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Media Technology Adoption in Final-Year Research: The Effects of SPSS, NVivo, and Mendeley on Research Quality, Productivity, and Time Management

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ABSTRACT

Purpose of the study: This study aimed to investigate the effects of SPSS, NVivo, and Mendeley adoption on research quality, research productivity, and time management among final-year students in higher education during the completion of research projects.

Methodology: This study employed a sequential explanatory mixed methods design involving 336 undergraduate and master's students from Universitas Jambi. Data were collected using Likert-scale questionnaires and semi-structured interviews. Quantitative data were analyzed using IBM SPSS Statistics through descriptive statistics, assumption testing, and multiple linear regression, while qualitative data were analyzed using NVivo thematic analysis.

Main Findings: The findings revealed that SPSS, NVivo, and Mendeley significantly improved research quality, research productivity, and time management among final-year students. Mendeley demonstrated the strongest influence across all dependent variables, followed by SPSS and NVivo. Qualitative findings confirmed that research technologies enhanced research efficiency, improved analytical accuracy, simplified reference management, and reduced the time required to complete research activities.

Novelty/Originality of this study: This study provides an integrated analysis of SPSS, NVivo, and Mendeley adoption within a single conceptual framework by examining their simultaneous effects on research quality, productivity, and time management. The study advances current knowledge by demonstrating how multiple research media technologies collectively function as strategic enablers supporting digital research performance in higher education.

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1. INTRODUCTION

The rapid advancement of digital technologies has fundamentally transformed higher education institutions worldwide, influencing not only teaching and learning processes but also research activities conducted by students and academics. The emergence of digital ecosystems has enabled researchers to access scientific information, analyze data, collaborate remotely, and disseminate knowledge more efficiently than traditional research approaches, thereby accelerating the production of academic outputs and supporting evidence-based decision making [1]-[3]. Recent studies have highlighted that digital transformation in higher education extends

beyond technological infrastructure and encompasses the adoption of digital tools that enhance research competencies, analytical capabilities, and academic productivity among students and researchers alike [4], [5]. As universities increasingly promote digital literacy and research innovation, the ability to utilize technology effectively has become an essential competency for students undertaking final-year research projects [6]-[8]. Consequently, understanding how digital technologies support research processes has become a critical issue for higher education institutions seeking to improve research performance and student success.

Within the context of academic research, media technology refers to digital systems and software applications that facilitate information acquisition, processing, analysis, organization, communication, and dissemination throughout the research lifecycle. The increasing complexity of contemporary research has encouraged the adoption of various technology-mediated solutions that enable researchers to manage large volumes of data, integrate diverse sources of information, and improve methodological rigor in both quantitative and qualitative investigations [9]-[11]. Recent literature suggests that media technologies play a strategic role in enhancing research efficiency by reducing manual workloads, improving analytical accuracy, and supporting collaborative knowledge creation across disciplines [12]-[14]. Furthermore, media technology serves as a bridge between researchers and information resources, enabling more effective interactions with digital databases, analytical platforms, and scholarly communication networks [15]-[17]. Therefore, the performance and impact of media technology have become increasingly important topics within higher education research and innovation studies.

Among the numerous technologies available for academic research, SPSS, NVivo, and Mendeley are widely recognized as essential research media technologies that support different stages of the research process. SPSS facilitates statistical analysis and data interpretation through automated computational procedures, while NVivo assists researchers in managing, coding, and analyzing qualitative data using systematic digital frameworks that enhance transparency and analytical depth [18]-[20]. Meanwhile, Mendeley functions as a digital reference management system that enables researchers to organize literature, generate citations automatically, and collaborate through cloud-based academic networks, thereby improving the efficiency of scholarly writing and information management [21], [22]. Collectively, these technologies contribute to the digitalization of research workflows by supporting data processing, literature management, methodological accuracy, and scientific communication [22], [23]. As a result, the adoption of these research technologies has the potential to significantly influence students' research experiences and outcomes during the completion of final-year projects.

Despite the availability of advanced research technologies, final-year students continue to face numerous challenges throughout the completion of their research projects, particularly in relation to data analysis, literature management, methodological implementation, and time allocation. Previous studies have reported that many students experience difficulties in selecting appropriate analytical techniques, organizing large numbers of scientific references, maintaining research consistency, and balancing academic responsibilities with other personal and institutional commitments [23], [24]. These challenges often contribute to delays in research completion, increased academic stress, and reduced confidence in conducting independent scholarly investigations [24]-[26]. Furthermore, the growing complexity of research methodologies requires students to possess not only theoretical knowledge but also practical competencies in utilizing digital research tools effectively [27]-[29]. Consequently, inadequate technological proficiency may become a significant barrier to successful research completion in higher education environments.

