ENHANCING STUDENT'S CORRELATION ANALYSIS SKILLS WITH ONLINE CALCULATORS IN A BLENDED LEARNING ENVIRONMENT

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ABSTRACT: *This study provides evidence that integrating an online correlation calculator in a blended learning environment can enhance students' skills in correlation coefficient analysis. Conducted with Grade 11 students at Libungan National High School during the 2023-2024 school year, the research used a sequential explanatory mixed-methods design, combining quantitative data from a quasi-experimental pretest-posttest control group with qualitative insights. Over a two-week course, students used the Statistics Kingdom online correlation calculator and were assessed on performance, ease of use, usefulness, and self-efficacy. The results showed positive outcomes, reinforcing the benefits of technology integration in math education. This study highlights the advantages of digital tools in blended learning for improving statistical skills and calls for further research and strategic implementation.*

Keywords: Correlation coefficient analysis, Online correlation calculator, Blended learning

INTRODUCTION

In today's data-driven era, statistical analysis is crucial for informed decision-making across various fields. One fundamental technique is the correlation coefficient, which measures the strength and direction of the association between two variables [1]. Pearson's correlation coefficient, denoted by "r" and ranging from -1 to +1, quantifies the linear relationship between two continuous variables and is pivotal for advanced data analysis [2].

Understanding Pearson's correlation coefficient enables students to:

1. Assess the correlation between variables.
2. Perform hypothesis tests to determine statistical significance.
3. Interpret research findings.
4. Recognize the assumptions and constraints of correlation analysis.
5. Develop critical thinking skills [3].

The Department of Education (DepEd) issued guidelines for modular distance learning during natural disasters, promoting learning continuity [4]. Consequently, Libungan's local government and school heads agreed on a blended learning approach to protect student wellness while fulfilling educational mandates.

Blended learning combines face-to-face instruction with online learning, enhancing engagement, flexibility, and outcomes [5]. However, students often struggle with understanding, computing, and interpreting correlation coefficients in blended settings due to the complexity of the concepts [6].

This study aims to optimize students' correlation coefficient analysis skills in blended learning using an online correlation calculator, specifically from Statistics Kingdom. This tool simplifies statistical operations, making data analysis accessible and efficient. It also offers interactive exercises for practice and immediate feedback [7].

The study seeks to demonstrate the effectiveness of the online correlation calculator in improving students' understanding, computation accuracy, and interpretation of correlation coefficients in blended learning environments. Ultimately, this digital innovation aims to equip students with the analytical skills necessary for success in a data-driven world.

2. METHODOLOGY

This study aimed to provide empirical evidence in optimizing students' correlation coefficient analysis through an online correlation calculator in blended learning. To achieve this, a sequential explanatory design was employed. Sequential explanatory design is a type of mixed-methods research design that involves collecting and analyzing quantitative and qualitative data to help explain or elaborate on the findings [8]. This design is used to better understand complex phenomena, gain insights into relationships between variables, and explore reasons behind statistical results of the study. Thus, the research study was divided into two distinct phases.

Phase 1 is quantitative data collection and analysis. In this phase, a quasi-experimental design was used. This enables the researchers to examine the causal effects of an intervention or treatment when random assignment of participants to control and experimental groups is not possible or ethical [9]. The study was conducted at Libungan National High School (LNHS) school year 2023-2024. The study comprised of two groups, an experimental group and control group. Drawing of lots was done to randomly assign the two sections of grade 11 Information and Communication Technology (ICT) class into experimental and control group. The experimental group is composed of 39 students while the control group is composed of 40 students. Pretest and posttest were administered to the two groups but only the experimental group was introduced to an online correlation calculator integrated into their blended learning course. The instrument used was a teacher-validated test involving the conceptual understanding and problem-solving skills of the students. The said instrument was tested and validated using KR 20 which yielded a reliability of 76.9%, a value considered reliable in the field of education. The instrument consisted of 40 items that measured knowledge, comprehension, application, and analysis of the topics taught. The quasi-experimental design is symbolized as follows [10].

