A Quasi-Experiment on the Effectiveness of Statistical Software Training Program in Developing Students' Data Analysis Skills in Practical Research II

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ABSTRACT

Statistical software has significantly enhanced data analysis, providing students with the precision and depth needed to extract meaningful insights from complex datasets. This study aimed to evaluate the effectiveness of a statistical software training program in enhancing students' data analysis skills within a Practical Research II subject. A quasi-experiment, pre-test/post-test design was employed to assess the effect of the training on a sample of ninety STEM students. The results of the study revealed a significant improvement in students' data analysis skills. The pre-test scores indicated a beginning level of proficiency, while the post-test scores demonstrated an approaching proficiency level. This significant difference, with a large effect size of 2.30, underscores the effectiveness of the training program in enhancing students' data analysis capabilities. Results revealed empirical evidence that the statistical software training program on the use of Data Analysis, a statistical software application embedded in Microsoft Excel significantly influences students' proficiency level as evidenced by comparing the pretest and posttest scores. By providing hands-on experience with this tool, students were able to develop their skills in statistical data analysis. The training also covered a range of statistical techniques, including descriptive and inferential statistics. The findings of this study highlight the importance of providing targeted training to enhance students' data analysis skills. By equipping students with the necessary tools and knowledge, teachers can empower them to conduct rigorous research and contribute meaningfully to academic and professional fields.

Keywords: Statistical Software, data analysis, training program, quasi-experiment, MS-EXCEL

INTRODUCTION

The Philippines' implementation of the K to 12 Basic Education Program demonstrates its unwavering commitment to educational excellence. As a flagship initiative, K to 12 aims to equip students with the knowledge, skills, and competencies necessary to thrive in the 21st century. By extending basic education to 12 years, the program seeks to provide students with a more comprehensive and relevant education that prepares them for higher education, the workforce, and global citizenship.

Aligned with the K to 12 visions, the Department of Education seeks to empower individuals through a rigorous and comprehensive education rooted in strong principles and a focus on excellence. One key aspect of this empowerment is the development of 21st-century skills, including the 4Cs: critical thinking, creative thinking, collaboration, and communication. Critical thinking refers to the ability of learners to analyze information, evaluate evidence, and draw logical conclusions. Creative thinking, on the other hand, involves the ability to generate innovative and original ideas, think outside the box, and approach problems from

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different perspectives. Collaboration, in this context, refers to the learners' ability to work together effectively, exchange ideas, and contribute to a shared goal. Communication, meanwhile, is the ability to express thoughts, ideas, and information clearly and effectively. By cultivating these essential skills, K to 12 aims to prepare students for a rapidly changing world and equip them with the tools they need to succeed in higher education, the workforce, and beyond.

Research plays a pivotal role in developing students' 21st-century skills. Engaging in research activities can foster critical thinking, problem-solving, creativity,

communication, and collaboration, all of which are essential for success in today's world. As Alismail and McGuire (2015) noted, students who engage in research develop stronger abilities in these areas. Rotherham and Willingham (2009) emphasize the importance of integrating critical thinking and problem-solving skills into curricula to prepare students for real-world challenges. By tackling complex problems during research, students learn to approach issues systematically and creatively. Furthermore, research activities can foster creativity by encouraging students to think outside the box and develop innovative solutions. The processes of formulating hypotheses, designing experiments, or creating projects provide opportunities for students to explore their creative potential (Alismail & McGuire, 2015). As Trilling and Fadel (2009) argue, cultivating creativity through research is essential for preparing students to become innovative citizens capable of addressing the complex challenges of the 21st century.

Effective communication is a fundamental skill for successful research, as emphasized by Crosta et al. (2023). Students must be able to articulate their ideas clearly and concisely, both in written reports and oral presentations. Collaborative research projects provide valuable opportunities for students to develop their communication skills by working effectively with peers and stakeholders. Moreover, research often involves teamwork, requiring students to collaborate with others to achieve common goals. This collaborative experience helps learners develop essential interpersonal skills, such as teamwork, negotiation, and understanding diverse perspectives. Engaging in group research projects has been shown to improve students' ability to work effectively in teams, a skill that is highly valued by employers in today's competitive job market (Crosta et al., 2023).

