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Exploring the correlation between students' performance in educational statistics and research methods in education: The influence of undergraduate programs

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ABSTRACT

This study aimed to explore the correlation between students' performance in educational statistics and research methods in education, as well as investigate potential differences in performance based on their undergraduate programs. A cross-sectional design was employed, and data was collected from 170 students enrolled in master of philosophy programs in the department of education and psychology at the University of Cape Coast, Ghana. The correlation analysis revealed a strong positive correlation between students' performance in intermediate statistics in education and research methods in education. This indicates a close relationship between the two domains. The MANOVA analysis showed no significant differences in the linear combination of intermediate statistics in education and research methods in education scores across the different undergraduate programs. The tests of between-subjects effects further confirmed that the student's performance in intermediate statistics in education and research methods in education did not differ significantly across the different undergraduate programs. These findings contribute to the existing literature by providing insights into the correlation between educational statistics and research methods, and the influence of undergraduate program backgrounds on students' performance in these domains. The strong positive correlation between intermediate statistics and research methods highlights the importance of a solid foundation in statistics for understanding and applying research methods. Moreover, the consistent relationship across different academic backgrounds emphasizes the need for targeted interventions and support systems to enhance graduate students' competencies in these critical areas.

Keywords: Educational statistics, research methods, undergraduate programs, students' performance.

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INTRODUCTION

In today's educational landscape, the mastery of statistical concepts and research methodologies is increasingly recognized as fundamental for students pursuing advanced studies in various disciplines (Daniel, 2022; Wishkoski et al., 2022). Particularly in fields such as education and psychology, where empirical research plays a pivotal role in advancing knowledge and practice, proficiency in statistics and research methods is indispensable. However, the extent to which students' undergraduate program background influences their performance in intermediate statistics in education and subsequent research methods in education remains an

area of inquiry worthy of exploration.

Statistics education serves as a foundational pillar in equipping students with the necessary analytical skills to critically evaluate research findings, design empirical studies, and draw valid conclusions (Olgun, 2023; Dehalwar and Sharma, 2023). Therefore, it is reasonable to hypothesize that students who have received adequate training in statistics during their undergraduate education may exhibit a greater aptitude for understanding and applying statistical concepts in the context of research methods courses. Conversely, students with limited exposure to statistical concepts may face challenges in comprehending the intricacies of research methodologies, potentially impacting their academic performance in these courses.

The relationship between research and statistics is one of inseparable interdependence. Quantitative research, by its very nature, cannot reach its full potential without the application of appropriate statistical analysis. Statistics is not merely a supplementary tool, but an integral component that lends rigor, depth, and credibility to the research process. The choice of statistical techniques is directly tied to the research objectives and the scale of measurement used for the variables under investigation. This alignment between the research questions/hypotheses and the statistical methods employed is crucial for drawing meaningful and reliable conclusions from the data. Researchers who fail to navigate this statistical landscape effectively often find themselves lost in the complexities of data analysis.

The challenges associated with research methods and statistics are well-documented in the academic literature. Students, particularly in the field of psychology, often perceive these subjects as "dull, difficult, and distressing" (Haslam and McGarty, 2018). This perception can lead to anxiety, procrastination, and a reluctance to engage with the material, ultimately hindering their academic progress and research competencies. However, the literature also suggests that effective teaching practices can mitigate these challenges. Strategies such as a humorous teaching approach, encouragement from the instructor, and the acknowledgment of anxiety coupled with the introduction of coping mechanisms have been shown to reduce students' statistics anxiety (Chew and Dillon, 2014). By addressing these psychological barriers, educators can empower students to embrace the synergistic relationship between research and statistics, fostering a more positive and productive learning environment.

However, a significant challenge arises in the context of graduate programs in education, where a large proportion of students often lack a strong background in statistics, probability theory, and data analysis. The emphasis in their undergraduate training has traditionally been on the development of relational skills needed for curriculum design, instruction, pastoral care, and evaluative practices (Ensminger and Leder-Luis, 2020; Carbone et al., 2021; Pinto and Koichu, 2021). As a result, many graduates especially doctoral students in education find quantitative methods daunting and difficult (Hooker and Mentch, 2021), and few courses provide robust attention to statistics (Ake-Little et al., 2020). Consequently, most students "have had little or no undergraduate preparation in research design or data analysis (quantitative or qualitative) and lack knowledge of the epistemological foundations for social science research" (Dadzie, 2020). This gap in quantitative skills poses a significant challenge for graduate students in education, as they are expected to engage in rigorous research and data analysis as part of their academic pursuits.

