Examining the Impact of Statistical Features on Grade 11 Students' Performance in Statistics Using Calculators

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ABSTRACT

This research investigates how feature characteristics affect the academic achievement of Grade 11 students in the field of statistics, with a particular emphasis on the role played by the use of calculators. The control group utilized various scientific calculators that are typically employed in statistics classes. The experimental group utilized the statistical functionalities of the advanced calculator. The objective of this study is to ascertain the impact of statistical characteristics of calculators on the academic achievement of grade 11 students in the field of statistics. The study aimed to determine whether there was a notable disparity between the pretest scores of the two groups. Is there a substantial disparity between the pretest and posttest scores of the groups? Is there a substantial disparity in the gain scores between the two groups? Furthermore, provides a comprehensive assessment of the study. The study's findings indicate a notable disparity in the utilization of various statistical functions on calculators. The experimental group demonstrated superior performance and adeptly utilized the statistical aspects of advanced calculators. The students in the Control group had challenges when attempting to solve the z-test and p-value. The statistical functionality of advanced calculators becomes valuable in advanced statistical topics.

Keywords: *Calculator, Statistics, Students, Features, Performance*

Introduction

Teachers and learners worldwide have shown interest in various sorts of technology. Teachers utilize technology to enhance their capacity and proficiency in instruction. The utilization of calculators in educational settings has long been a subject of dispute among parents, students, and teachers. Nevertheless, individuals have come to recognize the substantial impact of calculators in addressing intricate and convoluted problem-solving tasks. Furthermore, this notion is corroborated by the Common Core Standards for Mathematics Practice (SMP).

The statistical characteristics of the advanced calculator streamline computations and enable the utilization of actual data, hence reducing tedium. A less frequently encountered aspect concerns the assessment performance and score. Research indicates that the utilization of specific calculator functionalities has been associated with enhanced academic performance among students (Carlson, 1996). Advanced calculators provide a comprehensive set of statistical functions that significantly influence students' academic achievement in areas such as Statistics, Science, and Mathematics. Data visualization is a highly influential feature that enables students to visually represent datasets. This visual depiction facilitates the perception of statistical patterns, hence enhancing students' ability to identify trends and outliers. Moreover, the inclusion of regression analysis allows students to create mathematical models that accurately represent real-life situations, hence improving their proficiency in applying statistical concepts to practical settings.

The inclusion of hypothesis testing and probability distributions in the calculators enhances students' comprehension of inferential statistics, empowering them to make well-informed judgments through meticulous

analysis. The interactive data input and analysis features promote active participation, enabling students to change datasets in real time and develop a sophisticated comprehension of how variables impact statistical results. The calculators' extensive statistical functions library streamlines intricate calculations, minimizing computational errors and improving the efficiency of statistical analysis.

As per Jones (1996), the utilization of a calculator in mathematics and statistics can reduce laborious procedures, allowing students to focus on the subject, enhance their higher-order thinking abilities, and acquire knowledge of practical applications. A robust calculator serves as an additional tool for students to enhance their cognitive perception and estimate abilities. It assists them by providing step-by-step techniques that are essential for comprehending mathematics and other disciplines. A major obstacle to students' performance in statistics is when they do not have access to or are not skilled in using the complex statistical functions of calculators. In the absence of these technological tools, students may face challenges when dealing with intricate statistical computations and analyses.
According to Jones (1996), the utilization of the advanced calculator eliminates pupils' nervousness when it comes to problem-solving. They will receive guidance in doing multiplication and other mathematical operations, enabling them to arrive at the correct solutions. The teacher should continue instructing the students to improve their mental estimate skills, enabling them to understand the practicality of using a calculator in problem-solving scenarios. This will help students to concentrate on the necessary problem-solving procedures.

Advanced calculators facilitate the utilization of authentic data in problem-solving. It facilitates rapid comprehension and comparison between the symbolic and tabular representations of data, providing many opportunities to explore how each form aids in data analysis. The Calculator application provides an affordable means for all learners to access statistics subjects and develop their statistical reasoning skills. Using this process, learners will analyze the data, contrast the outcomes with the anticipated results, articulate a model, and achieve the task without the use of a calculator.

Calculators can be employed to enhance students' problem-solving abilities and their metacognitive awareness. Utilizing calculators in instruction can present a method of teaching where learners can clearly outline the steps of their solutions while engaging in the activity. It can activate the appropriate cognitive processes related to the relevant framework of construction. According to Alin, Tajudin, and Konting (2007), the usage of a calculator can enhance students' conceptual knowledge.