To cultivate the 21st-century skills essential for success in today's complex world, educational frameworks must prioritize research-based learning. Studies by Alismail and McGuire (2015) and Chalkiadaki (2018) highlight the effectiveness of project-based and inquiry-based approaches in fostering critical thinking, problem-solving, communication, and collaboration skills. Research-oriented students, as defined by Casinto (2016), possess a strong motivation to explore, investigate, and critically analyze information. By developing these skills, students become better equipped to address real-world challenges and contribute meaningfully to society.

The K to 12 curriculum incorporates a series of research subjects designed to cultivate students' critical thinking, problem-solving, and research abilities. These subjects include Practical Research I (PR I), Practical Research II (PR II), Inquiries, Investigations, and Immersion (3Is), and Capstone Project (for STEM students). The present study delves into PR II, an applied research course within the K to 12 curriculum, provides a significant opportunity to develop these essential skills. As an applied discipline, it emphasizes quantitative research methods, allowing students to engage in systematic inquiry, data analysis, and evidence-based reasoning. By applying these methods, students can gain practical experience in conducting research studies, interpreting data, and drawing meaningful conclusions.

To effectively harness the potential of research for developing critical thinking, creative thinking, communication, and collaboration skills, the researchers conducted a pre-assessment to identify specific areas where students required additional support and guidance. This assessment, based on the validated construct developed by Molina (2019), measured student competence in three key areas: research

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conceptualization, research design, and data analysis. By understanding students' strengths and weaknesses in these areas, the researchers were able to tailor their intervention to address specific needs and improve overall research skills.

The assessment results indicated that students exhibited a moderate level of competence in research conceptualization (mean = 2.73) and research method and design formulation (mean = 2.53). This suggests that students possessed a basic understanding of these concepts but required additional support and guidance from their teachers to fully grasp and apply them effectively. However, students encountered significant challenges in data gathering, processing, and analysis, as evidenced by the lowest mean score of 2.23. This indicates that while students were aware of the necessary steps, they lacked the practical skills and knowledge to independently execute these tasks without substantial assistance.

To gain a deeper understanding of the specific challenges faced by students, the researchers conducted interviews. The findings revealed that many students lacked a solid foundation in statistics and research methodologies, particularly when dealing with large datasets. Despite having completed a Statistics and Probability course in Grade 11, students often struggled to select appropriate statistical tools for their research. Additionally, the interviews highlighted difficulties in effectively presenting, analyzing, and interpreting data.

To address the identified challenges in data analysis, the researchers conducted a targeted statistical software training session focused on Data Analysis, a powerful tool embedded within Microsoft Excel, to equip students with the necessary skills and knowledge to effectively utilize descriptive and inferential statistical techniques. Microsoft Excel 2010, a widely used component of the Microsoft Office suite, offers a powerful set of tools for data analysis. While Excel can perform basic statistical analyses, such as descriptive statistics (mean, median, mode, skewness, kurtosis) and inferential statistics (t-tests, ANOVA, correlation, and regression), its capabilities are limited compared to specialized statistical software packages. For more complex analyses, such as logistic regression, survival analysis, factor analysis, and multivariate analysis, Excel may not be the most suitable tool (Mattew, Sunday 2014).

The widespread adoption of statistical software has revolutionized research practices across various disciplines. By automating complex calculations and reducing the risk of human error, these tools have significantly enhanced the quality and efficiency of research (Abatan & Olayemi, 2014). As Okaygbue et al. (2021) noted, statistical software helps researchers avoid common mathematical mistakes and ensures the accuracy of their findings, provided that the data is entered correctly. As emphasized by Bargagliotti et al. (2020), developing proficiency in statistical software is a crucial learning outcome for undergraduate students.

The findings from this research can be utilized to develop targeted interventions and enhancement programs that address the specific needs of students and improve overall research outcomes. By providing students with hands-on training in data analysis, the researchers aim to enhance their data literacy, empowering them to conduct rigorous and reliable research. This focused approach can help students overcome common challenges, such as selecting appropriate statistical tools and interpreting data effectively. Ultimately, this will lead to a higher quality of student research and contribute to the advancement of knowledge in various fields.

FRAMEWORK

The present study utilized the Input-Process-Output (IPO) model in figure 1, to provide a visual representation of the research workflow. The IPO model offers a clear structure to depict the relationships between the study's **inputs** (independent variables), **processes** (data processing), and **outputs** (dependent variables and expected outcomes).