The existing evidence presents a nuanced and complex relationship between students' undergraduate preparation and their success in graduate educational programs. While some studies have suggested that a strong background in educational statistics and research methods during the undergraduate years can positively impact graduate-level performance, the evidence is not unequivocal. The argument that a lack of exposure to educational statistics and research methods during the undergraduate program would make it difficult for students to excel in their graduate studies is not fully supported by the literature. Koehler et al. (2017) and others have found a positive relationship between undergraduate preparation and graduate program success, indicating that a solid foundation in these areas can indeed benefit students. However, the evidence is mixed, with some studies finding no significant influence between undergraduate preparation and graduate-level knowledge of statistics and research methods (Dadzie and Ahorsu-Walker, 2022; Mendoza-Sanchez et al., 2022).

The underlying assumption that statistics and research methods are inherently intertwined and that a deficiency in one would necessarily lead to difficulties in the other is also not universally supported. Some studies have found that students can excel in research methods without a strong background in statistics, and vice versa (Dadzie and Annan-Brew, 2023). This suggests that the relationship between these two domains may be more complex and multifaceted than a simple causal link. It is important to recognize that the transition from undergraduate to graduate studies, particularly in the field of education, involves a range of factors beyond just statistical and research competencies. Factors such as critical thinking, problem-solving skills, and the ability to integrate theoretical and practical knowledge may also play a significant role in determining graduate-level success (Dadzie et al., 2024; Mendoza-Sanchez et al., 2022). Based on these foundational principles, the current study was guided by two main research objectives:

1. To explore the correlation between students' performance in educational statistics and research methods in education.

2. To investigate potential differences in performance among students in educational statistics and research methods in education based on their undergraduate programs.

Research question

1. What is the correlation between students' performance in educational statistics and research methods in education?
2. Are there any differences in performance among students in educational statistics and research methods in education based on their undergraduate programs?

LITERATURE REVIEW

Theoretical frameworks, such as the skill acquisition theory and Campbell's model of job performance, suggest that undergraduate research experience can be a crucial factor in determining graduate-level success (Gilmore et al., 2015; Campbell et al., 1993). These theories emphasize the importance of hands-on practice and the development of declarative knowledge, procedural knowledge, and motivation as key drivers of performance.

Additionally, the cognitive apprenticeship model highlights the role of interaction with established researchers in fostering disciplinary-appropriate thinking and skill development (Brown et al., 1989). This model suggests that the mentorship and guidance provided during undergraduate research experiences can significantly benefit students as they transition to graduate-level studies. These theoretical foundations provide a strong rationale for the potential benefits of undergraduate research experience in enhancing students' preparedness and competencies for success in graduate programs.

However, the search results also present a surprising discrepancy between the theoretical expectations and the empirical evidence. Meta-analytical studies have shown a lack of correlation between undergraduate research experience and graduate academic performance in educational statistics and research methods, with uncertainties regarding degree attainment and publication performance (Miller et al., 2021). This discrepancy may be attributed to the varying operationalization of research experience across studies, ranging from a simple binary presence or absence to more nuanced factors like the duration of involvement or the completion of an undergraduate thesis (Cox et al., 2009; Weiner, 2012; Hall, 2020).

Correlation between students' performance in educational statistics and research methods in education

The studies conducted by Feng, Fan and Chen (2022), Batool et al. (2023), Ajai and Ogungbile (2023), and Abid et al. (2022) collectively contribute to understanding the correlation between students' performance in educational statistics and research methods in education. Feng, Fan and Chen (2022) and Batool et al. (2023) focus on predictive modeling and performance analysis using data mining techniques in educational contexts. Feng, Fan and Chen (2022) propose a comprehensive approach integrating clustering, discriminant analysis, and convolutional neural networks to predict students' academic performance. Similarly, Batool et al. (2023) conducted a comparative analysis of student performance prediction models and data mining algorithms, emphasizing the importance of factors such as academic records and demographic characteristics.