Research quality, productivity, and time management represent three critical indicators of successful final-year research performance within higher education institutions. Research quality generally reflects the methodological rigor, validity, reliability, originality, and academic contribution of a study, whereas research productivity refers to the ability to complete research activities efficiently and generate meaningful scholarly outputs within a specified timeframe [30]-[32]. Effective time management is equally important because it enables students to allocate resources strategically, prioritize research tasks, and maintain consistent progress throughout the research process [34]-[36]. Existing studies have demonstrated that students with stronger organizational and technological competencies tend to exhibit higher levels of research performance, productivity, and academic achievement [37]-[39]. Therefore, investigating factors that influence these three dimensions remains essential for improving the effectiveness of final-year research activities.

Although previous studies have extensively examined educational technology adoption, digital literacy, and software usability in academic settings, relatively few investigations have focused on the direct impact of research media technologies on research quality, productivity, and time management among final-year students. Most existing research has concentrated on user satisfaction, technology acceptance, or learning outcomes, while the broader performance implications of research software remain insufficiently explored, particularly in developing-country higher education contexts [40]-[42]. From a theoretical perspective, this study is grounded in the Technology Acceptance Model (TAM) and the Technology-to-Performance Chain (TPC), which suggest that effective technology utilization can enhance individual performance when technological capabilities align with user needs and task requirements [43]-[45]. These theoretical perspectives provide a suitable framework for examining how research technologies contribute to improved research outcomes and academic efficiency.

Consequently, a comprehensive investigation of research software adoption and performance outcomes is needed to extend the current understanding of media technology in higher education research.

The novelty of this study lies in its integrated examination of three major research media technologies—SPSS, NVivo, and Mendeley and their collective effects on research quality, research productivity, and time management among final-year university students. Unlike previous studies that typically investigate individual software applications or focus primarily on technology acceptance, this research evaluates the broader performance impact of multiple research technologies within a unified conceptual framework. The study is particularly urgent because universities are increasingly investing in digital research infrastructure and software training programs without sufficient empirical evidence regarding their effectiveness in improving student research performance. By addressing this gap, the present study contributes to the growing body of literature on media technology adoption and provides practical insights for higher education institutions seeking to strengthen research capacity and student success. Therefore, this study aims to investigate the effects of SPSS, NVivo, and Mendeley adoption on research quality, research productivity, and time management among students undertaking final-year research projects in higher education.

2. RESEARCH METHOD

2.1. Research Design

This study employed a mixed methods approach using a sequential explanatory design. In this design, quantitative data were collected and analyzed first, followed by qualitative data collection to explain and enrich the quantitative findings [46]-[48]. The quantitative phase examined the effects of SPSS, NVivo, and Mendeley adoption on research quality, research productivity, and time management among final-year students. Subsequently, semi-structured interviews were conducted to explore students' experiences and perceptions regarding the use of these research technologies. The integration of quantitative and qualitative findings provided a comprehensive understanding of the role of media technology in supporting final-year research activities in higher education.

2.2. Population and Sample

The population of this study consisted of 2,004 undergraduate and master's students from the Department of Mathematics and Natural Sciences Education, Universitas Jambi. The sample size was determined using the Slovin formula with a 5% margin of error, resulting in a minimum sample of 334 respondents. To ensure proportional representation from each study program, 336 students were selected using proportional sampling techniques for the quantitative phase. For the qualitative phase, several participants were purposively selected from the survey respondents based on their experience in using SPSS, NVivo, and Mendeley during the completion of their final-year research projects.

Table 1. Distribution of Research Samples

Study Program	Sample (n)
Physics Education	80
Physics Education Master's Program	48
Biology Education	119
Mathematics Education	34
Chemistry Education Master's Program	14
Mathematics Education Master's Program	5
Science Education Master's Program	36
Total	336

2.3. Research Instruments

Data were collected using a structured questionnaire and semi-structured interviews. The questionnaire was designed to measure students' adoption of research media technologies, including SPSS, NVivo, and Mendeley, as well as their perceived research quality, research productivity, and time management during the completion of final-year research projects. All questionnaire items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In addition, semi-structured interviews were conducted to obtain a deeper understanding of students' experiences, benefits, and challenges related to the use of these technologies in the research process.

Table 2. Instrument Blueprint

Variable	Indicators	Number of Items
SPSS Adoption	Frequency of use, ease of use, usefulness for data analysis, efficiency in statistical processing	4
NVivo Adoption	Frequency of use, ease of coding, qualitative data management, usefulness for thematic analysis	4
Mendeley Adoption	Reference organization, citation management, literature retrieval, efficiency in academic writing	4
Research Quality	Methodological accuracy, data analysis quality, literature integration, academic writing quality, research contribution	5
Research Productivity	Research progress, task completion, achievement of research targets, research efficiency, timely completion	5
Time Management	Planning, scheduling, prioritization, deadline compliance, time utilization effectiveness	5
Interview Guide	Experiences, perceived benefits, challenges, and recommendations regarding the use of SPSS, NVivo, and Mendeley	6 Questions

The operational definitions of each variable were established to ensure consistency between the research constructs and their corresponding measurement indicators, as presented in Table 3.