Experimental Group	O_1	X	O_2
Control Group	O_1		O_2

where: O_1 = pretest of the control and experimental groups
O_2 = posttest of the control and experimental groups
X = treatment (Online Correlation Calculator)

The online correlation calculator used in this study is the free website statistics calculator known as Statistics Kingdom. The research was conducted over two-week classes that align with the Department of Education's mathematics curriculum guide for grade 11. Quantitative data was collected through pre- and post-intervention surveys, focusing on students' perceived ease of use, usefulness, and self-efficacy in analyzing correlation coefficients using the online calculator. Additionally, students' performance data in correlation coefficient analysis tasks were gathered. Descriptive and inferential statistical methods including independent t-tests, were utilized to determine the significant difference between the two groups' test results.

The phase 2 of this research is qualitative data collection and analysis. A sub-sample of participants from phase 1, reflecting diverse performance levels and perceptions, was selected for qualitative data collection. Semi-structured interviews and focus group discussions were conducted to explore the students' experiences, challenges, and perceived benefits of using the online correlation calculator in the blended learning environment. Qualitative data were transcribed, coded, and thematically analyzed to identify common themes and patterns [11]. These themes were then used to explain and interpret the quantitative findings from Phase 1.

For the final stage, the quantitative and qualitative results will be merged and collectively analyzed to gain a comprehensive understanding of how the online correlation calculator influences students' performance and perceptions in analyzing correlation coefficients in blended learning environment [8]. One possible limitation of the study could be related to the generalizability of the findings. Since the research focuses on a specific group of students within a blended learning environment, the results may not be applicable to students in different educational settings or those with varying levels of technological proficiency. Additionally, the study's duration and sample size might also pose limitations, as they could restrict the scope and depth of the conclusions drawn from the research.

3. RESULTS AND DISCUSSION

Since $n \leq 50$, we used the Shapiro-Wilk test to check the normality of observations in the pretest scores of the control and experimental groups. Table 1 below shows that pretest scores in the two groups did not show a significant departure from normality: control group [$W(40)=0.95$, p=.057], experimental group [$W(39)=0.94$, p=.052]. Hence, we accept the H_0. It is assumed that the data in the two groups are normally distributed.

Table 1. Test of normality of observations in pretest scores

	Shapiro-Wilk		
	Statistic	df	P
Control Group (n=40)	.9464	38	.057
Experimental Group(n=39)	.9378	37	.052

Mean and percentages were calculated to ascertain the significant difference between the pretest scores, post test scores and gain scores of the experimental group and those in the control group. Meanwhile, independent paired t-tests were conducted to examine the changes in students' performance after using the online correlation calculator.

Table 2. Comparing pretest and posttest mean scores, gain scores, and percentages between experimental and control groups

	Experimental Group		Control Group	
	Mean	Percent (%)	Mean	Percent (%)
Pretest scores	11.15	27.9	11.35	28.4
Posttest scores	26.90	67.2	24.83	62.1
Gain scores	15.74	39.4	13.48	33.7

Table 2 shows the comparative results of the pretest, posttest, and gain scores between the experimental and control group. In Pretest results, experimental group obtained a mean score of 11.15 which indicates that the students were able to answer 27.9% correctly of the test. However, the control group obtained a mean score of 11.35 which indicates that the students were able to answer 28.4% of the test. The results imply that the students in both groups have little prior knowledge about correlation coefficient analysis. For the posttest results, the experimental group attained a mean score of 26.90 which indicates that the students were able to answer 67.2% correctly of the test. However, the control group attained a mean score of 24.83 which indicates that the students were able to answer 62.1% correctly of the test. This implies that both groups surpassed the passing rate of 50% of the 40-item test and learned significantly in the lesson. But it is noticeable that experimental group scored higher with a difference of 5.18% compared to control group. As for the gain scores, the experimental group obtained a gain mean score of 15.74 which indicates that on the average, students in this group gained the score of 15.74 (39.4%) in the test. However, the control group obtained a gain mean score of 13.48. This indicates that the students in this group gained 33.7% of the perfect score. This implies that the students in experimental group exceeded the students in control group on correlation coefficient analysis.

Table 3. Summary of t-test results for group differences in the pretest scores

	M	SD	T(77)	p
Experimental group (n=39)	11.15	2.23	0.403^{NS}	.688
Control group (n=40)	11.35	2.09		

Table 3 shows the results of the t-test analysis, which compares the math pretest scores of both the control and experimental groups. Students in the experimental group achieved a mean math pretest score of M=11.15 (SD=2.23), whereas the control group obtained a mean score of M=11.35 (SD=2.09). The t-test revealed no statistical significant difference between the two groups, $t(77)=0.40303$, $p=0.68805 > 0.05$. This implies that the two groups were closely comparable and therefore, re-sectioning of the students is not an option. The null hypothesis that there is no significant difference between the pretest scores of the experimental and control groups was not rejected.