In contrast, Ajai and Ogungbile (2023) investigate the relationship between instructional methods, student attitudes, and gender on geometry performance. Although their study focuses on geometry instruction, it underscores the significance of instructional strategies in shaping students' academic outcomes. Abid et al. (2022) explore the association between students' interpersonal skills and academic achievement, highlighting the indirect relationship between interpersonal skills and performance. While their study does not directly examine statistics or research methods, it underscores the importance of holistic student development and its potential impact on academic success.

Differences in performance among students in educational statistics and research methods in education based on their undergraduate programs

The studies conducted by Lindsay et al. (2023), Gnjidic et al. (2023), Atkinson (2023), Qahmash et al. (2023) and Wishkoski et al. (2022) shed light on various aspects of students' performance and experiences in educational statistics and research methods across different undergraduate programs. These studies collectively provide insights into the factors influencing student outcomes and perceptions in this domain. Lindsay et al. (2023) and Wishkoski et al. (2022) focus on students' perceptions and attitudes towards research practices and methods. Lindsay et al. (2023) found that statistics anxiety remains prevalent among psychology students, despite enhancements in research methods and statistics teaching. Wishkoski et al. (2022) observed changes in students' attitudes and perceptions of research methods over a semester, indicating the potential impact of pedagogical approaches on student experiences.

In contrast, Gnjidic et al. (2023) investigated the relationship between various factors, such as coursework performance, supervisor characteristics, and project type, with overall academic performance in pharmacy students completing an honors research program. They found

differences in performance based on gender, student status (domestic vs. international), and project type, highlighting the multifaceted nature of student outcomes. Atkinson (2023) explored the correlation between preparatory assignments and project performance in basic data analytics concepts. The study revealed differences in correlations between male and female learners, suggesting potential gender-related variations in learning outcomes. Qahmash et al. (2023) applied statistical and educational data mining approaches to study the relationship between pre-admission criteria and student performance in medical programs. Their findings underscored the importance of revising admission criteria to better predict student success and optimize program selection processes.

Theoretical background

The theoretical background of the study emphasizes the importance of understanding the relationship between educational statistics and research methods in determining student performance in graduate-level education. It discusses the foundational role of statistics in equipping students with analytical skills and highlights the interconnectedness of different academic domains. The study also explores theoretical frameworks such as the cognitive apprenticeship model and skill acquisition theory, which suggest that undergraduate research experience can enhance students' preparedness for success in graduate programs. Additionally, it acknowledges the complexities of the relationship between statistics and research methods, noting that deficiencies in one domain may not necessarily lead to difficulties in the other. Overall, the theoretical background underscores the significance of considering various factors beyond statistical and research competencies in determining student success in education.

Literature gap

The existing literature highlights the importance of understanding the factors that influence student performance in educational statistics and research methods, as these skills are fundamental for success in graduate-level education and research. While the studies reviewed provide valuable insights into the broader context of student academic performance, there is a need for more targeted research that directly examines the correlation between students' performance in these two interrelated domains, particularly in the context of their undergraduate program backgrounds. Insufficient exploration of the long-term effects of undergraduate research experience on graduate academic performance, while the study mentions discrepancies between theoretical expectations and empirical evidence regarding the correlation between undergraduate research experience and graduate academic performance. Limited investigation into the intersectionality of student backgrounds and performance in educational statistics and research methods, mentions the need for more targeted research that directly examines the correlation between students' performance in these two domains based on their undergraduate program backgrounds.

METHODS

This study employed a cross-sectional design to investigate how students' undergraduate program backgrounds influenced their performance in intermediate statistics in education and research methods in education within Master of Philosophy programs under the Department of Education and Psychology. The study included students from the 2021 and 2022 cohorts to ensure equivalent test items for assessing performance. Participants were drawn from six Master of Philosophy programs: Measurement and Evaluation, Home Economics, Special Education, Educational Psychology, Sociology, and Guidance and Counseling. All students took intermediate statistics in education in the first semester and research methods in education in the second semester.

Data collection utilized a pro-forma achievement sheet, recording both continuous assessment and end-of-semester scores for the intermediate statistics and research methods courses. The undergraduate programs were categorized into those with related education backgrounds social science programs and medical-related programs. A convenient sampling method was employed, resulting in a sample of 170 students enrolled in the Master of Philosophy programs.

