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Educators' knowledge, skills and competence as correlates of SPSS output interpretation ability in Cross River State Public Universities, Nigeria: A Structural Equation Modelling (SEM) Approach

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Abstract

This study investigated the impact of knowledge, skills and competence of educators on their interpretation of SPSS data analysis output in public universities of Cross River State, Nigeria. The Structural Equation Modelling (SEM) was employed to evaluate both composite and individual impacts, covariances, and overall model fit. A correlational survey research design was employed in the study. Three hypotheses were stated for the study. The population of the study was 2,342 lecturers from three public universities in the study area, while the selected number of respondents was 720 utilizing the stratified random sampling technique. The use of the Educators' Knowledge, Skills and Competence Scale (EKSC-SIAS) which is reliable was used for the collection of data for the study. Data was analyzed with SPSS version 27 and AMOS version 27 as well. The outcome of the research revealed that Knowledge, Skills, and Competence had composite effect on SPSS interpretation ability ($F = 8.214$, $p < 05$). The strongest predictor was knowledge. The fit indices for the model where good and further analysis of SEM confirmed the presence of significant covariances among the constructs ($\chi^2/df = 2.18$; CFI = .93; TLI = .92; RMSEA = .046). In general, it is concluded that the SPSS interpretation ability of educators depends on knowledge as a principal factor, while skills and professional competence are supportive factors. At the end of this study, the researchers made several recommendations. Among these recommendations, the researchers recommended a continuous research training, capacity-building workshops, and digital analytical tools for educators.

Keywords: Competence, Data Analysis, Educators Knowledge, Skills, Structural Equation Modelling (SEM), SPSS.

Introduction

It is important to state that today's students must be able to interpret and analyze statistical data about their own research and that of others. This is because, evidence-based research is becoming increasingly important, hence, knowing how to use the Statistical Package for Social Sciences, or SPSS, is an essential analytical skill for lecturers who are tutors or teachers of these students in universities. Despite the increase in SPSS utilization in Nigerian Universities, many teachers or lecturers are unable to accurately interpret the statistical outputs generated from data analysis and this is a cause for worry. This is due to their failure to completely understand the SPSS packages. Consequently, causing errors to occur in their research findings.

How teachers use and interpret data depends on their knowledge, analytical skills and ability. Knowledge is an understanding of the theory of statistical concepts and research methods. Skills are the ability to use analytical tools. Competence is applying them correctly and reliably in practice. All these constructs jointly positioned such educators in their ability to interpret the outputs from the SPSS software for credible research undertaking.

According to Ajayi and Afolabi (2022), educators with a higher understanding of data concepts are better able to make informed and reliable interpretations of research results. Getting knowledge comes before getting skills and being competent (Boyatzis, 2018; Biggs & Tang, 2021). So, knowledge is essential for competence. That is, it shapes the practical and analytical abilities of an individual. Oladipo and Bello (2020) posit that theoretical knowledge of research design can only lead to the effective application of software if it is complemented by skill. Garfield and Ben-Zvi (2022) believed that practice-based learning builds learners' confidence in statistics and performance in statistics.

Past research studies have exposed gaps in SPSS literacy of educators. Eze (2021), Nwosu and Uka (2022), Nwogwugwu et al.; (2024) and Akintunde (2024) reported that educators are having knowledge of SPSS but many lack analytical knowledge and competence. There are insufficient training and exposure for statistical tools. Research indicates that teacher's knowledge and skills are closely related to instilling research capability and engage in research (Akintunde, 2024; Adebayo & Oladele, 2022; Oladipo & Bello, 2020).

Akintunde (2024), stated that some educators can use digital statistical tools such as SPSS based on their knowledge base and research competence. Also, Adebayo and Oladele (2022) found a high connection between higher-order research skills and educators' analytical literacy. In contrast Eze and Okon (2021) noted that low exposure to statistical packages and research training hamper competence. Understanding a theory and being able to apply it might lead to the right interpretation of outputs. It follows the principles of both CBLT and experiential learning (Kolb, 2015; Biggs & Tang, 2021). Skills can be developed through practice and knowledge. It is essential to continuously engage in the skill during real work under supervision to master it.

Kolb (2015) stated that experiential learning functions in a cyclical and reinforcing way, whereby theory and practice reinforce one another. Having a strong knowledge base can also help build competence. According to Ajibade (2022), competence goes beyond the school environment and develops through practice. Doing something repeatedly makes one capable or good at something, implying that practice makes perfect. This is consistent with the Competency-Based Education Model.

Experiential learning theory and competency-based learning theory develop professional competencies through the use of evidence-based learning, making theory practice more practical (Boyatzis, 2018; Kolb, 2015; Biggs & Tang, 2021). Nonetheless, there is little or no study in Nigeria that has employed SEM to assess the structural relationships among knowledge, skills, competence and SPSS interpretation ability. This analysis fits this gap by assessing the composite and constituent effects of these constructs, interrelationships, and overall model fit.

Theoretical and Conceptual Framework

This study is grounded in Competency-Based Learning Theory (CBLT), which emphasizes measurable acquisition and demonstration of abilities rather than mere knowledge accumulation (Boyatzis, 2018; Biggs & Tang, 2021). The theory posits that professional competence emerges when learners integrate knowledge, skills, and attitudes in authentic performance contexts. Within higher education, this integration ensures that educators not only understand research concepts but can also apply them effectively using digital analytical tools such as SPSS. According to CBLT, knowledge represents the cognitive domain, theoretical understanding of statistical principles, data types, and analytical logic. Skills correspond to the psychomotor domain, reflecting the practical ability to execute data management, perform analyses, and interpret results using SPSS commands and procedures. Competence embodies the integrative domain, capturing an educator's consistent, adaptive, and contextually appropriate use of knowledge and skills to generate valid interpretations of data outputs.

