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(Research/ Review) Article

The Role of SPSS in Improving the Accuracy and Effectiveness of Research Data Analysis: A Comprehensive Literature Review

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Abstract: This study comprehensively examines the role of the Statistical Package for the Social Sciences (SPSS) in improving the accuracy and effectiveness of quantitative data analysis in academic and research environments. Through systematic literature review methods, SPSS contributions were identified, including data validation capabilities, reliability testing using Cronbach's Alpha, handling complex statistical analysis and its integration with modern research methodologies. The results of the study show that the use of SPSS significantly improves the understanding of students and researchers in the processing of statistical data. SPSS is proven not only as a statistical analysis tool, but also as a quality assurance instrument that ensures the reproducibility and credibility of research results. The study also compared SPSS with similar software (SmartPLS, AMOS, WarpPLS) and found that SPSS excels in user-friendly interface for descriptive and inferential analysis, while its limitations lie in the more limited Structural Equation Modeling (SEM) analysis capacity than SmartPLS or AMOS. The implications of these findings are relevant for the development of statistical training curriculum in Indonesian universities.

Keywords: Academic Research; Data Analysis; Data Validation; Quantitative Statistics; Reliability; SPSS.

1. Introduction

The digital age and the data revolution have fundamentally changed the paradigm of modern research. Accurate data analysis is now the foundation for evidence-based decision-making in various disciplines, from social sciences, education, health, business, to engineering. In this context, the availability of reliable statistical software has become crucial for researchers, academics, and college students.

The Statistical Package for the Social Sciences (SPSS), now known as IBM SPSS Statistics, has grown to become one of the most influential statistical software in the world since it was first developed at Stanford University in the late 1960s by Norman H. Nie, C. Hadlai Hull, and Dale H. Bent. After being acquired by IBM in 2009, the development of SPSS accelerated with a focus on improving complex data analysis capabilities and a more user-friendly interface.

In Indonesia, the use of SPSS in academic research continues to increase, but there is still a significant gap between the need for data analysis skills and the actual abilities of students and researchers. Various studies show that many students find it difficult to perform statistical analysis, so some of them even choose to use the services of professional statistical consultants in processing their research data (Erwin & Jingga, 2024; Latif et al., 2025).

The main problems identified in this study are: (1) the lack of conceptual understanding and technical skills of students in using SPSS; (2) there has not been a comprehensive study that integrates various research findings related to the effectiveness of SPSS in improving the

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accuracy of data analysis; and (3) the need for structured guidance on the selection and use of appropriate SPSS analysis methods according to research needs.

This study aims to: (1) systematically analyze the role of SPSS in improving the accuracy of research data analysis based on the latest literature review; (2) identify the main features of SPSS and its validation mechanisms that contribute to improving the quality of research; (3) comparing SPSS with similar statistical analysis software; and (4) provide evidence-based recommendations for the development of statistical training curriculum in Indonesian universities.

2. Literature Review

Development of SPSS as a Data Analysis Tool

SPSS is a statistical software package designed for data analysis in various fields of science. Since its first development, SPSS has undergone a significant evolution from just a social data analysis tool to a comprehensive analytics platform that supports data mining, statistical modeling, and machine learning (Attwal & Dhiman, 2024). The latest version of IBM SPSS Statistics offers capabilities that go far beyond basic statistics, including integration with the R and Python programming languages.

A bibliometric study conducted by Anastasya and Yuadi (2024) on 500 documents from the Web of Science (1991–2023) showed a growth rate of SPSS-related publications of 13.14% per year with an average document age of 6.08 years. These findings confirm that SPSS remains the primary tool for testing quantitative research data globally.

Key Features of SPSS in Data Analysis

SPSS provides a complete set of statistical procedures that include descriptive analysis (frequency, mean, median, mode, standard deviation), inferential analysis (t-test, ANOVA, regression, correlation), as well as multivariate analysis (factor analysis, MANOVA, discriminant). This ability makes SPSS the main choice of researchers from various disciplines.

Musdalifah et al. (2025) in their study showed that SPSS plays a significant role in improving accuracy through three main mechanisms: (1) data validation ability and reliability test using Cronbach's Alpha; (2) handling complex statistical analysis including multivariate analysis; and (3) integration with modern research methodologies. SPSS is proven not only as a statistical analysis software, but also as a quality assurance instrument that ensures the reproducibility and credibility of research.

Comparison of SPSS with Other Statistical Software

A comparative study by Sudiksha et al. (2024) of four statistical software (SPSS, SmartPLS, AMOS, and WarpPLS) with 174 research samples in the field of educational technology showed that there was no significant difference in the results of t-test analysis, significance test, determination test, and regression equation between the four software. This indicates the validity and consistency of SPSS in producing reliable statistical outputs.