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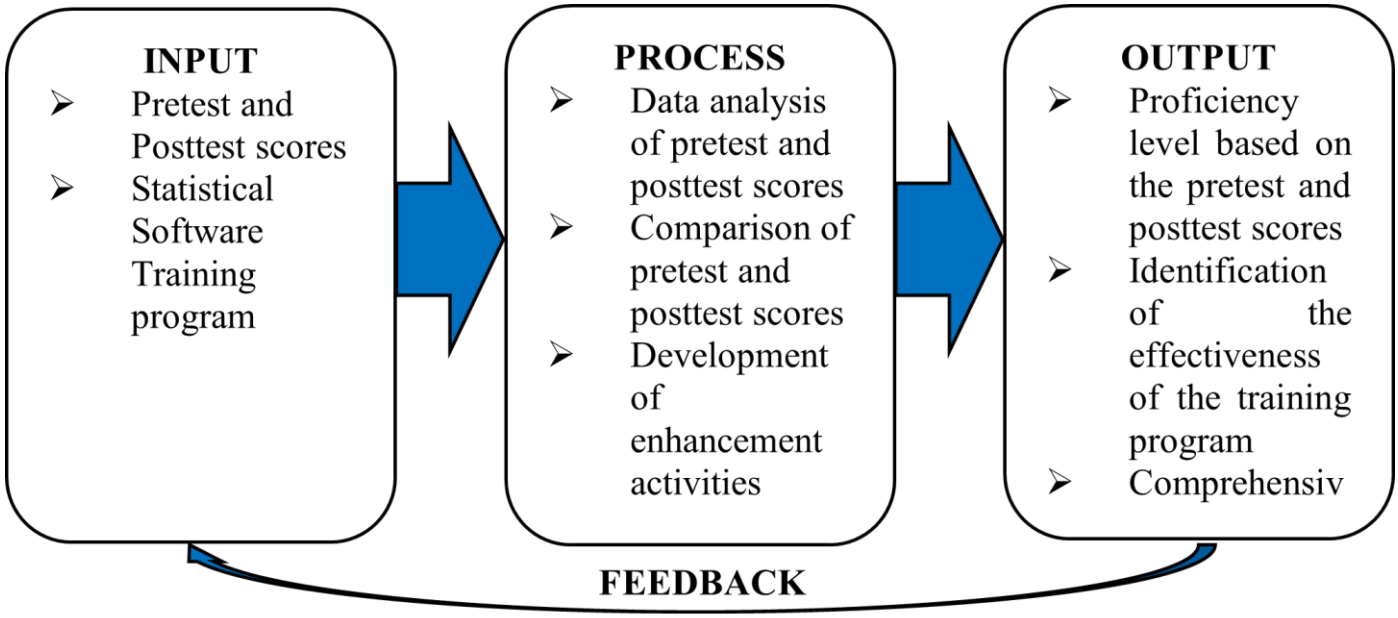

Figure 1. Conceptual Paradigm of the Study

The input component of the IPO model encompasses the pretest and posttest scores of the participants, as well as the statistical software training conducted by the teacher. These elements serve as the independent variables of the study. The process component involves data management and analysis, including comparing pretest and posttest results and formulating an action plan based on these findings. The output component presents the dependent variables and desired outcomes, such as determining students' proficiency level, evaluating the efficacy of the training program and producing a comprehensive action plan to address identified training challenges.

By explicitly outlining the conceptual framework, researchers established a clear roadmap for the study. This blueprint guided the research process, ensuring coherence, focus, and logical progression from problem identification to solution proposal. The conceptual framework served as a foundational structure, informing data collection, analysis, and interpretation while maintaining alignment with the study's objectives.

The present study aims to evaluate the effectiveness of a statistical software training program in enhancing the data analysis skills of STEM students enrolled in Practical Research II. The ultimate goal is to propose specific enhancement programs or activities to further improve students' research performance. Specifically, the research seeks to answer the following questions:

1. What is the proficiency level of the respondents before and after participating in the training, as measured by their pre-test and post-test scores?

2. Does Statistical Software training program significantly influence the proficiency level of the respondents, as evidenced by the comparison of pretest and posttest scores?