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By positioning these constructs within the CBLT framework, the study conceptualizes educators' SPSS interpretation ability as a function of progressive mastery, from cognitive comprehension (knowledge) to applied performance (skills) and professional synthesis (competence). This theoretical alignment provides a coherent basis for the Structural Equation Modelling (SEM) approach, which examines the interrelationships among these latent constructs and their combined influence on educators' analytical capability.

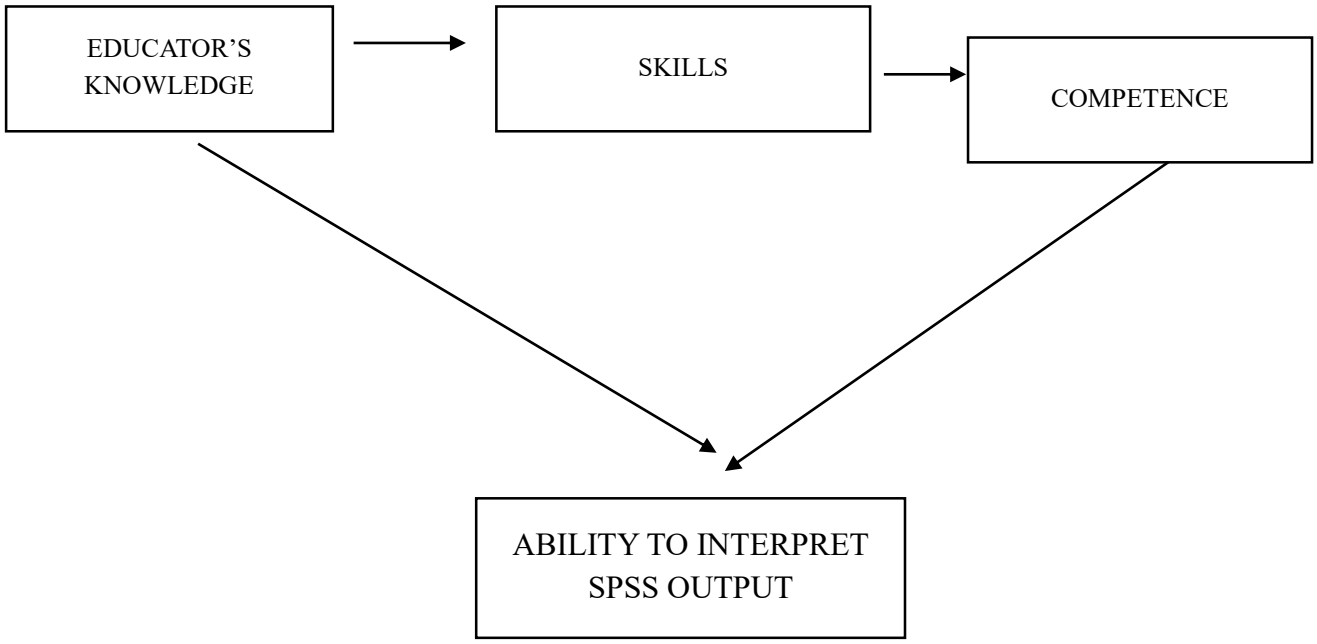

FIG 1: Conceptual frame work showing the relationship between educators' knowledge, skills, competence and ability to interprete SPSS output

Hypotheses

1. Educators' knowledge, skills, and competence have no significant composite influence on SPSS interpretation ability.
2. There are no significant covariances among knowledge, skills, competence, and SPSS interpretation ability.
3. The overall items do not demonstrate a good model fit for the four constructs in SEM.

Materials and Methods

Research Design

This study used correlational survey design guided by Structural Equation Modelling (SEM) approach. The design was considered appropriate as the study seeks to determine the composite and relative effect of educators' professional knowledge, skills and competence on the interpretation of SPSS data analyses; and to assess the covariances and model fit among the variables. The reason that the SEM approach was applied here is that it estimates simultaneous relationships among both observed and latent variables within a single model.

Population and Sample

The study was carried out in the public universities of Cross River State, Nigeria which include University of Calabar (UNICAL), University of Cross River State (UNICROSS) and Cross River University of Education (UNICROSS). The institutions were chosen because they are the major public tertiary institutions in the state in which teaching and learning that are oriented toward research are actively done. A large proportion of their academic staff engage in data analysis and education research. This makes them a good choice for the study. The target population of the study was 1,238 lecturers from three universities (Registry, UNICAL, UNICROSS and CRUTECH,

2024) comprising Assistant Lecturer to Professor. Participants who have used SPSS at least once in their research, publication and during student supervision were included in the study. Also, the participants should be a full-time academic staff of public universities in Cross River State, Nigeria. Besides, only respondents who willingly consented to become part of the study and who properly completed the research instrument were surveyed. Moreover, the participants should have at least one (1) year teaching/research experience to ensure that they have carried out some level of data analysis and are familiar with its procedures. In contrast, individuals were excluded if they were either not staff members such as administrative or technical staff and are not mainly teaching or data analysis staff members, part-time or adjunct lecturers that do not have a consistent responsibility of research or teaching, refuse participation or incomplete response, or lecturer who are on study leave, sabbatical, or other long-term absence during the data collection period.