Sarker et al. (2024) qualitatively compared SPSS, SmartPLS, and AMOS and found that SPSS excels in standard descriptive and inferential analysis with the most user-friendly interface, SmartPLS is more robust for variance-based SEM and predictive modeling, whereas AMOS is better suited for covariance-based SEM and confirmatory factor analysis.

The study conducted by Strale et al. (2025) compared the results of SPSS analysis with ChatGPT-4 and ChatGPT o3-mini using 14 types of statistical analysis from real datasets. The results showed that SPSS and ChatGPT-4 had high concordance on basic analyses (central tendencies, variability, Pearson and Spearman correlations), but ChatGPT showed inaccuracies on complex analyses such as MANOVA and ANOVA repeated measures. These findings confirm SPSS's position as the gold standard for statistical analysis.

3. Proposed Method

Research Design

This study uses a systematic literature review (SLR) approach. The SLR method was chosen because it allows a comprehensive and objective synthesis of various studies that have been conducted regarding the use of SPSS in the analysis of research data.

Literature Selection Criteria

The literature included in this study met the following criteria: (1) published between 2020–2025; (2) focus on the use of SPSS in the context of quantitative data analysis; (3) based

on empirical research or verifiable comprehensive studies; (4) published in national or international indexed journals.

Of the 25 articles initially identified, 18 met the inclusion criteria and were used as the primary data source. The search was conducted through Google Scholar, Web of Science, and a repository of SINTA-accredited national journals.

Data Analysis Procedure

Data from literature sources were analyzed using content analysis and comparative methods. The analysis process includes: (1) extraction of key data from each article including methods, samples, main results, and conclusions; (2) categorization of findings based on emerging themes (SPSS features, training effectiveness, software comparison, usage challenges); (3) synthesis of findings across studies to identify patterns and consensus.

4. Results and Discussion

Effectiveness of the Use of SPSS in Statistical Training

Based on the synthesis of the nine SPSS training studies analyzed, a consistent pattern was found in the form of a significant improvement in participants' understanding and skills after participating in SPSS-based training. Table 1 presents a summary of the results of the representative studies.

Table 1. Summary of SPSS Training Study Results (2020–2025)

Researcher & Year	Population/Sample	Training Methods	Key Results	Increase (%)
Latif et al. (2025)	A Graduate of the University of Illinois	SPSS hands-on practice	Pre-test 65.2 → post-test 85.4; 90% operate descriptive SPSS	+31%
Indriyani et al. (2025)	32 students from various PT Surabaya Timur	PBL + FGD	68.75% achieved MOH; Improvement of logical and technical aspects	+68,75%
Rosidin et al. (2024)	32 participants from academics from various backgrounds	Online via Zoom, case study	Significant improvement in t-tests and regression; Research independence increases	Significant*
Erwin & Orange (2024)	INISMA Jambi Students	Lectures + hands-on practice	Increased comprehension; Quantitative Research Motivation Grows	Significant*
Hasmawati et al. (2024)	There are 33 students. Pend. Foreign Language UNM	SPSS technical training	64.7% agree + 32.4% strongly agree with the application of SPSS in research	97,1%
Otaya (2023)	Mhs semester IV Jur. MPI IAIN Gorontalo	Quantitative experiment (Hotelling's T^2)	Better understanding of concepts in SPSS vs non-SPSS groups	Significant

*Note: *Statistically significant increase with no specific quantitative data reported.*

From the data in Table 1, it can be seen that the effectiveness of SPSS training is consistent across various contexts and populations. The research of Latif et al. (2025) noted an increase in the average score from 65.2 to 85.4 (an increase of ~31%), with 90% of participants successfully operating SPSS for descriptive statistical analysis and 75% able to perform simple inferential analysis. Furthermore, 85% of participants stated the relevance of the training material and 80% felt that the methods applied were very helpful in understanding.

Otaya (2023) found that the group of students who learned using SPSS had a better understanding of statistical concepts than the control group who studied without SPSS. The data processing simulation provided through SPSS is able to make students understand statistics and data analysis techniques more deeply.