The research aimed to explore the correlation between students' performance in educational statistics and research methods in education, as well as investigate potential differences in performance based on their undergraduate programs. The study utilized statistical analysis, regression analysis, and correlation analysis to examine the relationship between the variables of interest. Assumptions such as normality, linearity, homoscedasticity, independence of residuals, and multicollinearity were assessed to ensure the validity of the analysis. The findings were presented in tables and discussed in relation to existing literature and research objectives.

The sequential course arrangement hypothesized that a strong foundation in statistics would positively affect students' understanding and performance in research methods. By introducing statistics before research methods, the curriculum strategically leveraged students' prior knowledge and skills, facilitating a more coherent and

scaffolder learning experience. This methodological approach aligns with educational best practices, promoting progressive learning and enhanced comprehension of research concepts. By establishing a statistical foundation first, students are better equipped to approach research methods effectively. Additionally, the use of a convenient sampling method to obtain 170 students enhances the study's feasibility and practicality. While this sampling method may limit generalizability, the comprehensive data collection strategy ensures representative findings within the sampled population. Overall, the study's methodological framework, combining a cross-sectional design, sequential course structure, and convenient sampling, provides a robust platform for investigating the influence of undergraduate program backgrounds on students' performance in educational statistics and research methods.

RESULTS

Demographic characteristics of respondents

This section provides an overview of the respondents' demographic distribution. The demographic information encompassing gender, undergraduate program and master program are presented in Table 1.

Table 1. Demographic data of students.

	Frequency	Percent
Gender		
Male	136	80
Female	34	20
Undergraduate program		
Education	77	45.3
Social Science	89	52.4
Medical related program	4	2.4
Master of philosophy program		
Measurement and Evaluation	19	11.2
Home Economics	44	25.8
Special Education	14	8.2
Educational Psychology	45	26.5
Sociology	7	8.7
Guidance and Counselling	41	24.1

Source: Field Survey (2024)

The provided demographic data of students shows a breakdown of gender distribution and undergraduate and Master's programs. In terms of gender, 136 students are male, representing 80%, while 34 students are female, making up 20% of the total. Regarding undergraduate programs, Education has 77 students (45.3%), Social Science has 89 students (52.4%), and Medical-related programs have 4 students (2.4%). For Master of Philosophy programs, Measurement and Evaluation has 19 students (11.2%), Home Economics has 44 students (25.8%), Special Education has 14 students (8.2%), Educational Psychology has 45 students (26.5%), Sociology has 7 students (8.7%), and Guidance and Counselling have 41 students (24.1%).

This data provides a comprehensive overview of the student population in terms of gender distribution and academic programs, highlighting the diversity and distribution within the student body across different programs and fields of study.

Research question one: What is the correlation between students' performance in educational statistics and research methods in education?

Research Question One aimed to explore the correlation between students' performance in educational statistics and research methods in education. To investigate this relationship, a correlation analysis was conducted. Before proceeding with the analysis, assumptions including normality, linearity, homoscedasticity, and independence of residuals were assessed (Pallant, 2020). Normality was evaluated to ensure that the data followed a normal distribution. Linearity was examined to confirm that there was a linear relationship between the variables. Homoscedasticity was assessed to ensure that the variance of the residuals was constant across all levels of the independent variable. Additionally, multicollinearity was examined to check for high correlations between the variables, following recommendations from relevant literature (Pallant, 2020). Specifically, the correlation coefficients were assessed to ensure that there was at least some relationship with the dependent variable. The results of these assumption tests were then analyzed to determine the suitability of the data for correlation analysis (Table 2).

The correlation analysis presented in Table 2 indicates a strong positive correlation between Intermediate Statistics in Education and Research Methods in Education, with a Pearson correlation coefficient of 0.791**. This correlation is statistically significant at a p-value of 0.000, based on a two-tailed test. The sample size for both Intermediate Statistics and Research Methods in Education is 170. This strong positive correlation suggests a close relationship between intermediate statistics and research methods in education.

Table 2. Correlations for muticollinearity assumption.