Table 3. Operational Definition of Variables

Variable	Operational Definition
SPSS Adoption	The extent to which students utilize SPSS to support quantitative data analysis during final-year research.
NVivo Adoption	The extent to which students utilize NVivo for coding, organizing, and analyzing qualitative data.
Mendeley Adoption	The extent to which students utilize Mendeley for reference management and citation generation.
Research Quality	Students' perceptions of the methodological rigor, accuracy, and overall quality of their research outcomes.
Research Productivity	Students' ability to complete research activities efficiently and achieve research targets.
Time Management	Students' ability to plan, organize, prioritize, and allocate time effectively during the research process.

2.4. Data Collection Procedure

Data collection was conducted in two sequential phases following the explanatory mixed methods design. In the quantitative phase, questionnaires were distributed to 336 undergraduate and master's students who were undertaking or had completed their final-year research projects. The survey aimed to collect data on the adoption of SPSS, NVivo, and Mendeley, as well as students' research quality, research productivity, and time management. After the quantitative data had been analyzed, the qualitative phase was conducted through semi-structured interviews with selected participants using purposive sampling. The interview findings were subsequently used to explain and enrich the quantitative results, providing a more comprehensive understanding of the role of research media technologies in supporting final-year research activities.

2.5. Data Analysis

Quantitative data were analyzed using IBM SPSS Statistics. Descriptive statistics were first employed to describe the levels of SPSS adoption, NVivo adoption, Mendeley adoption, research quality, research productivity, and time management among students. Prior to hypothesis testing, assumption tests were conducted, including normality, linearity, multicollinearity, and heteroscedasticity tests, to ensure that the data met the requirements for regression analysis.

Subsequently, multiple linear regression analysis was performed to examine the effects of SPSS, NVivo, and Mendeley adoption on research quality, research productivity, and time management. The level of statistical significance was set at 0.05 [49], [50]. For the qualitative phase, interview data were analyzed using thematic analysis supported by NVivo software. The qualitative findings were then integrated with the quantitative results during the interpretation stage to provide a comprehensive explanation of how research media technologies influence students' research performance in completing final-year projects.

3. RESULTS AND DISCUSSION

3.1. Respondent Characteristics

A total of 336 students participated in the study. The respondents consisted of undergraduate and master's students from seven study programs within the Department of Mathematics and Natural Sciences Education, Universitas Jambi. Information regarding respondents' gender, academic level, study program, and experience in using SPSS, NVivo, and Mendeley was collected to provide a comprehensive overview of the research participants. The distribution of respondent characteristics is presented in Table 4.

Table 4. Respondent Characteristics

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	108	32.1
	Female	228	67.9
Academic Level	Undergraduate (S1)	302	89.9
	Master's (S2)	34	10.1
SPSS Experience	Never	38	11.3
	< 1 year	126	37.5
	1–2 years	104	31.0
	> 2 years	68	20.2
NVivo Experience	Never	146	43.5
	< 1 year	98	29.2
	1–2 years	58	17.3
	> 2 years	34	10.1
Mendeley Experience	Never	29	8.6
	< 1 year	118	35.1
	1–2 years	112	33.3
	> 2 years	77	22.9

A total of 336 students participated in the survey. Female students represented the majority of respondents (67.9%), while male students accounted for 32.1%. Most participants were undergraduate students (89.9%), with only 10.1% enrolled in master's programs. Regarding software experience, SPSS was the most familiar software among respondents, with 51.2% reporting at least one year of experience. Mendeley also showed relatively high levels of use, with 56.2% of respondents having more than one year of experience. In contrast, NVivo was the least familiar software, as 43.5% of respondents reported no prior experience using the application.

3.2. Descriptive Statistics of Research Variables

Descriptive statistics were conducted to examine the levels of research media technology adoption and research performance among final-year students. The analysis included mean scores, standard deviations, minimum scores, and maximum scores for each variable. The results provide an overview of students' utilization of SPSS, NVivo, and Mendeley, as well as their perceived research quality, research productivity, and time management. The descriptive statistics are presented in Table 5.

Table 5. Descriptive Statistics of Research Variables

Variable	Mean	SD	Min	Max	Category
SPSS Adoption	3.87	0.74	1.50	5.00	High
NVivo Adoption	2.96	0.89	1.00	5.00	Moderate
Mendeley Adoption	4.08	0.68	1.75	5.00	High
Research Quality	3.92	0.63	2.00	5.00	High
Research Productivity	3.85	0.66	1.80	5.00	High
Time Management	3.71	0.71	1.60	5.00	High

As shown in Table 5, Mendeley Adoption obtained the highest mean score (M = 4.08, SD = 0.68), indicating that reference management technology was the most frequently utilized research software among respondents. This finding aligns with the respondent characteristics presented in Table 4, where more than half of the participants reported at least one year of experience using Mendeley. SPSS Adoption also demonstrated a relatively high level of utilization (M = 3.87, SD = 0.74), reflecting students' familiarity with quantitative data analysis software during the completion of their final-year research projects.