All public universities were selected as part of the study using a stratified random sampling technique. The different levels of academic ranks and specializations were split into strata in the following ways: Academic Rank; Assistant Lecturer (AL), Lecturer II (L II), Lecturer I (LI), Senior Lecturer (SL), and Professor (P); Specialization; Educational Measurement and Evaluation (EME), Guidance and Counselling (GC), Curriculum Studies (CS) and Educational Psychology (EP). Within each stratum, participants were randomly selected out of departmental staff lists. According to this approach which enhanced representativeness and minimized sampling bias. A study with 720 respondents as the sample size, which is about 30% of the target population. Before participation all the participants gave informed consent. The respondents participated in the study on a voluntary basis. They were assured that the information would be treated with utmost confidentiality and is for academic purposes only. The people who take part in the study won't face any physical, psychological or professional harm. The demographic information indicated that there were 445 respondents (61.8%) who were male and 275 respondents (38.2%) who were female.

Male teachers made up the majority of the sample which is the usual gender appearance in Nigerian public universities. Most respondents were aged between 35 and 44 years (32.2%), followed by those aged 45-54 years (28.9%). This means that many of the participants were mature adults that were mid-career thus likely they were highly experienced professionals with good qualifications. Most of the participants had an academic rank of Lecturer II (23.8%) and Senior Lecturers (22.9%). Professors/Readers (18.1%). The distribution is balanced across all the academic cadres which allows for the opinions of junior academic staff as well as senior academic staff. With regards to years of teaching experience 80% respondents had more than five years of teaching experience which indicates that most participants had adequate exposure to academic research and statistical data analysis. According to their gender, academic rank, and teaching experience, the respondents reflect diversity. The mix gave balanced and realistic representation of teachers in public universities in Cross River State therefore enhancing the credibility and contextual generalizability of the findings of the study.

Instrumentation and Measures

The researchers designed a scale titled' Educators' Knowledge, Skills and Competence in SPSS Interpretation Ability Scale (EKSC-SIAS) through which data were collected. The instrument was made up of four subscales that related to the latent constructs. The Knowledge Subscale focused on how much educators know of statistical concepts and data analysis procedures. For example, a statement would be, "I know the statistical test to use for a certain hypothesis." The Skills Subscale gauged the extent to which educators can complete SPSS action (e.g., "I can correctly enter and label my variables in SPSS"). The Competence Subscale assessed the functional and competent application of knowledge and skills for interpreting SPSS outputs (e.g., "I can explain the SPSS output correctly to others"). The final subscale entitled Interpretation Ability consists of six items dealing with overall accuracy of analytical interpretation. Each subscale had five items and all the items used a four-point Likert scale (1 = Strongly Disagree, 4 = Strongly Agree). Participants gave consent before participation. Taking part in this study was completely voluntary. The respondents were guaranteed that the information would be kept strictly confidential and was used only for academic and research purposes.

Participant safety was a priority while conducting the research and there were no risks. The face and content validity of the instrument was determined according to an expert review of three experts into Educational Measurement and Evaluation. In order to ascertain the construct validity 30 academic

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staff of the University of Uyo which was not actually part of the main study was used for the pilot test. This instrument's reliability was analyzed by means of the application of Cronbach alpha. The overall coefficient achieved was 0.84 which indicates that the instrument was reliable and appropriate to use for the main study.

To the selected respondents, the researchers personally administered the questionnaires after obtaining official permission from the authorities of the university. Participants were assured of confidentiality and anonymity and the purpose of the study was explained. All the questionnaires were collected on time, thereby recording a valid response rate of 100%. The data that were collected were coded and analyzed through the IBM SPSS (version 27) and AMOS (version 26).

Method of data Analysis: The demographic variables of the participants were summarized using descriptive statistics which include mean and frequency counts. For the hypotheses testing, inferential analyses were conducted to see how educators' knowledge, skills, and competence together and individually impact on ability to interpret SPSS was examined using multiple regressions technique While to investigate the relationship among variables and overall fitness was done using covariance analysis and Structural Equation Modelling (SEM). The various SEM model fit indices included Chi-square (χ^2), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), Tucker-Lewis Index (TLI) and Root Mean Square Error of Approximation (RMSEA), and significance are at $p < 0.05$. If the p-value is less than 0.05 ($p < 0.05$), reject the null hypothesis (H_0) and accept the alternate hypothesis.

Results

The results are presented in line with the hypotheses of the study and summarized in tables and figures.

Hypothesis One

The first hypothesis states that there is no significant combined impact of the teachers' knowledge, skills and competence on their ability to interpret SPSS data. To determine how these variables together affected teachers' SPSS interpretation ability, multiple regression analysis was employed (Table 1).