		Intermediate statistics in education	Research methods in education
Intermediate statistics in education	Pearson Correlation	1	.791**
	Sig. (2-tailed)		.000
	N	170	170
Research methods in education	Pearson Correlation	.791**	1
	Sig. (2-tailed)	.000	
	N	170	170

The normality of residuals was assessed through a detailed examination of the histogram. The histogram displayed a roughly bell-shaped curve, indicating an approximately normal distribution of residuals. This visual inspection, coupled with a normal probability plot, provided substantial evidence to conclude that the assumption of normality in the regression residuals was satisfied. The symmetric and unimodal nature of the histogram affirmed that the residuals followed a normal distribution (Figures 1 to 4) supporting the reliability of the regression analysis results. Furthermore, collinearity diagnostics were examined to assess the assumptions of multicollinearity. The variance inflation factor (VIF) for internal scores was well within an acceptable range (1.00), indicating no issues of multicollinearity. The condition index, at 27.574, was below the common threshold of 30, further supporting the absence of multicollinearity (Pallant, 2020). The main result from the regression analysis is presented in Table 3.

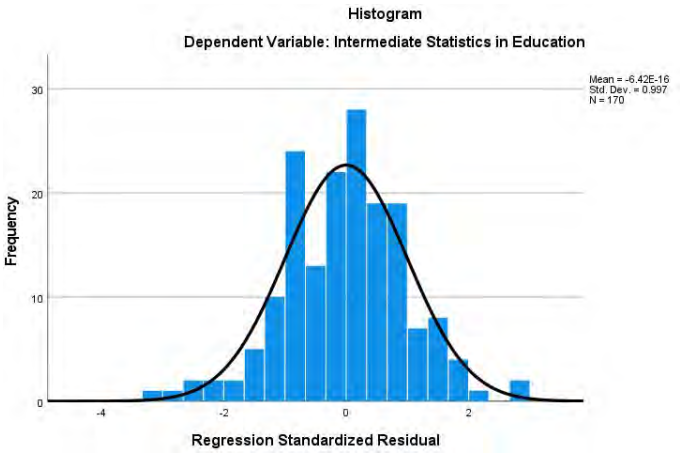

Figure 1. Regression residual.

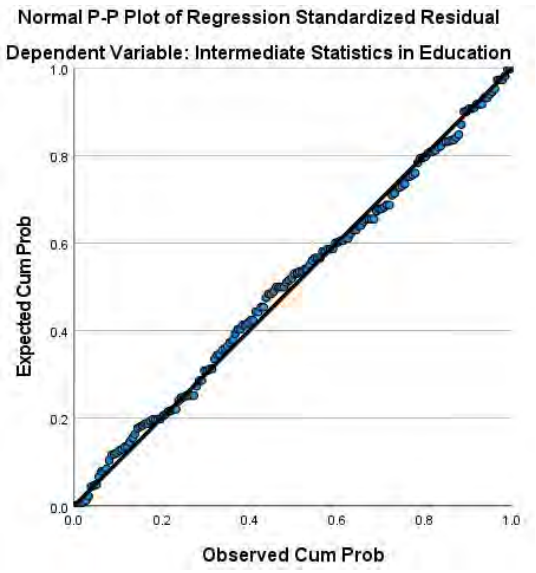

Figure 2. Normal P-P plot.

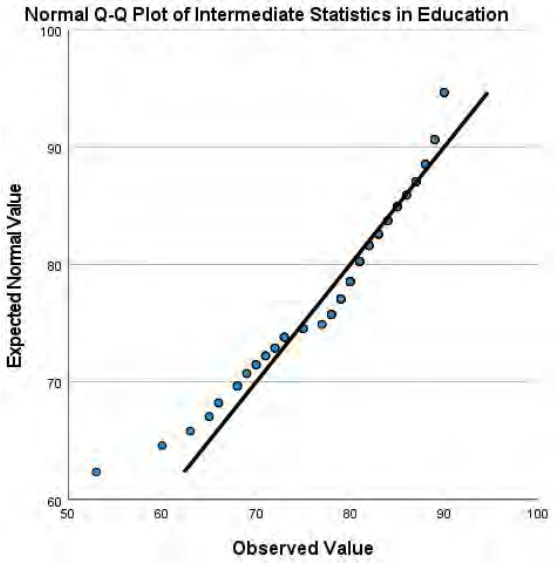

Figure 3. Q-Q plot.