Table 4. T-test results for group differences in the posttest scores

	M	SD	T(77)	p
Experimental group (n=39)	26.90	4.44	-2.05837	.042
Control group (n=40)	24.83	4.51		

Table 4 presents the findings of the t-test analysis, which compares the math posttest scores of the control and experimental groups. The mean difference in the posttest scores of the two groups was 2.07% (5.18%) in favor of the experimental group. The t-test for independent samples used to analyze the data yielded a value significant at 0.05 level ($t = -2.05837$, $p = 0.04294 < 0.05$). This means that students who were using correlation coefficient calculator outperformed students in the control group revealing a positive effect of the intervention on students' performance.

Table 5. T-Test results for group differences in the gain scores

	M	SD	T(77)	p
Experimental group (n=39)	15.74	4.13	-2.281	.025
Control group (n=40)	13.48	4.68		

The results of the t-test analysis comparing math gain scores between the control and experimental groups are presented in Table 5. Students in the experimental group achieved a mean math gain score of M=15.74 (SD=4.13), whereas in the control group obtained a mean score of M=13.48 (SD=4.68). The t-test revealed a statistically significant difference between the two groups, $t(77)=-2.28145$, $p=0.02529 < 0.05$. This indicates that the students exposed to online correlation coefficient scored significantly higher on the math test compared to students in the control group. These findings are supported by Gulbahar & Kalelioglu [12] that integrating technology into mathematics education enhance students' problem-solving skills, critical thinking, and motivation to learn mathematics. Furthermore, blended learning has the potential to improve student performance in mathematics, particularly when combined with innovative teaching strategies [13]. Thus, technology integration in mathematics education under blended learning environments can positively affect student learning outcomes, engagement, motivation, and attitudes toward mathematics. Nonetheless, it's crucial to acknowledge that the efficacy of blended learning could vary based on the strategy of implementation, the technology employed, and contextual variables.

The qualitative data collection and analysis yielded several important themes and insights. Participants noted that utilizing an online correlation calculator in blended learning settings enhanced their comprehension of correlation coefficient analysis. This observation aligns with prior studies that underscore the advantages of incorporating technology into statistics education [14]. Furthermore, students perceived the online correlation calculator as easy to use, which contributed to its successful integration into blended learning settings. In addition, they found the platform to be valuable tool for analyzing data and solving problems related to the topic, thus enhancing their overall learning experience [15]. Additionally, students reported increased confidence in their ability to perform correlation coefficient analysis using the online calculator, contributing to their overall perception of the tool's effectiveness [16]. Some feed-backs were the following:

"It helped me understand correlation analysis better by providing real-time feedback and visualization."

"I would recommend using an online correlation calculator in blended learning to future statistics students because it is important to note that while online correlation calculators can be valuable tools, students should also develop a solid foundation in statistical thinking skills."

"Online correlation calculator boosts student collaboration and communication. Students can work together on data projects, share ideas, and discuss results instantly, enhancing engagement and learning effectiveness through teamwork and sharing perspectives."

"I became more interested in correlation analysis because I don't have much difficulty anymore because I use the online correlation calculator. It's a big help for me."

"Using this online correlation calculator in blended learning has better prepared me for real-world application analysis. Dahil dito, mas na-enhance ang aking ability to quickly and accurately compute correlation coefficients and interpret the relationships between variables making me more proficient in data analysis and decision-making process in real-world."

4. CONCLUSIONS

Based on the results and findings of the study, online correlation calculator enriched students' learning of correlation coefficient analysis. Students performed better with the aid of the online correlation calculator in blended learning environment. Moreover, it positively impacted their performances and improved self-efficacy in doing correlation coefficient analysis.

5. RECOMMENDATIONS

Hence, teachers teaching correlation coefficient analysis in blended learning environments should maximize the use of online correlation calculators. Educators should be provided with professional development opportunities to learn about the benefits and effective use of online correlation calculators in blended learning environments. Future studies should explore more of online correlation calculators across various educational settings and with different student populations, including diverse age groups, academic levels, strand, and cultural backgrounds.

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