Table 1: Multiple regression analysis for the composite variables

R=.180[a] R Square=.032 Adjusted R Square=.028 Std. Error of the Estimate =2.70994

Model	Source of Variation	Sum of Squares	Df	Mean Square	F-ratio	p-level
	Regression	180.966	3	60.322	8.214	< .001
	Residuals	5412.381	737	7.344		
	Total	5593.347	740			

		Unstandardized coefficients		Standardized coefficients		
Model	Predictor(s)	B	Std. Error	Beta	t	p-level
1	(Constant)	5.534	.420		13.189	.000
	Knowledge	.135	.031	.162	4.398	.000
	Practical skills	.072	.048	.057	1.512	.131
	Competence	-.004	.035	-.005	-.121	.903

The model summary results showed that the correlation coefficient (R) was .180. This suggests that the predictors had moderate positive relationship with the dependent variable. The value of R^2 .032 indicates that 3.2 percent of the explained variance in ability to interpret SPSS is traceable to educators' know-how, skill, and competence. This suggests that a model of this sort will not explain much. The results of ANOVA indicates that the model is significant, $F(3, 737) = 8.214$, $p < .001$ meaning that the predictors combined are significant in affecting the ability to interpret the SPSS output.

Consequently, the null hypothesis was rejected. The coefficients table showed a positive and significant association between the knowledge of educators on SPSS interpretation at ($B = .135$, $\beta = .162$, $t = 4.398$, $p < .001$). The findings reveal that the increase in knowledge will enhance the correct interpretation of SPSS. In contrast, professional competencies ($B = .072$, $\beta = .057$, $t = 1.512$, $p = .131$) and ability ($B = -.004$, $\beta = -.005$, $t = -.121$, $p = .903$) were

neither significant predictor. It implies that knowledge is the most significant driver impacting performance nevertheless there are other factors too. The low R 2 value indicates that other factors that may have contributed to the results include exposure to ICT, frequency use of SPSS, opportunities for training, access to digital literacy and motivation.

Hypothesis two

The second hypothesis examined how teachers' knowledge, abilities, competencies, and SPSS interpretation are related. The measurement and structural associations among the four latent constructs were estimated through Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) (Figure 1).

The CFA showed that the items for each construct had adequate factor loadings. Knowledge indicators showed loadings between .48 and .77, practical skill indicators between .49 and .80, competence indicators between .39 and .77, and interpretation ability indicators between .52 and .82, thereby indicating that the items measured the respective latent constructs reliably. Results from the covariance analysis in Table 2 indicate that the relationships among the constructs are all significant ($p < .001$) and have standardized coefficients between .34 and .49. In particular, the following combinations emerged as significant correlated: knowledge + knowledge ($\beta = .41$), knowledge + competence ($\beta = .39$), practical skill + competence ($\beta = .41$), competence + SPSS output ($\beta = .43$), knowledge + SPSS output ($\beta = .49$), and practical skill + SPSS output ($\beta = .34$).

Figure 1 displays a model for examining the validity of the measurement and structural relationships of four latent constructs of educators' knowledge, skills, competence and ability to interpreting SPSS data Analysis outputs among public university lecturers in Cross River State, Nigeria. The various latent constructs in the figure have been measured by several observed variables called indictors, with error terms. It also shows the structural paths (indirect and direct effects) among the four measurement constructs.

Number of observations= 720
Estimation method = Maximum Likelihood
Log likelihood = 12,854.72
Constrained items: 56

1. [NKNOW5] KAISDOQ
2. [NPRAC5] PSAISDOQ
3. [NCOMP5] CAISDOQ
4. [SPSSDATA1] AISDOQ

The analysis of Fig 1 indicates that the items measuring the various structures are distinct from one another. In unstandardized Confirmatory Factor Analysis (CFA), one item assessing a latent variable was confined to a regression weight of 1 as a criterion. Consequently, items NKNOW2, NKNOW3, NKNOW4, and NKNOW5, which assess knowledge of SPSS data analysis outputs, had favourable factor loadings between .48 and .77 (48% - 77%). Going forward, items NPRAC1, NPRAC2, NPRAC3 and NPRAC4 also has factor loadings that range from .49-.80 (i.e 49% - 80%) respectively, and these factor loadings were good as well as measures of the latent variable (Practical skills in interpreting SPSS data output. Similarly, items such as NCOMP1, NCOMP2, NCOMP3 and NCOMP4 measuring the latent variable such as competence and application of SPSS Data output all had factor loadings ranging from .39-.77 (39%-77%) which as well indicates good items.

The dependent variable which is the ability to interpreting SPSS data output was measured with items such as SPSSDATA2, SPSSDATA3, SPSSDATA4, SPSSDATA5 and SPSSDATA6 and their various factor loadings of .52 (52%), .66 (66%), .60 (60%), .82(82%) and .63 (63%) also indicating that the items are good measures of the latent variables measuring Ability to interpreting SPSS Data output. According to Hooper, Coughlan, and Mullen (2008), it is advisable to evaluate the compatibility of each construct and its elements individually to identify any particularly weak items. Overall, the factor loadings of all items, except for those that were constrained, were satisfactory for assessing the factors KAISDOQ, PSAISDOQ, CAISDOQ, and AISDOQ.

Covariances Between Latent Constructs

In Table 2 below, we report the covariances among the latent constructs used in the CFG. The papers show both unstandardised and standardised estimates, with S.E., C.R. and Levels of significance reported. All relationships

in the assessment were statistically significant at p-value less than.001. In addition, the findings also showed the standardized coefficients is between 0.42-0.64, which is a sign of a moderate to strong positive associations among the constructs. The outcome also indicated the critical ratio (C.R. values of >1.96) to indicate a strong agreement of these linkages (Byrne, 2016; Kline, 2016).