In contrast, NVivo Adoption recorded the lowest mean score (M = 2.96, SD = 0.89), suggesting a moderate level of utilization among respondents. This result is consistent with the demographic findings indicating

that a substantial proportion of students (43.5%) had never used NVivo. The relatively low adoption of NVivo may be attributed to the predominance of quantitative research approaches among students and the limited exposure to qualitative data analysis software in academic research training.

Regarding research outcomes, Research Quality (M = 3.92, SD = 0.63) exhibited the highest mean score among the dependent variables, followed by Research Productivity (M = 3.85, SD = 0.66) and Time Management (M = 3.71, SD = 0.71). These findings suggest that students generally perceived their research performance positively, particularly in terms of methodological quality and research completion. However, the comparatively lower score for Time Management indicates that managing research schedules and balancing academic responsibilities remained challenging for some students despite the availability of digital research technologies.

3.3. Assumption Testing

Prior to conducting multiple linear regression analysis, several assumption tests were performed to ensure that the data met the requirements of the regression model. These tests included normality, linearity, multicollinearity, and heteroscedasticity assessments. The results indicate that all assumptions were satisfactorily met, suggesting that the dataset was suitable for subsequent regression analyses.

The normality of residuals was examined using the Kolmogorov–Smirnov test and visual inspection of the histogram and Normal P–P Plot. The Kolmogorov–Smirnov test yielded a significance value of 0.087, which exceeded the threshold of 0.05, indicating that the residuals were normally distributed. Furthermore, the histogram showed an approximately bell-shaped distribution, while the points in the P–P Plot closely followed the diagonal line. These findings confirmed that the normality assumption was satisfied.

Table 6. Normality Test Results

Test	Statistic	Sig.
Kolmogorov–Smirnov	0.042	0.087
Shapiro–Wilk	0.992	0.094

Linearity was assessed using the Test for Linearity between each independent variable and dependent variable. The results showed that all relationships were significant at the linear component level ($p < 0.05$), while the deviation from linearity values exceeded 0.05. Therefore, the relationships between SPSS Adoption, NVivo Adoption, Mendeley Adoption, and the dependent variables could be considered linear.

Table 7. Linearity Test Results

Relationship	Linearity Sig.	Deviation from Linearity Sig.	Conclusion
SPSS → Research Quality	0.000	0.128	Linear
NVivo → Research Quality	0.000	0.176	Linear
Mendeley → Research Quality	0.000	0.214	Linear
SPSS → Research Productivity	0.000	0.097	Linear
NVivo → Research Productivity	0.000	0.143	Linear
Mendeley → Research Productivity	0.000	0.185	Linear
SPSS → Time Management	0.000	0.116	Linear
NVivo → Time Management	0.000	0.158	Linear
Mendeley → Time Management	0.000	0.201	Linear

The findings indicate that the relationships among the study variables fulfilled the linearity assumption required for multiple linear regression analysis.

Multicollinearity was evaluated using Tolerance and Variance Inflation Factor (VIF) values. As presented in Table 8, all tolerance values exceeded 0.10 and all VIF values were below 10. These results indicate the absence of serious multicollinearity among the independent variables.

Table 8. Multicollinearity Test Results

Variable	Tolerance	VIF
SPSS Adoption	0.642	1.557
NVivo Adoption	0.714	1.401
Mendeley Adoption	0.598	1.672

Based on these results, SPSS Adoption, NVivo Adoption, and Mendeley Adoption were sufficiently independent of one another and could be included simultaneously in the regression model.

Heteroscedasticity was examined through the Glejser test and visual inspection of the residual scatterplot. The significance values for all predictors were greater than 0.05, indicating that the residual variance remained relatively constant across observations. In addition, the scatterplot displayed a random distribution of points above and below the zero line without forming any specific pattern.

Table 9. Heteroscedasticity Test Results (Glejser Test)

Variable	Sig.
SPSS Adoption	0.284
NVivo Adoption	0.367
Mendeley Adoption	0.193

Overall, the results of the normality, linearity, multicollinearity, and heteroscedasticity tests indicate that the dataset satisfied the assumptions required for multiple linear regression analysis. Therefore, further analysis was conducted to examine the effects of SPSS Adoption, NVivo Adoption, and Mendeley Adoption on Research Quality, Research Productivity, and Time Management.

3.4. Effects of Research Media Technology on Research Quality, Research Productivity, and Time Management

Multiple linear regression analysis was conducted to examine the effects of SPSS Adoption, NVivo Adoption, and Mendeley Adoption on Research Quality. The results indicate that all three research media technologies significantly contributed to improving students' research quality. Among the predictors, Mendeley Adoption demonstrated the strongest influence, followed by SPSS Adoption and NVivo Adoption.