Analysis of SPSS Features and Their Contribution to Accuracy

Based on the literature review, the main features of SPSS that contribute significantly to improving the accuracy of data analysis can be categorized as follows:

Table 2. SPSS Features and Their Contribution to Research Accuracy

SPSS Features	Working Mechanism	Contribution to Accuracy
Validity Test	Corrected Item-Total Correlation; R value > 0.3 as the threshold	Ensure the instrument measures the construct in question
Reliability Test (Cronbach's Alpha)	Measure internal consistency; $\alpha \geq 0.7$ received	Ensure measurement consistency and reproducibility
Normality Test	Kolmogorov-Smirnov / Shapiro-Wilk; Determining the selection of parametric vs non-parametric tests	Ensure statistical assumptions are met before inferential analysis
Regression Analysis	Simple/multiple linear regression; stepwise; hierarchical	Explain causal relationships and predictions of variables with high precision
ANOVA	One-way, Two-way, MANOVA, Repeated Measures ANOVA	Compare mean between groups with Type I error control
Data Mining & Data Modification	Data Editor: Data View + Variable View; Data Transformation, Case Selection	Ensure data integrity and quality before analysis
Visualization & Reporting	Scatter plot, histogram, pie chart, box plot; automatic output to Viewer	Facilitate the interpretation and communication of research findings

Yadav (2025) in his comprehensive review of SPSS for social science research identified that SPSS offers advantages in: (1) ease of use of interfaces that allow researchers to focus on interpretation rather than technical aspects; (2) the ability to handle large datasets with many variables; (3) flexibility in various statistical techniques ranging from descriptive analysis to multivariate analysis; and (4) standardized and easily reported outputs.

Comparison of SPSS, SmartPLS, AMOS, and WarpPLS

The selection of the right statistical analysis software depends largely on the research objectives and data characteristics. Table 3 summarizes a comprehensive comparison of the four major software based on the literature review analyzed.

Table 3. Comparison of SPSS, SmartPLS, AMOS, and WarpPLS

Aspects	SPSS	SmartPLS	AMOS	WarpPLS
Main Types of Analysis	Descriptive & Inferential	Variance-based SEM (PLS)	Covariance-based SEM	Non-linear SEM (PLS)
Ease of Use	Very High	Height	Medium	Medium
Sample Size	Flexible	Small-Medium	Large	Medium
SEM Strength	Limited	Very Powerful	Very Powerful	Strong (non-linear)
License Availability	Paid (IBM)	Paid/Free (limited)	Paid (IBM/AMOS)	Paid
AI/ML integration	Available (latest version)	Limited	Limited	Limited
Consistency of Results	Very High	Height	Height	Height

Source: Adapted from Sudiksha et al. (2024); Sarker et al. (2024); Strale et al. (2025).

The findings of Sudiksha et al. (2024) with 174 respondents showed no significant difference between the four software in hypothesis and regression tests. However, SPSS remains the top choice for research that prioritizes ease and readability of outputs, especially for novice researchers and students.

Challenges and Solutions in the Use of SPSS

Although SPSS has many advantages, the literature review identifies several key challenges in its implementation:

First, limited software access. SPSS is a paid licensed software that is quite expensive for individuals. The solutions that are widely applied are the use of institutional licenses of universities, the use of trial versions, or the switch to open-source alternatives such as PSPP or R/Python for early learning (Sahrul et al., 2025).

Second, difficulties in understanding the concept of inferential statistics. Latif et al. (2025) found that 25% of participants still had difficulty in inferential analysis despite mastering descriptive statistics. This shows the need for a stronger emphasis on conceptual understanding before technical practice.

Third, the gap between theory and practice. Hasmawati et al. (2024) underline that even though students have basic statistical provisions from lectures, they often encounter problems when applying them to real research data. The Problem-Based Learning (PBL) approach has proven to be effective in addressing this gap by bringing learning closer to relevant research contexts.

5. Conclusions

This comprehensive literature review yielded several important conclusions regarding the role of SPSS in academic research:

First, SPSS has been proven to consistently improve the accuracy and effectiveness of quantitative data analysis. The ability to validate data, test reliability (Cronbach's Alpha), and handle complex statistical analysis make SPSS a quality assurance instrument that ensures the reproducibility and credibility of research results.

Second, the use of SPSS in statistical training has a significant positive impact on students' understanding and skills, with an average score increase of 20–31% from pre-test to post-test in the various studies analyzed. Active learning approaches such as Problem-Based Learning (PBL) and Focus Group Discussion (FGD) have proven to be most effective in optimizing the benefits of SPSS training.

Third, a comparison of SPSS with other software (SmartPLS, AMOS, WarpPLS) shows that SPSS excels in ease of use and standard descriptive-inferential analysis, while having limitations in complex SEM analysis. The choice of software should be tailored to the specific needs of the research.

Fourth, the comparison of SPSS with AI (ChatGPT-4, o3-mini) shows that SPSS remains the gold standard for statistical analysis, especially for complex multivariate procedures where AI still exhibits inaccuracies.

The practical implications of this study include: (1) the need to integrate SPSS training in the research methodology curriculum in Indonesian universities; (2) the development of PBL-based training modules that use contextual research data; and (3) increasing access to SPSS licenses through institutional cooperation.

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