Thus, this research examined the impact of statistical elements of calculators, offering valuable information to improve students' competency and assist instructors in customizing instructional techniques to tackle specific issues. The study provides teachers with significant insights, enabling them to modify their teaching methods based on a nuanced comprehension of students' challenges with statistical tasks that involve the use of calculators. This focused adjustment ultimately promotes a more efficient and captivating learning atmosphere. Outside of the classroom, the results of the study have wider implications for educational leadership. Division superintendents, education program directors, and school principals can utilize the findings to influence policies that promote technical progress in statistics instruction. Furthermore, the research provides valuable insights for organizing seminars and conferences, which facilitate continuous professional growth for educators. Through the incorporation of cutting-edge technologies and methodologies, educational leaders can enhance the dynamic and forward-thinking nature of mathematics instruction at both the institutional and systemic levels.

Methodology

Sampling

The experimental group, comprising 60 Grade 11 students, solely employed the Run-Math and STAT capabilities of the advanced calculator to tackle z-test, t-test, and regression/correlation problems related to hypothesis testing. In addition to utilizing this technical method, the students also made use of t-tables and z-tables provided by the teacher. The statistical functions of the advanced calculator were crucial in effectively solving intricate statistical analyses, encompassing computations for z-tests, t-tests, and p-values.

The research included a separate component called the control group, which consisted of 57 Grade 11 students. This group utilized scientific calculators to perform z-tests, t-tests, and regression/correlation analyses as components of their hypothesis testing techniques. The scientific calculators used by the control group were proficient in resolving correlation and regression analyses, but they were unable to calculate z-values, t-values, and p-values.

Data Collection Procedure

Before administering the pretest, the researcher provided a comprehensive explanation of the research's objective to both groups. Subsequently, the pretest was delivered in the two groups during the initial session of the class. The groups utilized the calculator, z-table, and t-table to complete the pretest in a time frame of 45 minutes. The experimental group utilized the Run-Math and Statistical functionalities of the advanced calculator throughout the post-test. In addition, they were permitted to utilize a z-table and a t-table. The experimental group utilized a scientific calculator, t-table, and z-table for control purposes. Both groups responded within a time frame of 45 minutes.

Data Analysis Procedure

The research investigation employed a quantitative approach. The collected data were examined and interpreted utilizing the t-test, which compares the means of two groups, to measure the disparity between the two groups.

Results and Discussion

As shown in Table 1, the p-value is higher than 0.05, indicating that there is no statistically significant difference in the performance of the two groups during the pretest. Both groups utilized the scientific calculator during the examination and were allotted a duration of 45 minutes to respond to the test, indicating that both groups had an equal level of comprehension of the presented hypothesis testing.

Table 1: Difference between the pretest scores of the two groups

	Mean	SD	Computed t	p-value	Conclusion
Control	4	1.37			
Experimental	4.4	1.67	-1.08	.8973	Not Significant

Table 2 displays the notable enhancement in the performance of the two groups. The experimental group utilized the statistics function and Run-Math feature of the advanced calculator to raise the mean from 4.4 to 9.8. The statistical feature of the advanced calculator streamlines complex methods, enabling pupils to concentrate on the subject at hand. During the posttest, the experimental group's pupils demonstrated a 50% improvement in their performance on the test items, indicating the positive influence of the advanced calculator. During the pretest, the participants responded to the questions for a duration exceeding 40 minutes; but during the posttest, a portion of the students completed the items in less than 35 minutes. This demonstrates how the participants efficiently resolved the provided problems using the advanced calculator, which allowed them sufficient time to review their results. The advanced capabilities of advanced calculators can enhance statistical analysis beyond the proficiency and capacity of students. According to Gorman (2008), the calculator enhances student interactivity and improves performance.

Conversely, the control group showed notable enhancement in their performance during the posttest, with 86% of students answering the questions correctly. The exam results demonstrated the students' progress following the discussion and introduction of the statistical functionalities of the scientific calculator. The average score rose from 4 to 7.8. During the pretest, students completed the test in 30 minutes. However, on the posttest, it took them 45 minutes to complete the test, since they were required to demonstrate the lengthy process of solving the problems. In contrast, the non-honor students completed the test in 40 minutes due to their lack of interest in complex problem-solving methods.