3. Based on the findings of the study, what enhancement strategies can be developed to ensure the training program's continuous improvement and effectiveness?

This study aims to evaluate the effectiveness of a statistical software training program in enhancing the data analysis skills of STEM students in Practical Research II at Kapayapaan Integrated School. Specifically, the research focuses on the effectiveness of the training on students' ability to utilize statistical software tools for data analysis, interpret and analyze research findings, and apply research principles to real-world problems.

The study is limited to a sample of ninety (90) STEM students from Kapayapaan Integrated School. This sample size may not be sufficiently large to generalize the findings to a broader population of students. The

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findings of this study may be specific to the unique context of Kapayapaan Integrated School, including its curriculum, resources, and faculty. The results may not be directly applicable to other schools with different characteristics. While the research instrument was validated by school authorities, it may still have limitations in its ability to comprehensively assess all aspects of research competence, particularly in capturing subtle nuances of student learning. The one-quarter duration of the study may not be sufficient to fully assess the long-term effect of the training program on students' research skills.

To ensure the focus of the study, the following delimitations are in place. Firstly, the study is specifically focused on enhancing students' quantitative research skills and may not address other aspects of research methodology, such as qualitative research. Secondly, while the study covers a wide range of statistical techniques, it may not delve into advanced data analysis methods or specialized research areas. Thirdly, the data collection is limited to one quarter of the school year 2022-2023, and no follow-up assessments are conducted beyond this period. Lastly, the study does not explore factors outside of the school environment that may influence students' research competence, such as individual differences, socioeconomic factors, or extracurricular activities.

METHODOLOGY

This study employed a quasi-experimental, pre-test/post-test design. As noted by Creswell & Creswell (2018), quasi-experimental designs are characterized by the researcher's inability to randomly assign participants to control and experimental groups. Given the practical limitations of randomly assigning students to groups in an educational setting, a pre-test/post-test design was deemed appropriate for this study.

In this design, all participants were assigned to a single group and received statistical software training intervention. By administering pretests before the intervention and posttests after the intervention, the researchers were able to measure the change in students' data analysis skills and attribute any significant differences to the effects of the training program.

The participants in this research were Grade 12 Science, Technology, Engineering and Mathematics (STEM) students enrolled in Practical Research II subject at Kapayapaan Integrated School. A random sampling method was employed to select ninety (90) students from the STEM strand. Data was collected during the second quarter of the 2022-2023 academic year.

A researcher-developed pretest and posttest were used as the primary data collection instruments. These tests were designed to measure students' proficiency levels before and after the conduct of the training program, focusing on data analysis. The instruments consisted of fifty items multiple-choice type test, aligned with the Most Essential Learning Competencies (MELCs) for the subject in Practical Research II. To ensure content validity, the pretest and posttest instruments underwent a validation process by a panel of three experienced research teachers. The experts' feedback was instrumental in refining the instruments to accurately measure students' research proficiency and align with the study's objectives.

Table 1 presents the arbitrary scale used to measure students' research proficiency levels before and after the conduct of the training program, based on DepEd guidelines. **Advanced** level means that the students exceed core requirements in knowledge, skills, and understandings, and can independently apply them to authentic performance tasks. Meanwhile, **proficient** level indicates that students have developed fundamental knowledge, skills, and understandings, and can independently apply them to authentic performance tasks. **Approaching proficiency** level, on the other hand, implies that the students have developed fundamental knowledge, skills, and understandings, and can apply them to authentic performance tasks with minimal guidance. Further, **developing** level signifies that the students possess minimal knowledge, skills, and understandings and require significant support to complete authentic performance tasks. And lastly, **beginning** level means that the students struggle with prerequisite knowledge and skills and require substantial support to understand and complete tasks.

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Table 1. Arbitrary Scale for the Students' Numeracy Level

Description	**Interpretation**	**Classification**
90% of the score and above	If the learner got 45-50 correct answers	Advanced
85%-89% of the score	If the learner got 44-43 correct answers	Proficient
80%-84% of the score	If the learner got 42-40 correct answers	Approaching Proficiency
75%-79% of the score	If the learner got 37-39 correct answers	Developing
74% of the score below	If the learner got 0-36 correct answers	Beginning

Source: DepEd Order No. 31, series 2012

A rigorous validation process ensured the reliability of the research instrument. Following this, data collection commenced after obtaining formal approval from the school head. Informed consent was secured from participating students to uphold ethical standards and ensure voluntary participation.