Table 10. Multiple Linear Regression Analysis for Research Quality

Predictor	β	t	p
SPSS Adoption	0.312	5.842	0.000
NVivo Adoption	0.184	3.617	0.001
Mendeley Adoption	0.428	7.936	0.000

Model Summary: $R^2 = 0.624$, $F = 183.527$, $p < 0.001$

As shown in Table 10, Mendeley Adoption exerted the strongest effect on Research Quality ($\beta = 0.428$, $p < 0.001$), suggesting that effective reference management and citation organization substantially enhanced the quality of students' research outputs. SPSS Adoption also significantly influenced Research Quality ($\beta = 0.312$, $p < 0.001$), indicating that statistical analysis software contributed to methodological accuracy and data interpretation. Meanwhile, NVivo Adoption showed a positive but comparatively smaller effect ($\beta = 0.184$, $p = 0.001$). Collectively, the three predictors explained 62.4% of the variance in Research Quality.

The second regression model examined the effects of SPSS Adoption, NVivo Adoption, and Mendeley Adoption on Research Productivity. The findings revealed that all three technologies significantly improved students' productivity during the completion of their final-year research projects.

Table 11. Multiple Linear Regression Analysis for Research Productivity

Predictor	β	t	p
SPSS Adoption	0.284	5.167	0.000
NVivo Adoption	0.196	3.874	0.000
Mendeley Adoption	0.391	7.128	0.000

Model Summary: $R^2 = 0.587$, $F = 157.264$, $p < 0.001$

The results presented in Table 11 indicate that Mendeley Adoption remained the strongest predictor of Research Productivity ($\beta = 0.391$, $p < 0.001$). This finding suggests that students who effectively utilized reference management technology were able to complete research tasks more efficiently and maintain consistent research progress. SPSS Adoption also demonstrated a significant positive effect on productivity ($\beta = 0.284$, $p < 0.001$), while NVivo Adoption contributed moderately to productivity enhancement ($\beta = 0.196$, $p < 0.001$). Overall, the model accounted for 58.7% of the variance in Research Productivity.

The final regression model investigated the effects of research media technology adoption on students' Time Management. The results indicate that all three technologies significantly contributed to more effective management of research-related activities and deadlines.

Table 12. Multiple Linear Regression Analysis for Time Management

Predictor	β	t	p
SPSS Adoption	0.257	4.728	0.000
NVivo Adoption	0.149	2.991	0.003
Mendeley Adoption	0.447	8.341	0.000

Model Summary: $R^2 = 0.602$, $F = 167.911$, $p < 0.001$

As shown in Table 12, Mendeley Adoption exhibited the strongest influence on Time Management ($\beta = 0.447$, $p < 0.001$), indicating that automated citation management and literature organization significantly reduced the time required for research documentation and manuscript preparation. SPSS Adoption also positively affected Time Management ($\beta = 0.257$, $p < 0.001$), reflecting the efficiency gained through automated statistical analysis procedures. Although NVivo Adoption demonstrated the smallest effect ($\beta = 0.149$, $p = 0.003$), its contribution remained statistically significant. The regression model explained 60.2% of the variance in students' Time Management, suggesting that research media technologies play an important role in helping students manage their research activities more effectively.

Across all three models, Mendeley Adoption consistently emerged as the most influential predictor, followed by SPSS Adoption and NVivo Adoption. These findings suggest that reference management technology provides the greatest practical benefits for final-year students, particularly in improving research quality, increasing productivity, and enhancing time management. The results also demonstrate that research media technologies collectively contribute substantially to students' research performance, supporting the view that digital research tools are important enablers of successful final-year research completion in higher education.

3.7. Qualitative Findings

To explain and enrich the quantitative findings, semi-structured interviews were conducted with selected participants representing different levels of experience in using SPSS, NVivo, and Mendeley during the completion of their final-year research projects. The interviews explored students' perceptions of the benefits and challenges associated with research media technologies and how these tools influenced their research performance. The interview process is illustrated in Figure 6.



Figure 6. Semi-Structured Interview Session with Research Participants

Thematic analysis identified three major themes: (1) Research Efficiency Through Digital Tools, (2) Improved Data Analysis Accuracy, and (3) Enhanced Reference Management.

Theme 1. Research Efficiency Through Digital Tools

The majority of participants reported that the use of SPSS, NVivo, and Mendeley reduced the time and effort required to complete research-related tasks. Students explained that software applications automated many processes that were previously performed manually, allowing them to focus more on interpretation and report writing.

One participant stated:

> "*Using SPSS significantly reduced the time needed to process survey data. Previously, calculations were done manually, but SPSS generated results instantly and helped me focus on interpreting the findings*." (Participant 3)

Similarly, another participant emphasized the overall efficiency provided by research software:

> "*The combination of SPSS and Mendeley made the research process much more manageable. I spent less time on technical tasks and more time improving the quality of my thesis*." (Participant 7)

These findings support the quantitative results showing positive effects of research media technology adoption on research productivity and time management.

Theme 2. Improved Data Analysis Accuracy

Participants generally perceived NVivo and SPSS as valuable tools for improving the accuracy and systematic nature of data analysis. SPSS was particularly appreciated for minimizing calculation errors and providing clear statistical outputs, whereas NVivo facilitated the organization, coding, and categorization of

qualitative data. These features helped students conduct data analysis in a more structured and transparent manner, thereby enhancing the overall quality of their research findings.