Table 2: Difference between the pre-test and post-test scores of the two groups

	Pretest		Posttest				
	Mean	SD	Mean	SD	Computed t	p-value	Conclusion
Control	4	1.37	7.78	1.83	-12.62	0.00001	Significant
Experimental	4.4	1.67	9.8	1.91	-15.75	0.00001	Significant

Table 3 displays a p-value that is below 0.05. A considerable disparity in performance was seen between the two groups. The experimental group demonstrates superior performance than the control group, as evidenced by a higher mean. The participants in the experiment responded to the examination more efficiently by providing concise solutions. The statistical features of advanced calculators reduce the time required to solve problems by directly providing solutions and offering additional advanced features. This eliminates the lengthy procedure often involved in statistical problems, making it easier for pupils. The advanced calculator's statistical capabilities enable the resolution of complex statistical problems, whereas the control group must rely on lengthy manual calculations that require significant effort and the use of multiple formulas.

Table 3: Difference between the gain scores of the two groups

	N	Mean	SD	Computed t	p-value	Conclusion
Control	57	7.78	1.83	-5.89	0.00992	Significant
Experimental	60	9.8	1.91			

During the study, the researcher noted the disparity in the use of a scientific calculator by the control group and the statistical capabilities of an advanced calculator by the experimental group in teaching Grade 11 Statistics. The pupils in the control group encountered challenges during the extensive problem-solving procedure. Regarding the issue that requires a lengthy process for resolution, the researcher had to instruct the control group on the sequential method, resulting in a significant amount of time being spent discussing the problem and determining the necessary values. Furthermore, pupils were also expressing additional inquiries on the specific keystrokes to be utilized on the calculator, hence increasing the level of complexity. Consequently, this necessitated individualized tutorials on the proper manipulation of the calculator. The scientific calculator lacks the necessary computational capabilities to directly tackle statistical questions. During the experimental group session, when the researcher presented the lengthy procedure for answering the statistical problems, the respondents became fatigued and disinterested due to it being the final time of the afternoon. Nevertheless, upon being informed about the benefits of utilizing the calculator for solving statistical problems, the respondents displayed keenness. The teaching of hypothesis testing themes was facilitated by attentive and appreciative respondents who recognized the significance of utilizing a calculator for problem-solving. The advanced calculator's statistical capabilities are valuable for advanced statistical concepts such as p-value, f-test, Chi-square, and ANOVA.

Different tactics are utilized to teach the two groups utilizing advanced and scientific calculators. The control group faces challenges in utilizing the statistical functionalities of the scientific calculator due to the complexity of the key inputs and the limited capabilities of the calculator in solving advanced statistical problems. In contrast, the experimental group demonstrated proficiency in utilizing the advanced calculators for statistical analysis, including tasks such as completing the t-test, z-test, p-value, chi-square, ANOVA, and F-test, without encountering any difficulty.

Conclusion

During the 6-week research study, testing indicated a notable disparity in the use of the scientific calculator by the control group and the statistical capabilities of the advanced calculator employed by the experimental group. During the Control group discussion, students encountered challenges when attempting to solve the z-test and p-value. The statistical capabilities of the scientific calculator are restricted to a select few domains. The students successfully answered the complex problems, but the group demonstrated superior performance.

The students exhibited a higher level of engagement during the classroom conversation. When teaching statistics, there is a notable disparity in the performance of both groups. This finding suggests that the statistical characteristics of advanced calculators offer the benefit of efficiently handling statistical issues without excessive time consumption. These factors enhance the students' motivation to engage in the classroom discourse. The integration of advanced calculators in statistics education has resulted in major benefits, including more student engagement in class discussions and revealing a substantial discrepancy in performance among different groups. Advanced calculators, due to their versatile features, are essential tools for effectively addressing statistical issues and enhancing the learning experience by making it more interactive. These calculators enhance students' ability to understand statistical topics by using visual representations, allowing for a more intuitive understanding of patterns and correlations in data. The utilization of this visual method not only improves problem-solving abilities but also promotes cooperative exploration during classroom discussions, as students can easily exchange and examine graphical results. Furthermore, the utilization of advanced calculators not only enhances academic achievement but also fosters the cultivation of a more interactive and visually focused approach to statistics instruction.

The researcher's findings suggest that it is crucial to prioritize the development of students' proficiency in utilizing advanced calculators in the domains of Statistics, Science, and Mathematics. Teachers specializing in Statistics, Science, and Mathematics should integrate different tools, such as the advanced calculator into their classroom discussions. Additionally, it is convincing to perform further research with a larger sample size to corroborate the results of the study about the use of advanced calculators. To bolster the trustworthiness of the research outcomes, it is essential to underscore the importance of continual investigation and assessment. Conducting additional studies with larger and more diverse groups of participants will enhance the reliability of the evidence demonstrating the beneficial effects of advanced calculators.

Contributions of Authors

The study's author did the entire research process, including data gathering, analysis, and work development.

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Conflict of Interests

The authors declare that no conflict of interest is associated with this research study.

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