Knowledge and practical skills have a significant positive relationship (β=.41, p<.001). There was also a significant positive relationship between knowledge and competence and application (β=0.39, p<.001). According to the result, practical skills were significantly related to competence; (β=.41, p.001). Competence and SPSS Output had the strongest relationship (11 words) The knowledge of statistics significantly relates to ability to interpreting spss output with the following result β=0.49, p=.001 and at the end, practically skill positively relates to ability to interpreting spss output β=0.34, p<.001.

Table 2: The covariances between the latent constructs included in the confirmatory factor analysis (CFA).

Estimate	Unstandardized Estimate	S.E.	C.R.	p-level	Standardized Estimate
Knowledge ↔ PracSkills	0.41	0.082	5.268	***	0.59
Knowledge ↔ Competence	0.39	0.095	3.979	***	0.42
PracSkills ↔ Competence	0.41	0.089	4.507	***	0.61
Competence ↔ SPSS Output	0.43	0.073	4.082	***	0.49
Knowledge ↔ SPSS Output	0.49	0.081	3.234	.001	0.64
PracSkills ↔ SPSS Output	0.34	0.079	3.924	***	0.61

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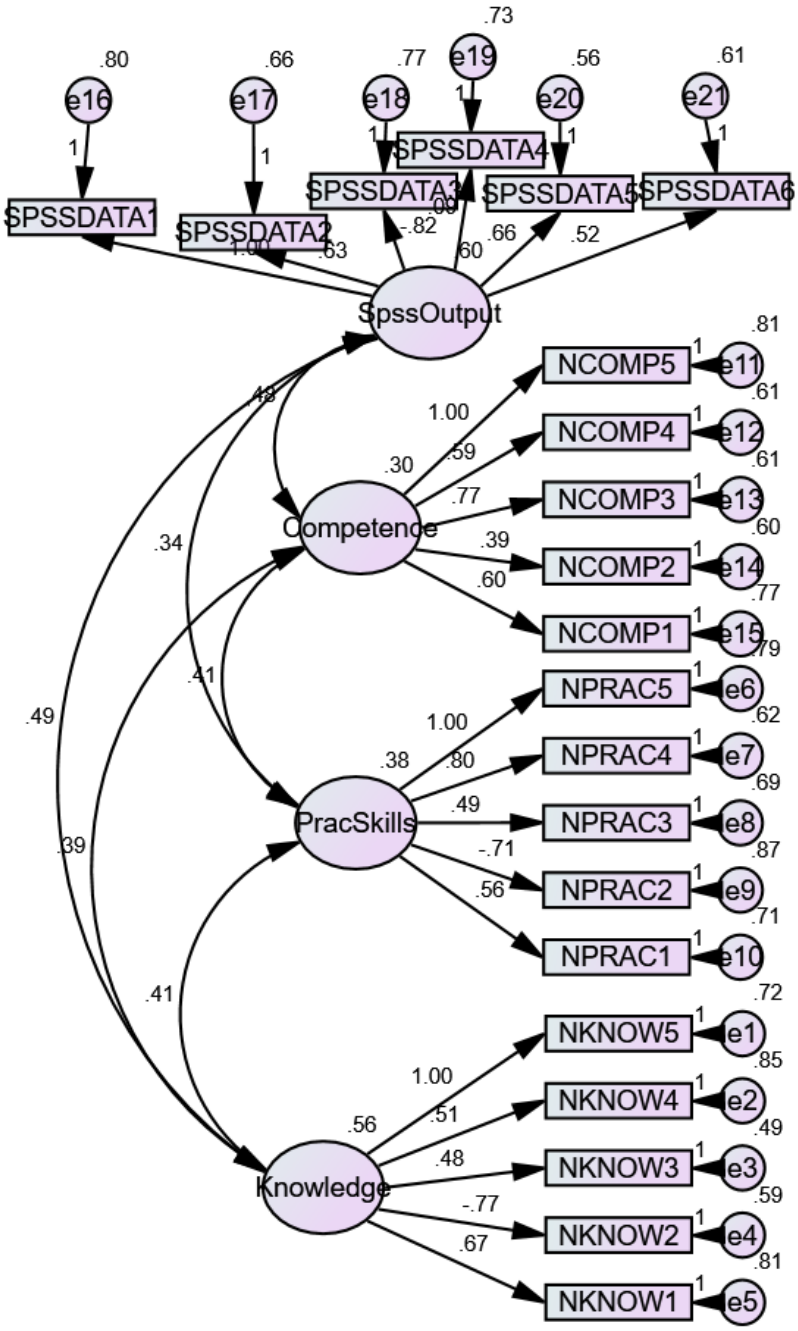

FIG 1: Confirmatory Factor Analysis (CFA) (Unstandardized estimates) within a Structural Equation Modeling (SEM) Framework.