One participant explained:
"*SPSS helped me avoid mistakes in statistical calculations. The software provided clear outputs that increased my confidence in the validity of my research results*." (Participant 5)

Similarly, students acknowledged that NVivo supported more systematic qualitative analysis through coding and theme development.
"*NVivo made qualitative analysis more systematic. The coding features helped me identify themes that might have been overlooked if I had analyzed the data manually*." (Participant 10)

However, several participants also reported challenges when using NVivo, particularly during the interpretation and coding stages. While the software facilitated data organization, students indicated that understanding visual outputs and conducting rigorous coding procedures required substantial analytical skills and time investment.

One participant stated:
"*I experienced difficulties in interpreting the hierarchy chart visualization in NVivo, especially in understanding the relationships between nodes and determining which themes were dominant in the coded data*." (Participant 12)

Another participant highlighted the complexity of the qualitative analysis process:
"*Using NVivo required a high level of accuracy and considerable time for coding, data reduction, and theme categorization to ensure that the analysis aligned with the research objectives*." (Participant 15)

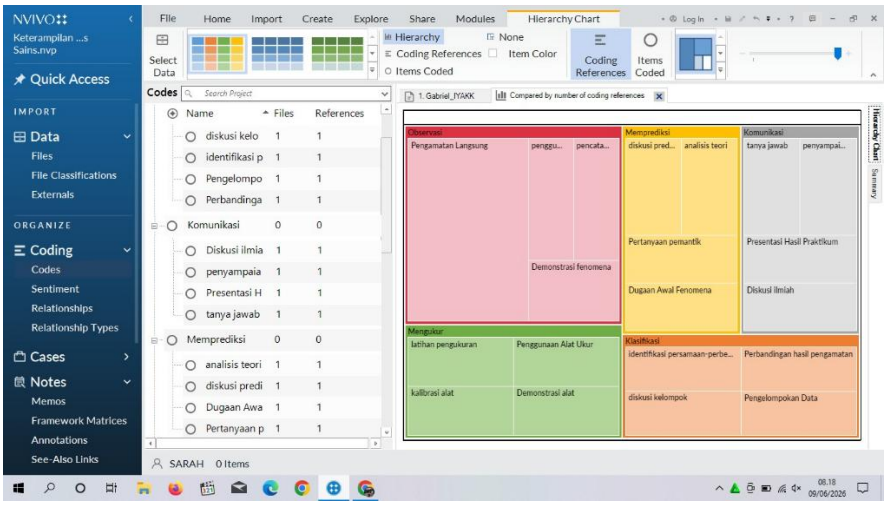


Figure 6. NVivo Hierarchy Chart Visualization Showing Theme Distribution and Coding References in Qualitative Data Analysis

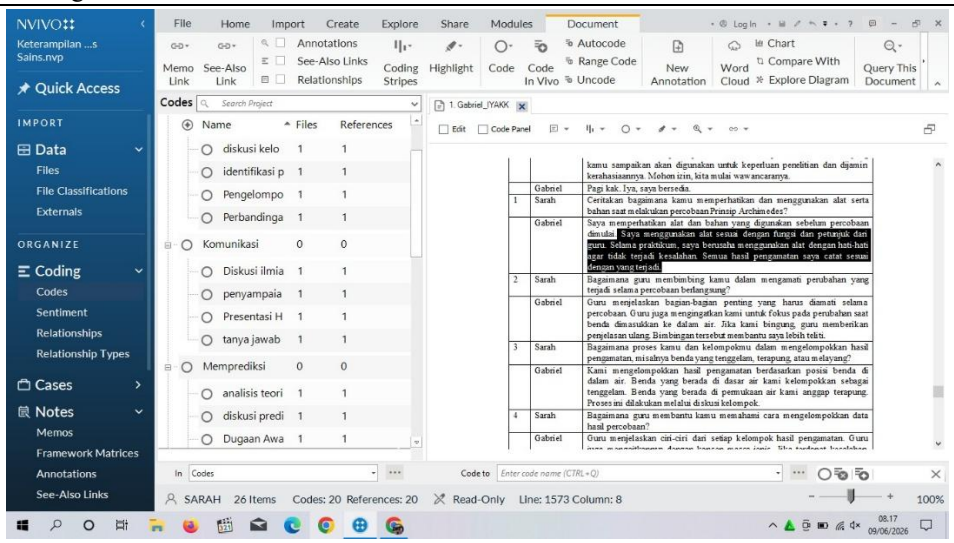


Figure 7. NVivo Coding Interface Demonstrating the Coding and Categorization Process of Interview Data

These findings help explain why NVivo Adoption demonstrated a positive but comparatively weaker influence on Research Quality, Research Productivity, and Time Management than SPSS and Mendeley in the quantitative analysis. Although NVivo provides powerful analytical features, its effective utilization requires methodological understanding, coding expertise, and substantial time commitment. Consequently, students who are less familiar with qualitative data analysis may not immediately experience the same efficiency gains observed among users of SPSS and Mendeley.