To establish baseline, a pretest was administered to all participants at the beginning of the second quarter, academic year 2022-2023. The designed training program was then implemented by the teacher to the target participants. Recognizing the students' data analysis challenges, the teacher-initiated Project READERS, a focused statistical software training session, to equip students with the necessary skills. The training session focused on the use of Data Analysis, a statistical software application embedded in Microsoft Excel. By providing hands-on experience with this tool, students were able to develop their skills in statistical data analysis. The training covered a range of statistical techniques, including descriptive and inferential statistics. The training covered the entire second quarter so that students could grasp the concepts in utilizing the Data Analysis tool. At the end of the second quarter, a post test was conducted to measure the effect of the intervention strategy. The collected data underwent rigorous statistical analysis to determine the effectiveness of the implemented statistical software training program.

Upon data collection, the questionnaires were meticulously analyzed using a combination of descriptive and inferential statistical techniques. Descriptive statistics, including frequency count and percentage, were employed to summarize the distribution of responses and provide insights into the overall characteristics of the sample. The mean score was calculated to determine the central tendency of the data, which served as an indicator of the respondents' initial and final levels of research proficiency.

To evaluate the effectiveness of the statistical software training program, a paired t-test was utilized to compare the mean scores of the pretest and posttest. This statistical analysis allowed for a rigorous examination of the intervention's impact on students' data analysis skills. By comparing the mean scores, the researchers could determine whether the training program led to a statistically significant improvement in students' proficiency level.

To finish the investigation, the researchers had an adequate grasp of ethical issues. The respondents' voluntary participation in the survey was highly regarded. For respondents to completely comprehend the ramifications of participating and be able to make an informed decision without feeling pressured or coerced, the researchers gave sufficient information and reassurance. Language that is offensive, discriminatory, or otherwise objectionable was not used when creating the surveys. It was severely enforced to properly credit and acknowledge the works of other authors. Proper citation was properly observed. The information was handled with the utmost confidentiality and respect and will be used purely for academic purposes only. The researchers make sure that the research complies with all relevant ethical standards outlined in the Data Privacy Act of 2012.

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RESULTS AND DISCUSSION

Students' Proficiency level

Proficiency level in education typically refers to a student's demonstrated mastery of specific skills, knowledge, and competencies within a particular subject or area of study. It is often assessed through various methods, including exams, quizzes, projects, and observations, and categorized using descriptors such as: **Beginning, Developing, Approaching Proficiency, Proficient,** and **Advanced.** In this study, the proficiency level of the students measured through a 50-item multiple choice type test which includes topics in descriptive and inferential statistics.

Table 2 presents the distribution of pretest and posttest proficiency levels of the respondents. Results reported that the mean pretest score was 34.09 (SD=3.14), which falls within the beginning level based on the established proficiency scale. A significant majority of students (86.67%) were categorized as beginning level, while only 13.33% were classified as developing level. These findings suggest that a substantial portion of the respondents struggled with the foundational knowledge and skills necessary for success in research specifically in computing, interpreting and analyzing data. This indicates a need for targeted interventions to address these learning gaps and prepare students for future academic challenges.

Table 2. Proficiency Level of the Respondents Based on their Pretest and Posttest Mean Scores

Description	**Pretest**		**Posttest**	
	frequency	*%*	*frequency*	*%*
Advance	0	0	10	11.11
Proficient	0	0	19	21.11
Approaching Proficiency	0	0	34	37.78
Developing	12	13.33	27	30.00
Beginning	78	86.67	0	0
Total	**90**	**100**	**90**	**100**
Mean	**34.09 (SD=3.14)**		**41.02 (SD=2.88)**	
Interpretation	**Beginning**		**Approaching Proficiency**	

Meanwhile, the posttest scores revealed a notable improvement in the respondents' proficiency level. The mean posttest score was 41.02 (SD=2.88), which falls within the approaching proficiency level. This indicates a substantial increase in overall performance compared to the pretest results. The distribution of posttest scores further highlights the positive effect of the intervention. Thirty-seven-point seventy-eight percent (37.78%) of the respondents demonstrated approaching proficiency, indicating a solid understanding of the concepts with minimal guidance. Meanwhile, 30% of the students were classified as developing, showing progress but still requiring support to master certain aspects of the subject matter. Meanwhile, 21.11% (proficient) of the respondents achieved a high level of proficiency, demonstrating a strong grasp of the concepts and skills, and only 11.11% (advanced) of the students' exceeded expectations and demonstrated exceptional mastery of the subject.