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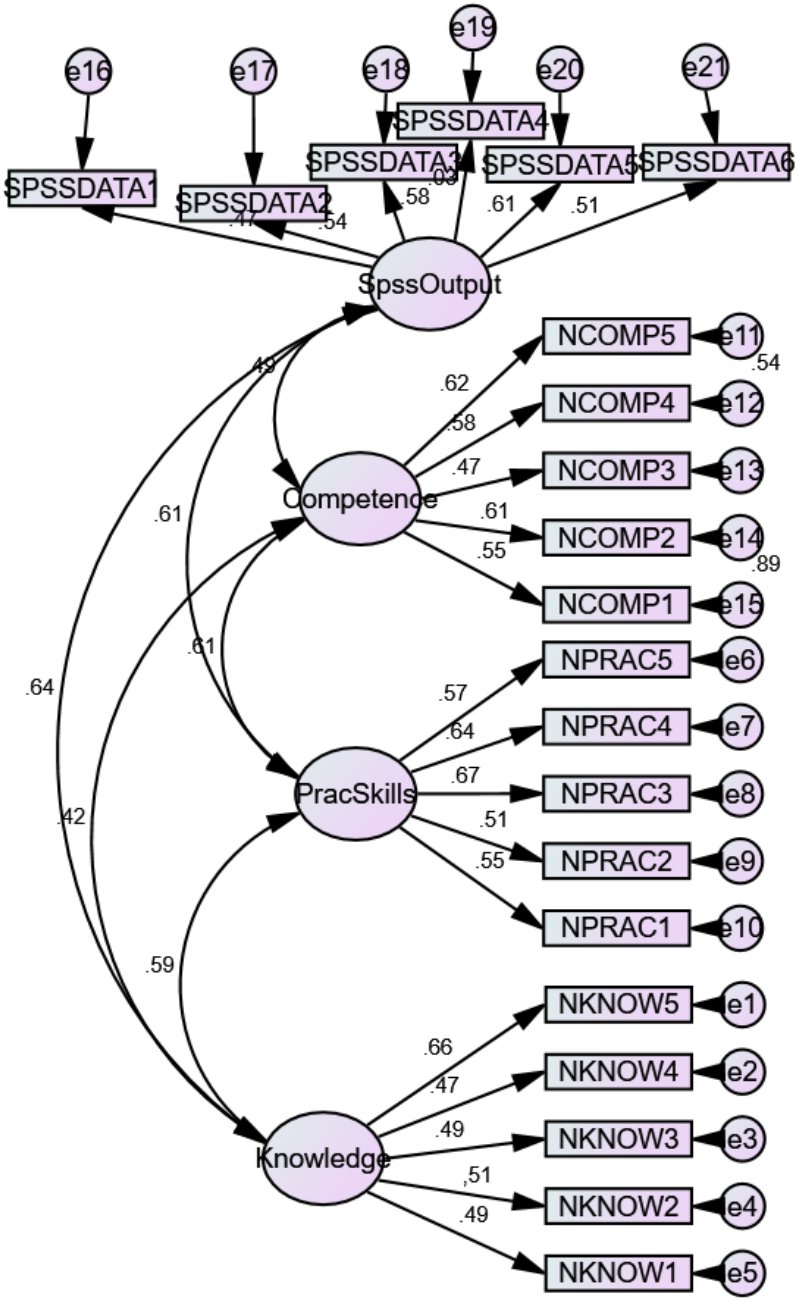

FIG 2: Confirmatory Factor Analysis (CFA) (standardized estimates) within a structural Equation Modeling (SEM) Framework.

Hypothesis three: The third hypothesis stated that the model fit of all the items is not good for the four constructs of the SEM. To determine the overall model fit of the SEM, various indices were used. The Chi square of the model was 241.54, while the degrees of freedom was 118. Moreover, CFI was .954, TLI was .942 and RMSEA was .046. The given values are above cut-offs suggested in case of recommended fit (Hu & Bentler, 1999). As a result, the four constructs have together a valid and reliable structure, namely knowledge, practical skills, competence and interpretation ability. Hence, it can be concluded that the null hypothesis was rejected for poor model fit.

Discussion of Findings

Results from hypothesis one provided rich insights related to the cognitive and professional attributes that strengthen the statistics interpretation ability of educators. The finding implies that educators having a strong statistical and methodological know-how have more confidence and are more accurate when dealing with quantitative research tools (Cohen and Manion, 2020). A possible reason for this finding is that educators with a solid background in statistics are more familiar with data analysis procedures, including understanding variables, interpreting outputs, and making informed decisions based on statistical results. Additionally, methodological knowledge enhances their ability to select appropriate analytical techniques and avoid common errors in data interpretation. This combination of skills reduces uncertainty and increases self-efficacy when handling statistical tasks. Furthermore, continuous exposure to research activities and professional development opportunities may also contribute to improved competence in statistical interpretation. Ajayi and Afolabi (2022) also found that educators with a higher understanding of data concepts are better able to make informed and reliable interpretations of research results.

The study also found that knowledge significantly impacted teachers' ability to interpret the SPSS data output directly, more so than skills and competence. This finding is in line with Competency-Based Learning Theory (CBLT) which defines learning as a constructive process wherein cognitive, psychomotor, and affective are interconnected progressively. Generally, getting knowledge comes before getting skills and being competent (Boyatzis, 2018; Biggs & Tang, 2021). So, knowledge is essential for competence. That is, it shapes the practical and analytical abilities of an individual.

Yet, the measurable but weaker associations recorded for skills and competence may be due to the structural and pedagogic constraints in many Nigerian universities. While academic staff are likely to know how to do "stats", a lack of access to digital labs, not enough SPSS training and heavy teaching loads often gets in the way of "doing". Thus, a "knowing-doing" gap emerges, where an instructor knows a statistic but does not engage in the doing, other than interpreting output. The mismatch between theoretical proficiency and practical competence thus contrasts with CBLT expectations that require skills to be continuously shown and refined through practice and feedback (Boyatzis, 2018).