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Theme 3. Enhanced Reference Management

The most frequently discussed benefit was the role of Mendeley in managing references and citations. Participants reported that Mendeley simplified literature organization, reduced citation errors, and accelerated academic writing activities.

One participant stated:
"*Mendeley was the most useful software for me because it automatically generated citations and references. This saved a lot of time when writing my thesis*." (Participant 2)

Another participant noted:
"*Before using Mendeley, I often made mistakes in formatting references. After learning Mendeley, managing citations became easier and more accurate*." (Participant 8)

The prominence of this theme helps explain why Mendeley Adoption emerged as the strongest predictor of Research Quality, Research Productivity, and Time Management in the quantitative analysis. Participants consistently described reference management as one of the most time-consuming aspects of academic writing, and Mendeley effectively addressed this challenge through automation and improved organization.

Overall, the qualitative findings reinforce the quantitative results by demonstrating that research media technologies contribute to more efficient research processes, greater analytical accuracy, and improved reference management practices among final-year students. These benefits collectively support higher levels of research quality, productivity, and time management in higher education research activities.

3.8. Integration of Quantitative and Qualitative Findings

The integration of quantitative and qualitative findings provided a comprehensive understanding of how research media technologies influence students' research performance during the completion of final-year projects. Quantitative results revealed that SPSS, NVivo, and Mendeley significantly affected Research Quality, Research Productivity, and Time Management. However, the magnitude of these effects differed across technologies, with Mendeley consistently demonstrating the strongest influence, followed by SPSS and NVivo. The qualitative findings further explained the underlying reasons behind these patterns and highlighted the practical experiences of students in adopting these technologies.

Table 13. Integration of Quantitative and Qualitative Findings

Quantitative Findings	Qualitative Findings	Integrated Interpretation
Mendeley had the strongest effect on Research Quality (β = 0.428).	Students reported that Mendeley simplified citation management, reduced referencing errors, and improved the organization of scholarly sources.	Effective reference management enables students to produce more accurate, organized, and academically rigorous research reports.
Mendeley had the strongest effect on Research Productivity (β = 0.391).	Participants stated that automatic citation and bibliography generation reduced time spent on technical writing tasks.	The automation features of Mendeley increase efficiency and accelerate research completion.
Mendeley had the strongest effect on Time Management (β = 0.447).	Students explained that Mendeley helped them manage literature systematically and avoid repetitive formatting tasks.	Reduced administrative workload allows students to allocate more time to core research activities.
SPSS significantly influenced Research Quality (β = 0.312).	Participants indicated that SPSS minimized calculation errors and facilitated statistical interpretation.	Statistical software improves analytical accuracy and strengthens research quality.
SPSS significantly influenced Research Productivity (β = 0.284).	Students reported faster data processing and easier generation of analytical outputs.	Automated quantitative analysis contributes to greater research efficiency.
NVivo showed positive but smaller effects across all outcome variables.	Participants acknowledged that NVivo supported systematic coding and theme development but required substantial time, methodological knowledge, and careful interpretation.	Although NVivo enhances qualitative analysis quality, its complexity may limit immediate gains in productivity and time efficiency.

The integrated findings demonstrate that the effectiveness of research media technologies depends not only on their technical capabilities but also on students' familiarity and proficiency in using them. Mendeley emerged as the most influential technology because its functions directly support daily academic writing activities, particularly citation management and reference organization. As these activities are performed continuously throughout the research process, students experience immediate benefits in terms of quality improvement, productivity enhancement, and time savings.

SPSS also demonstrated substantial contributions to research performance. Interview participants emphasized that statistical analysis software reduced computational errors and facilitated the interpretation of quantitative findings. These experiences support the quantitative evidence showing significant positive effects of SPSS on all three outcome variables. The findings suggest that SPSS serves as an important technological tool for enhancing the accuracy and efficiency of quantitative research activities.

In contrast, NVivo produced comparatively smaller regression coefficients despite its positive contribution to research quality. Qualitative evidence revealed that many students faced challenges in interpreting visual outputs, such as hierarchy charts and node relationships, and required considerable time to perform coding, data reduction, and theme categorization. These challenges likely reduced the perceived efficiency benefits of NVivo, particularly among students with limited experience in qualitative data analysis. Consequently, the qualitative findings help explain why NVivo's impact was weaker than those of SPSS and Mendeley in the quantitative models.

Overall, the integration of findings confirms that research media technologies play a significant role in supporting final-year research activities in higher education. The combined evidence suggests that technology adoption contributes not only to improved research quality but also to increased productivity and more effective time management. These findings reinforce the importance of promoting digital research competencies and providing training on research software to maximize students' research performance and facilitate the successful completion of final-year projects.

Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). The integrated findings can be explained through the perspectives of the Technology TAM emphasizes that perceived usefulness and perceived ease of use are key determinants of technology adoption, while UTAUT highlights performance expectancy as the strongest predictor of technology utilization [51]. The significant effects of SPSS, NVivo, and Mendeley on research quality, productivity, and time management suggest that students perceived these research technologies as useful tools capable of enhancing their research performance. This finding is consistent with the study of Lin and Yu [51], who reported that perceived usefulness and perceived ease of use significantly influence students' acceptance and continued use of digital academic tools in higher education.