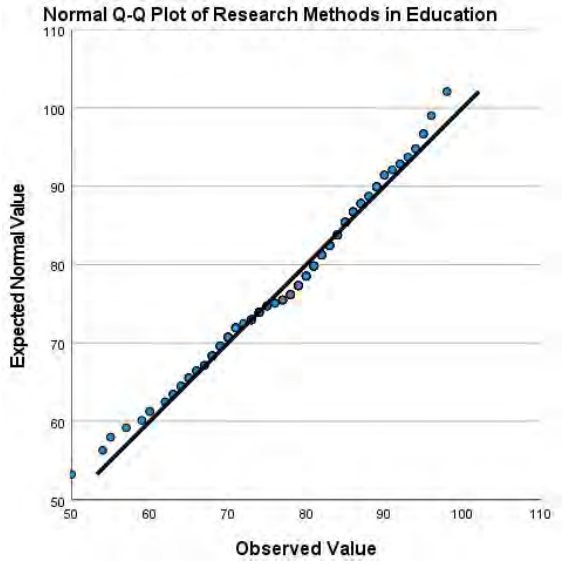

Figure 4. Q-Q plot.

The results presented in Table 3 indicate a regression analysis assessing the prediction of performance in Research Methods based on certain model statistics. The regression model shows a significant relationship, as evidenced by a high F-value of 280.57 and a corresponding p-value of .000***, indicating that the model is statistically significant. The R-squared value of 0.625 suggests that approximately 62.5% of the variance in performance in Research Methods can be explained by the predictor variables of students' performance in statistics in education. The strong F-value and R-squared value signify that the regression model is a good fit for predicting performance in Research Methods. The high F-value indicates that the model's explanatory variables are collectively significant in predicting the outcome variable. Additionally, the R-squared value of 0.625 implies that a substantial portion of the variability in Research Methods performance can be accounted for by the variables in the model. Moreover, the Durbin-Watson statistic of 1.94 indicates that there is no significant autocorrelation present in the model's residuals, suggesting that the observations are independent. This further strengthens the reliability of the regression analysis results. In conclusion, the statistical analysis presented in Table 3 provides robust evidence supporting the predictive capability of the model in determining performance in Research Methods. The strong F-value, high R-squared value, and the absence of autocorrelation in the residuals collectively indicate the effectiveness and validity of the regression model in predicting students' performance in Research Methods.

Table 3. Performance statistics predict performance in research method.

Model		Sum of squares	Df	Mean square	F	R	R^2	P	Durbin-watson
1	Regression	4708.62	1	4708.62	280.57	.791	.625	.000***	1.94
	Residual	2819.43	168	16.78					
	Total	7528.05	169						

Source: Field Survey (2024).

Research question two: Are there any differences in performance among students in educational statistics and research methods in education based on their undergraduate programs?

Research question two aimed to investigate potential differences in performance among students in educational statistics and research methods in education based on their undergraduate programs. To address this question, a MANOVA analysis was conducted to compare the mean differences between students' performance in the two courses across different undergraduate programs. Before proceeding with the analysis, assumptions of normality and homogeneity of variance were assessed. The initial evaluation of assumptions, including normality and homogeneity of variance, revealed no identified violations, indicating that all conditions were satisfactory. The Levene test of homogeneity of equal variance is presented in Table 4, confirming the equality of variances across groups. Additionally, normality was assessed using a Q-Q plot, as shown in Figures 3 and 4, which further supported the suitability of the data for analysis. These preliminary assessments ensured that the data met the necessary assumptions for conducting the MANOVA analysis to examine potential differences in performance among students in educational statistics and research methods in education based on their undergraduate programs.

The statistical analysis presented in the provided tables offers compelling insights into the relationship between students' performance in Intermediate Statistics in

Education and Research Methods in Education, as well as the influence of their undergraduate program on this relationship. The Box's M test results indicate that the covariance matrices of the two dependent variables are statistically equivalent across the different undergraduate programs. The Box's M statistic is 8.942, with an F-value of 1.278 and a corresponding p-value of 0.267. This suggests that the null hypothesis of equal covariance matrices across the groups cannot be rejected, indicating that the covariance matrices are statistically equivalent.

Table 4. Levene's test of equality of error variances[a].

