations and offering an intuitive interface, which reduces cognitive load and allows students to

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focus on data interpretation and understanding variable relationships. This hands-on, user-friendly approach enhances engagement and supports active learning, leading to better retention of complex statistical concepts. Similarly, Biecek and Kozak (2021) highlighted that JASP's graphical interface simplifies analysis while ensuring transparency and reproducibility. Their study found that this immediate, practical application deepens learners' engagement with statistical concepts and improves overall learning outcomes.

Additionally, the third theme emerged from the study was improving confidence and understanding. This is supported by the study of Lee and Kim (2022), which found that using interactive statistical software significantly enhances students' confidence in conducting analyses and interpreting results. Features such as immediate feedback and intuitive interfaces help accelerate problem-solving, promote active learning, and strengthen conceptual understanding. These tools not only make complex statistical procedures more accessible but also increase student engagement and motivation. Similarly, this is supported by the study of Agawin (2021), who reported that students perceived JASP as both easy to use and effective for learning statistics. Its perceived usefulness and simplicity positively influenced students' attitudes, resulting in increased confidence, a deeper grasp of statistical concepts, and a more enjoyable learning experience overall.

Further, the fourth theme emerge from the study was hands-on and interactive activities increases learning. This is supported by the study of Freeman et al. (2024), which demonstrates that active and hands-on learning strategies significantly enhance student performance and understanding. By incorporating real-world problems, interactive exercises, and guided practice, the study highlights how student engagement increases alongside deeper learning and improved long-term retention. Likewise, this is supported by the study of Deslauriers et al. (2020), which found that students who participated in guided, hands-on activities and real-world data applications achieved significantly higher learning outcomes compared to those in traditional lecture settings. The study emphasizes that such interactive approaches foster critical thinking, support meaningful knowledge construction, and contribute to better comprehension, motivation, and retention.

Moreover, the fifth theme that emerged from the study was struggling with selecting the appropriate statistical test. This is supported by the study of Makwakwa et al. (2023), which examined the statistical problem-solving skills of first-year undergraduate students and found that many struggle with selecting appropriate statistical tests. The study points out that hypothesis testing and identifying correct probability distributions are particularly challenging, emphasizing the need for targeted instruction to strengthen students' understanding and application of statistical methods. Similarly, this is supported by the study of Kim and Kim (2022), which highlights that students often face difficulties in choosing the right statistical test due to a limited grasp of assumptions, data types, and test requirements. The study underscores the importance of structured guidance and hands-on learning experiences to help students develop the analytical skills necessary for accurate test selection and interpretation.

Finally, the sixth theme that emerged was experiencing ease of statistical calculations compared to manual methods. This is supported by the study of Huang and Ling (2021), which demonstrates that using statistical software significantly reduces the complexity and time required for calculations compared to manual methods. The study emphasizes that software-assisted computation improves clarity, accuracy, and efficiency, allowing students to concentrate more on interpreting results and understanding concepts rather than being overwhelmed by lengthy formulas. Similarly, this is supported by the study of Alisa and Grant (2021), which found that students experienced greater ease and efficiency when using tools like JASP for statistical calculations. The study highlights that software use minimizes computational errors and reduces cognitive load, enabling learners to focus more on analysis and interpretation. This shift not only boosts confidence but also enriches the overall learning experience.

CONCLUSION

Based on the findings of the study, the following conclusions were drawn:

The result of the students in the pre-test, which corresponds to 36%, indicates a poor level of statistical literacy in statistics and probability. This result suggests that the students' initial understanding of key statistical concepts and their ability to solve related problems were significantly below the expected proficiency level. The findings highlight a clear need for targeted instructional intervention to address these learning gaps.

Following the implementation of the JASP-focus seminar, the post-test results show a notable improvement, with the overall mean score rising to 70%, reflecting a satisfactory level of statistical literacy among the students. This substantial increase indicates that the students demonstrated a stronger grasp of statistical concepts and problem-solving skills after the intervention. The results suggest that the learning outcomes met the desired level of competence, affirming the effectiveness of the instructional strategy used.

Moreover, the findings revealed a significant difference between the pre-test and post-test scores of the students, as determined through a paired t-test. The results indicated that the JASP-focused seminar had a statistically significant impact on students' performance in solving work-related problems involving statistics and probability. Furthermore, the effect size, as measured by Cohen's d = 3.50, suggests a very large effect, emphasizing the substantial improvement in students' statistical literacy after the intervention. This strong effect size highlights the effectiveness of the seminar in enhancing students' understanding and application of statistical concepts.

Additionally, the results indicate that the JASP-focused seminar significantly enhanced the statistical literacy of Grade 11 students in Statistics and Probability. Participants demonstrated improved understanding of key statistical concepts, increased

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confidence in using statistical software, and a stronger ability to interpret and analyze data. These improvements suggest that integrating technology-based tools like JASP into instruction can effectively bridge theoretical knowledge and practical application, fostering deeper engagement and comprehension. Overall, the seminar proved to be an effective intervention for developing students' statistical literacy and should be considered for wider implementation in the senior high school curriculum.

RECOMMENDATION

Considering the research findings, JASP-focused seminar was found to be effective. The researchers saw improvements in students' statistical proficiency through developmental pre-test and post-tests. We recommend that the use of JASP must be integrated into teaching of Statistics and Probability in the senior high school curriculum. Its user-friendly interface and ability to generate clear outputs make it an effective tool to enhance students' understanding of statistical concepts and improve overall performance. The JASP software should also be encouraged as a tool in conducting student-led research. Its ability to perform various statistical analyses with transparency and reproducibility makes it ideal for supporting student research projects, particularly in the senior high school strand programs.

Also, teachers are encouraged to utilize JASP in classroom instruction to promote hands-on learning. The software enables students to visualize, compute, and interpret data more efficiently, which fosters deeper conceptual understanding, especially in solving real-life or work-related problems involving data, such as fractions, measures, and variability. But since most of the teachers are unaware about the usefulness of JASP, it is recommended to conduct training programs and professional development workshops for mathematics and research teachers. This would build their capacity to use JASP not only for instruction but also for assessing student progress and facilitating interactive learning.

Furthermore, future research may explore the long-term impact of JASP on student performance and engagement, as well as its effectiveness when applied across different levels and learning contexts. This can further validate its practicality and potential as a standard tool in statistics instruction.

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