According to CBLT in theory, a person is competent when he or she repeatedly commences knowledge and skills in experiences. Limited exposure to authentic data driven research tasks may therefore account for the weak predictive power of practical skills and competence in the study. Moreover, institutional factors like inconsistent professional development programs, lack of software licenses, and technological inertia probably moderate the connection between knowledge acquisition and applied analytical ability. Due to a lack of institutions and infrastructure, teachers are not able to convert cognitive knowledge into performance skills.

The findings emphasize the need for a capacity-building training that promotes experiential learning and is focused on digital literacy. Incorporating workshops using SPSS relational analytics, collaborations and mentoring can boost the psychomotor and integrative aspects of educators' knowledge. This means that people do not gain communication competence through learning alone, but through performance, reflection, and feedback. Improving these processes would allow for a better transfer of knowledge to students and greater proficiency in the field.

Despite the model showing a statistically positive correlation among the constructs, the

low coefficient of determination (R^2 = 0.32) indicates that only 32% of educators' SPSS interpretation ability can be accounted for by knowledge, skills and competence. This means that there could be other factors that could influence their performance. For example, their mediating factors include exposure to training, digital self-efficacy, institutional support for research analytics, attitude to adopting technology, and others. The model explanatory power can be enhance by future research that include these mediating, moderating variables. Using mixed methods could give qualitative detail to quantitative patterns to enhance theoretical robustness.

To sum up, although the teachers in a public university are knowledgeable in theory, the institutional ecosystem may not yet adequately facilitate the ability to demonstrate analysis. Fixing this problem will require structural reform, teaching techniques and investment in research technology infrastructure. Continuous professional development programmes, workshops, and data-analysis module should be part of teacher education curricula to enhance the knowledge of educators too, the findings suggest. Through knowledge-oriented interventions, the educators' capacity to interpret statistical results can enhance evidence-based teaching and improve the quality of educational research.

The outcome of Hypothesis Two shows that knowledge, practical, and competence are reinforcing each other and significant towards the ability of the educators to generate and interpret SPSS outputs. Knowledge and practical skills correlate highly; thus, knowledge helps one acquire practical skills. A possible reason for this finding is that these three components are interdependent in the process of statistical analysis. Knowledge provides the theoretical understanding of statistical concepts, practical skills enable educators to operate SPSS and perform analyses, while competence reflects the ability to apply both knowledge and skills effectively in real situations. When combined, these elements create a comprehensive capacity that enhances accuracy and confidence in data generation and interpretation. Additionally, educators who regularly engage in research activities are likely to develop these attributes simultaneously, leading to improved overall performance in statistical tasks.

Nguyen and Tran (2021) also claimed that knowledge-driven engagement improves students' ability to use what they learn in practice. This expands students' analytical and critical thinking structures. Kolb (2015) further argued that experiential learning functions in a cyclical and reinforcing way, whereby theory and practice reinforce one another.

Having a strong knowledge base can also help build competence. According to Ajibade (2022), competence goes beyond the school environment and develops through practice. Doing something repeatedly makes one capable or good at something, implying that practice makes perfect. This is consistent with the Competency-Based Education Model. This model emphasizes the incorporation of skill-building experiences into curriculum design (Biggs & Tang, 2021). The study revealed that the competence of the educators significantly affected their ability to interpret t the output of SPSS. Competence is necessary for converting our knowledge into effective analysis. Aside from knowledge, theoretical understanding was also significantly related to interpretation ability. However, theoretical understanding alone was insufficient without practical competence. Oladipo and Bello (2020) claim that theoretical knowledge of research design can only lead to the effective application of software if it is complemented by skill. Garfield and Ben-Zvi (2022) believed that practice-based learning builds learners' confidence in and performance on statistics.

The composite reliabilities of all constructs exceed the threshold of 0.70. Hence, the knowledge, practical skills, competence, and interpretation ability are reliable measures. Furthermore, the four dimensions are empirically distinct but complementary parts of educators' overall statistical literacy. The study findings are in line with the report by Akintunde (2024), which stated that some educators can use digital statistical tools such as SPSS based on their knowledge base and research competence. Similarly, Adebayo and Oladele (2022) found a high connection between higher-order research skills and educators' analytical literacy. In contrast Eze and Okon (2021) noted that low

exposure to statistical packages and research training hamper competence. Overall, this study shows that systematically reinforcing the four factors: knowledge, skills, competence and interpretive ability can enhance educators' analytical performance and research capacity.

The third hypothesis states that overall items are not a good fit for the four (educator's knowledge, skills, competence and ability to interpret SPSS Data analysis) in the structural equation model. The model fit was calculated using several goodness-of-fit indices. The fit of the model to the data was acceptable $X2(118) = 241.54$, $P < .001$; CFI = .954; TLI = .942; RMSEA = .046 (90% CI = .039 – .053); SRMR = .041. Hu and Bentler (1999) state that models are acceptable when CFI and TLI values are above .90, and RMSEA and SRMR values are below .08. The proposed model fits the data well, as the results confirm. It appears that the overall model fit indices are satisfactory and the factor loadings are statistically significant. So, we rejected the null hypothesis which states that overall items do not make a good model fit and accepted the alternate hypothesis.

The outcome of this results has revealed very strong evidence that the four constructs educator's knowledge, practical skills, competence and ability to interpret SPSS data analysis jointly show a good model fit and valid measurement structure within the SEM. It was confirmed strongly that the research instruments measuring the constructs are reliable indicators of educators' statistical capability.