		Levene statistic	df1	df2	Sig.
Intermediate statistics in education	Based on mean	1.284	2	167	.280
	Based on median	1.244	2	167	.291
	Based on median and with adjusted df	1.244	2	155.951	.291
	Based on trimmed mean	1.139	2	167	.323
Research methods in education	Based on mean	.019	2	167	.981
	Based on median	.023	2	167	.977
	Based on median and with adjusted df	.023	2	166.700	.977
	Based on trimmed mean	.022	2	167	.979

Source: Field Survey (2024)

Table 5. Intermediate statistics and research methods across undergraduate programs.

Source	Dependent variable	df	Mean square	F	Sig.	Observed power[c]
Corrected model	Intermediate statistics in education	2	84.74	1.92	.149	.39
	Research methods in education	2	124.68	1.51	.224	.31
Intercept	Intermediate statistics in education	1	220889.91	5013.02	.000	1.00
	Research methods in education	1	209899.93	2544.79	.000	1.00
Undergraduate program	Intermediate statistics in education	2	84.74	1.92	.149	.39
	Research methods in education	2	124.68	1.51	.224	.31
Error	Intermediate statistics in education	167	44.06			
	Research methods in education	167	82.48			
Total	Intermediate statistics in education	170				
	Research methods in education	170				
Corrected total	Intermediate statistics in education	169				
	Research methods in education	169				

Source: Field survey (2024).

The multivariate test results further reinforce this finding. Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root all show non-significant results for the Undergraduate Program factor, with p-values ranging from 0.409 to 0.143. This indicates that there are no statistically significant differences in the linear combination of Intermediate Statistics in Education and Research Methods in Education scores across the different undergraduate programs. Levene's test results confirm that the assumption of homogeneity of variance is met for both dependent variables. The p-values for Intermediate Statistics in Education and Research Methods in Education are all greater than the significance level of 0.05, suggesting that the error variances are equal across

the groups.

The tests of between-subjects effects provide additional support for the consistency of students' performance in the two subjects across the undergraduate programs. The p-values for the Undergraduate Program factor are 0.149 for Intermediate Statistics in Education and 0.224 for Research Methods in Education, indicating that students' scores in these subjects do not differ significantly based on their chosen undergraduate program. Collectively, these results present a strong argument that the correlation between Intermediate Statistics in Education and Research Methods in Education is robust and consistent, regardless of students' undergraduate program. The statistical evidence suggests that the interplay between these two subjects is not significantly affected by students' academic background, but rather reflects a fundamental relationship that transcends the boundaries of specific undergraduate programs.

DISCUSSION

Correlation between students' performance in educational statistics and research methods in education

The findings of the current study are largely in line with the empirical evidence presented in the previous studies by Feng, Fan and Chen (2022), Batool et al. (2023), Ajai and Ogungbile (2023), and Abid et al. (2022). The current study's regression analysis demonstrates a strong and significant relationship between students' performance in educational statistics and their performance in research methods. The high F-value, R-squared value of 0.625, and absence of autocorrelation in the residuals collectively indicate that the regression model is a robust and reliable predictor of performance in research methods, with a substantial portion of the variability in the outcome variable being accounted for by the predictor variable.

This finding is consistent with the studies by Feng, Fan and Chen (2022) and Batool et al. (2023), which emphasize the importance of using data mining techniques and predictive modeling to understand and forecast students' academic performance. The current study's focus on the predictive relationship between statistics and research methods performance aligns with the broader theme of these studies, which highlights the value of leveraging student data to improve educational outcomes. Furthermore, while the current study does not directly examine instructional methods or interpersonal skills as in the studies by Ajai and Ogungbile (2023) and Abid et al. (2022), respectively, it underscores the interconnectedness of different academic domains and the need for a holistic approach to student development.

The strong predictive relationship between statistics and research methods performance suggests that students' competencies in these areas are closely linked, and interventions targeting one domain may have spillover effects on the other. In conclusion, the current study's findings are well-supported by the empirical evidence presented in the previous studies, reinforcing the importance of using data-driven approaches to understand and predict students' academic performance. The robust regression model and the substantial explanatory power of the predictor variable highlight the value of focusing on the relationship between related academic domains, such as statistics and research methods, to enhance educational outcomes.