These findings suggest that the training program was effective in helping students develop the fundamental knowledge, skills, and core understandings in analyzing data necessary for success in PR II. While there is still room for improvement, the overall increase in proficiency levels is encouraging and indicates that the students are well-prepared to move forward in their academic journey.

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Effectiveness of the Statistical Software Training program

Following the administration of the pretest and posttest, the collected data was meticulously analyzed. To determine the effectiveness of the statistical software training program, a paired t-test was employed to compare the mean scores of the pre-test and post-test. This statistical analysis allowed for a rigorous examination of the intervention's impact on students' data analysis skills. By comparing the mean scores, the researchers could assess whether the training program led to a statistically significant improvement in students' proficiency level.

Table 3. Test of Difference between the Pretest and Posttest Mean Scores

Group (n=90)	Mean	SD	t	Mean-Diff	Cohen's D	Effect Size
Pretest	34.09	3.14	36.590**	6.93	2.30	Huge
Posttest	41.02	2.88				

**. Test is Significant @ p-value<0.01, df=89 Cohen's d<=0.19: Very Small, d <=0.49: Small, d <=0.79: Medium, d <= 1.19: Large, d<=1.99: Very Large; d>=2.0: Huge.

Table 3 presents the results of the paired t-test, which was conducted to compare the mean scores of the pretest and posttest. The analysis revealed a statistically significant difference between the pretest and posttest mean scores [t(89) = 36.590, p < .01]. The effect size, as measured by Cohen's d, was calculated to be 2.30, which is considered a huge effect. This substantial difference between the pretest and posttest scores provides strong empirical evidence that the statistical software training program significantly enhanced the data analysis skills of the students. Therefore, the null hypothesis, which stated that there would be no significant difference between the pretest and posttest scores, was rejected. The results of this study suggest that the training program was successfully implemented and had a positive impact on students' data analysis skills, as evidenced by comparing the pretest and posttest scores.

Statistical software has become an indispensable tool for researchers and analysts across various fields, enabling them to extract meaningful insights from complex data sets. Numerous studies have highlighted the crucial role of these tools in enhancing research quality, facilitating data-driven decision-making, and advancing scientific knowledge. As Abatan and Olayemi (2014) noted, the emergence of statistical software in the 21st century has revolutionized the field of research, particularly in the physical and social sciences. By automating complex calculations and reducing the risk of human error, statistical software streamlines data analysis, allowing researchers to focus on interpreting results and drawing meaningful conclusions. Moreover, statistical software helps researchers avoid routine mathematical mistakes and ensures the accuracy of their findings, provided that the data is entered correctly (Okaygbue et al., 2021). This enhances the reliability and credibility of research outcomes.

CONCLUSION AND RECOMMENDATION

Summary of Findings

This study assesses the effectiveness of a targeted statistical software training program in developing the data analysis skills of STEM students enrolled in Practical Research II. The findings will be used to identify specific program enhancements and activities that can further improve students' ability to analyze data effectively.

A quasi-experimental, pretest/posttest research design was employed to evaluate the effectiveness of the training program. A researcher-developed pretest and posttest were administered to a sample of 90 STEM students to assess their data analysis skills before and after the training session. Frequency count, percentage, mean, and paired t-test were used to analyze the quantitative data.

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After the conduct of the survey, the following were derived from the study:

What is the level of proficiency of the respondents before and after participating in the training, as measured by their pre-test and post-test scores?

The study presents that a significant majority of students (86.67%) were categorized as beginning level, while only 13.33% were classified as developing level in the pretest. The mean pretest score was 34.09 (SD=3.14), which falls within the beginning level based on the established proficiency scale. These findings suggest that a substantial portion of the respondents struggled with the foundational knowledge and skills necessary for success in research.