The overall findings of the three hypotheses show us many things. According to the first hypothesis tested, educators' knowledge is the most potent and direct influence on eligibility to interpret SPSS. We found a positive relationship between the two. However, there is evidence that skills and competence have a weaker effect when looked at in isolation. The second result indicates that knowledge, skills, and competence are mutually reinforcing constructs of learning. A positive relationship was observed between knowledge and interpretation ability, suggesting that a strong theoretical understanding of statistical concepts significantly enhances educators' confidence and accuracy in handling data analysis. A possible reason for this finding is that knowledge serves as the foundation upon which interpretation is built, enabling educators to understand statistical procedures, outputs, and their implications. In contrast, skills and competence, when considered independently, demonstrated weaker effects. This may be because, without adequate conceptual knowledge, practical skills alone may not be sufficient for accurate interpretation of statistical results.

Understanding a theory and being able to apply it might lead to the right interpretation of outputs. It follows the principles of both CBLT and experiential learning (Kolb, 2015; Biggs & Tang, 2021). Skills can be developed through practice and knowledge. It is essential to continuously engage in the skill during real work under supervision to master it. The results confirmed through SEM support the idea that the constructs are distinct and complementary dimensions of teachers' statistical competence. The findings of the study stated that the instruments are reliable and valid, and the systematic reinforcement of knowledge, skills, and competence can enhance the educators' ability to do SPSS interpretation and overall research ability.

Implications for Research Training and University Education

Higher education should note these findings. They should take a competence-based approach that merges knowledge acquisition with the acquisition of skills and reflective practice. Colleges must create research and statistics guides which enable deeper engagement by teachers in the analysis of data, simulations, and group work. Access to technology and digital literacy is important in today's world. In order to ensure that knowledge does not remain knowledge, institutions must provide licensed SPSS software, a functional computer lab and continuous digital training. Mentorship courses, routine capacity-building programs, and research analytics workshops can enhance hands-on participation. Doing our research, preparation and practice means "knowing" and "doing" gets bridged. Furthermore, the program should emphasize genuine learning experiences. This will help link theoretical knowledge with research practice. If higher education nurtures reflective learning,

digital competence, and collaborative problem-solving among education professionals, it can be said that such professionals will be conceptually sound educators with research productivity and analytical competence.

Limitations of the Study

The study had a lot of limitations despite methodological rigor employed. Since the study only focused on public universities in Cross River State, the findings may not be generalizable to private universities or universities in other parts of the country because their infrastructure and training opportunities and research culture differ. The way the questionnaire was made may have caused some people to change their answers in a way that doesn't show the truth. Even if the tool was a reliable and valid measuring instrument, it was not enough to show the depth of educators' technical competence. Performance-based and observational measures may work better. Moreover, restricted access to SPSS software and computers at the institution may have limited the exposure of the respondents to computer data analysis, which may have affected their perceptions of themselves as proficient.

The cross-sectional design of the study limited the capabilities to attribute knowledge, skills and competence causation; longitudinal or mixed-method design studies in the future may further enhance the insights about developmental trajectories. The final results of SEM are based on model specification and measurement quality. The results could have also shown better fitness and explanatory power due to OMV like digital self-efficacy and institutional support. Although they limit confidence in the findings, they do not invalidate the conclusion of the study but rather provide important directions for future research, which includes the geographic expansion, longitudinal and performance-based approaches, and the use of qualitative methods to deepen knowledge of educators' analytic adequacy.

Conclusion

This study measures the joint effects of knowledge, skills and competence of educators on their capacity to interpret SPSS data analysis in public universities in Cross River State, Nigeria. This study investigated the relationships among these constructs and assessed the overall fit of the model using SEM. The researchers determined that educators' knowledge, skills, and competence have a significant influence on the ability to interpret SPSS. Most consistently most powerful predictor was knowledge indicating the theoretical role of knowledge in statistical reasoning.

Even though the effects of the variables were moderate when looked at separately, they represented a coherent, reliable model of teacher ability when considered together. The educators' ability can be capacity to read SPSS data based on their knowledge base, practical skills and professional competency explicitly in the study. By developing these areas of teaching through ongoing professional development, workshops, and changes in curriculum of research and statistics, will help increase research productivity and enhance analytical confidence. In the end, institutional investment in competence-based research training, educator scholarship will help improve the integration of theory with digital analytical practice.

Recommendations

The following recommendations are made based on the findings.

1. Organizations should have periodic workshops on SPSS and other statistical tools, so that the lecturer's ability, confidence and knowledge can improve in undertaking quantitative cases.
2. To enhance the curriculum, faculties must strengthen the courses in research and statistics by including more hands-on activities in SPSS for competence and accurate interpretation.
3. University management should provide access to licensed statistical software and sufficiently equipped computer laboratories.
4. Professor should encourage peer learning by establishing mentorship program for experienced lecturers to support their colleagues on data analysis and interpretation of research.
5. It is recommended that National Universities Commission (NUC) and council of the universities make it a requirement for continuous professional

development and condition for promotion to possess proficiency in data analysis.

6. University should invest in digital learning materials that offer self-learning modules/lessons, SPSS certification, etc to update selected educators with the latest research tools.

Ethical consideration

In this research, the authors involved human participants and the research was conducted in full compliance with ethical standards that involve human subjects. Participation in the study was voluntary, informed consent was obtained as well from all the respondents. The data that were used for the study were collected and analyzed with strict adherence to confidentiality and anonymity principles.

Conflict of interests

The authors of this research work declare that there is no conflict of interest.

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