Differences in performance among students in educational statistics and research methods in education based on their undergraduate programs

The current study's findings, which explore the relationship between students' performance in Intermediate Statistics in Education and Research Methods in Education across different undergraduate programs, align with the empirical evidence presented in the studies by Lindsay et al. (2023), Gnjidic et al. (2023), Atkinson (2023), Qahmash et al. (2023), and Wishkoski et al. (2022). The statistical analysis in the current study reveals that the covariance matrices of the two dependent variables (Intermediate Statistics in Education and Research Methods in Education) are statistically equivalent across various undergraduate programs. The Box's M test results, supported by the multivariate test outcomes, indicate no significant differences in the linear combination of scores between the two subjects across different undergraduate programs. Additionally, Levene's test confirms the homogeneity of variance for both dependent variables, further strengthening the argument for consistency in students' performance.

This consistency in the correlation between Intermediate Statistics in Education and Research Methods in Education, irrespective of the undergraduate program, is in line with the broader theme observed in the studies by Lindsay et al. (2023), Gnjidic et al. (2023), Atkinson (2023), Qahmash et al. (2023), and Wishkoski et al. (2022). These studies collectively emphasize the multifaceted nature of student outcomes, the impact of pedagogical approaches on student experiences, and the importance of factors like coursework performance, gender, and admission criteria on academic performance. Therefore, the current study's results, demonstrating the robust and consistent correlation between Intermediate Statistics in Education and Research Methods in Education across different undergraduate programs, are well-supported by the empirical studies in the field. The statistical evidence presented in the current study aligns with the broader research landscape, highlighting the fundamental relationship between these subjects that transcends the

variations in undergraduate programs.

Implication of the study

The research findings have several implications for understanding the relationship between students' performance in educational statistics and research methods in education. Firstly, the strong and significant correlation between these two domains suggests that a solid foundation in statistics is crucial for students to excel in research methods. This highlights the interconnectedness of different academic domains and the need for a holistic approach to student development.

Additionally, the findings emphasize the value of using data-driven approaches to predict and improve students' academic performance. By focusing on the relationship between related academic domains, such as statistics and research methods, educators and institutions can enhance educational outcomes and better prepare students for success in graduate programs.

Furthermore, the study's results underscore the importance of targeted interventions and support systems to enhance students' competencies in critical areas like statistics and research methods. By understanding the factors influencing student outcomes and perceptions in these domains, educators can tailor their teaching methods and support mechanisms to address any gaps or challenges students may face.

Overall, the research findings contribute to the existing literature by providing insights into the correlation between educational statistics and research methods, and by highlighting the fundamental relationship between these subjects that transcends variations in undergraduate programs. These implications can guide educators, institutions, and policymakers in designing effective strategies to enhance students' preparedness and competencies for success in graduate programs.

Limitations and future research

One limitation of this study is its narrow focus on the correlation between students' performance in educational statistics and research methods in education, which may hinder the generalizability of the findings to other academic disciplines or contexts. Additionally, the reliance on cross-sectional data presents another limitation, as it offers only a snapshot of students' performance at a single point in time, without capturing how their competencies evolve or the influence of various factors on this progression. Furthermore, the study may not have adequately accounted for potential confounding variables, such as prior academic background or external support systems, which could impact students' performance in educational statistics and research methods. Moving forward, future research could explore the impact of specific instructional methods or teaching approaches on student competencies in these areas, providing valuable insights for enhancing educational outcomes. Additionally, investigating the role of interpersonal skills, such as communication and teamwork, in relation to academic performance in statistics and research methods could offer further understanding of student success factors. Lastly, examining the relationship between undergraduate research experiences and graduate academic performance in these domains could help elucidate the benefits of research experiences on student success, bridging the gap between theoretical expectations and empirical evidence.

Conclusion

This study has shed light on the significant correlation between students' performance in educational statistics and research methods in education. The findings emphasize the importance of a solid foundation in statistics for excelling in research methods, highlighting the interconnectedness of different academic domains. By leveraging data-driven approaches and focusing on related academic domains, educators and institutions can enhance educational outcomes and better prepare students for success in graduate programs. The study's implications underscore the need for targeted interventions and support systems to address any gaps or challenges students may face in these critical areas. Overall, the research contributes to the existing literature by providing insights into the fundamental relationship between statistics and research methods, guiding educators, institutions, and policymakers in fostering student development and academic success.

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Ethics statement

Ethical guidelines for research were followed throughout; in particular, participants gave written informed consent and were made aware that they were free to withdraw anytime during data collection.

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