Meanwhile, the posttest scores revealed that 37.78% (approaching proficiency) of the respondents demonstrated a solid understanding of the concepts and could apply them with minimal guidance while 30% (developing) of the students showed progress but still required support to master certain aspects of the subject matter. Meanwhile, 21.11% (proficient) of the respondents achieved a high level of proficiency, demonstrating a strong grasp of the concepts and skills, and only 11.11% (advanced) of the students' exceeded expectations and demonstrated exceptional mastery of the subject. The mean posttest score was 41.02 (SD=2.88), which falls within the approaching proficiency level which indicates a substantial increase in overall performance compared to the pretest results.

Does Statistical Software training significantly influence the proficiency level of the respondents, as evidenced by the comparison of pre-test and post-test scores?

The analysis revealed a statistically significant difference between the pretest and posttest mean scores [$t(89) = 36.590$, $p < .01$]. The effect size, as measured by Cohen's d, was calculated to be 2.30, which is considered a huge effect. This substantial difference between the pretest and posttest scores provides strong empirical evidence that the statistical software training program significantly enhanced the data analysis skills of the students. Therefore, the null hypothesis, which stated that there would be no significant difference between the pretest and posttest scores, was rejected. This indicates that the statistical software training program is very effective in improving students' understanding of quantitative research, specifically in data analysis.

Based on the findings of the study, what targeted enhancement programs or activities can be proposed to further improve students' data analysis skills in Practical Research II?

Based on the findings of the study, the following enhancement programs or activities can be proposed to further improve students' data analysis skills:

The school should organize regular workshops and seminars that align with the K to 12 curriculum. These sessions should introduce students to advanced statistical techniques and data analysis tools, providing hands-on training and practical exercises to reinforce learning. Inviting experts in data analysis to conduct guest lectures can provide students with valuable insights and industry perspectives. By offering these opportunities, the school can empower students to become proficient data analysts and critical thinkers.

To embed data analysis skills into the curriculum, schools should integrate data analysis activities into various subjects, such as mathematics, science, and social studies. By incorporating real-world data sets into lessons, teachers can help students apply statistical concepts and problem-solving techniques to authentic scenarios. This approach not only reinforces data analysis skills but also enhances students' understanding of the subject matter.

To ensure that all students receive the support they need to succeed, schools should provide personalized support and mentorship. This can be achieved through one-on-one tutoring sessions or small group workshops, where students can receive individualized attention and address specific learning challenges. By

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offering tailored support, teachers can help students build confidence, overcome obstacles, and achieve their full potential in data analysis.

To bridge the gap between academia and industry, schools should organize industry visits and guest lectures to expose students to real-world applications of data analysis. Collaborating with industry professionals can provide students with valuable insights, mentorship, and internship opportunities. By engaging with industry experts, students can gain a deeper understanding of how data analysis is used to solve complex problems and make informed decisions.

By implementing these enhancement programs and activities, educational institutions can further empower students with the data analysis skills they need to succeed in the 21st century.

Based on the indicated findings, the following conclusions were drawn

The findings of this study indicate a significant improvement in students' data analysis skills following the implementation of the statistical software training program. The pretest results revealed a beginning level of proficiency, while the posttest scores demonstrated an approaching proficiency level. The substantial effect size of 2.30 further underscores the effectiveness of the training in enhancing students' understanding of quantitative research methods and their ability to utilize statistical software effectively. This further implies that the training program significantly influences students' proficiency level in data analysis. These results suggest that targeted interventions, such as statistical software training, can be a powerful tool for improving student research skills in data analysis and fostering data-driven inquiry.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

1. Expand the scope and duration of the statistical software training program to further enhance students' data analysis skills. This could include additional modules on advanced statistical techniques, data visualization, and research design.
2. Integrate statistical software training into the curriculum of relevant courses to ensure that students develop strong data analysis skills throughout their academic journey. This could involve incorporating hands-on exercises and projects that require the use of statistical software.
3. Provide professional development opportunities to maintain and improve teacher competency in using statistical software. This could include workshops, seminars and training courses that offer guidance and support.
4. Encourage students to work together on data analysis projects to foster a collaborative learning environment. This can help them develop their problem-solving skills, enhance their understanding of statistical concepts, and learn from each other.
5. Future research could explore the long-term impact of statistical software training on student outcomes, investigate the effectiveness of different teaching methods, and examine the role of technology in enhancing data analysis skills.

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