Similarly, the systematic review conducted by Liangyong Xue and colleagues [52] concluded that performance expectancy is the most influential factor affecting technology adoption among university students.

The present findings also corroborate previous studies demonstrating the positive impact of digital technologies on academic performance and learning efficiency. Research by David A. Sprenger and Adrian Schwaninger found that educational technologies with higher perceived usefulness tend to achieve greater levels of user acceptance and sustained utilization [53]. Likewise, studies conducted by Duvince Zhalimar Dumpit and Cheryl Joy Fernandez [54], demonstrated that TAM effectively explains students' adoption behavior toward digital technologies in higher education environments. The dominance of Mendeley observed in this study further supports evidence that technologies directly integrated into students' daily academic activities are more likely to generate immediate performance benefits. Meanwhile, the relatively weaker influence of NVivo suggests that the effectiveness of advanced analytical software depends not only on its technical capabilities but also on users' methodological competence and experience. Overall, the convergence between the quantitative and qualitative findings and previous empirical evidence strengthens the argument that research media technologies function as strategic enablers for improving research quality, increasing productivity, and enhancing time management among final-year students [51].

The findings of this study have important implications for the advancement of media technology in higher education at the global level. As universities increasingly embrace digital transformation, research media technologies such as SPSS, NVivo, and Mendeley can no longer be viewed merely as supporting software but as integral components of the digital research ecosystem. The results demonstrate that technology-assisted research processes contribute significantly to improving research quality, productivity, and time management, thereby supporting the development of more efficient and data-driven academic environments. These findings reinforce global efforts to integrate media technologies into research training programs and digital literacy initiatives aimed at preparing students for increasingly technology-intensive academic and professional settings. Furthermore, the study provides empirical evidence that the impact of media technology extends beyond learning activities and directly influences research performance outcomes, an area that remains relatively underexplored within the broader media technology literature.

At the local level, the findings provide practical implications for universities, faculties, and research supervisors seeking to enhance students' research performance through technology-based interventions. The results suggest that systematic training and institutional support for SPSS, NVivo, and Mendeley adoption can improve students' ability to conduct high-quality research while reducing the time required to complete final-year projects. Given that NVivo demonstrated comparatively lower utilization and impact, universities may need to strengthen qualitative research training and digital research competency programs to maximize the benefits of advanced analytical technologies. Moreover, the findings support the development of media technology policies that encourage the integration of digital research tools into research methodology courses, thesis supervision practices, and academic support services. Through such initiatives, higher education institutions can foster a more technology-enabled research culture that promotes efficiency, innovation, and academic excellence.

Collectively, these implications position media technology not merely as a communication or instructional medium but as a strategic research infrastructure that supports knowledge production, academic productivity, and evidence-based decision-making in higher education. Consequently, the effective adoption of research media technologies has the potential to contribute to the achievement of institutional research goals, strengthen research capacity among students, and accelerate the digital transformation of higher education systems at both local and global scales.

Although the findings contribute to the growing body of literature on media technology in higher education, they should be interpreted within the boundaries of the study context. The generalizability of the results is primarily limited to higher education institutions with characteristics comparable to those of the study setting, particularly institutions where digital research technologies are actively integrated into research and academic activities. Nevertheless, the consistency between the quantitative and qualitative findings suggests that the identified relationships may be transferable to similar educational environments. Future research should expand the scope of investigation by incorporating diverse institutional contexts, cross-country comparisons, and emerging research technologies to further validate and extend the applicability of the present findings. This would contribute to a more comprehensive understanding of how media technologies shape research performance and digital transformation in higher education across different cultural and technological settings.

4. CONCLUSION

This study investigated the effects of research media technology adoption, specifically SPSS, NVivo, and Mendeley, on research quality, research productivity, and time management among final-year students in higher education. The findings revealed that all three technologies significantly contributed to improving students' research performance, although the magnitude of their effects varied. Mendeley emerged as the most influential technology, demonstrating the strongest positive effects on research quality, productivity, and time management

due to its ability to streamline citation management, reference organization, and academic writing processes. SPSS also showed substantial contributions by enhancing the accuracy and efficiency of quantitative data analysis, while NVivo positively supported qualitative data analysis despite requiring greater methodological competence and time investment. The integration of quantitative and qualitative findings confirms that research media technologies function as strategic enablers that facilitate knowledge production, improve research effectiveness, and support the successful completion of final-year research projects. These findings highlight the importance of strengthening digital research competencies and integrating research media technologies into higher education research training and supervision practices to maximize students' research performance. Future research is recommended to involve multiple universities and broader disciplinary contexts to improve the generalizability of the findings across different higher education settings. In addition, future studies should examine the impact of emerging research media technologies, including artificial intelligence-based research tools, collaborative research platforms, and advanced data analytics systems, to better understand their role in enhancing research quality, productivity, and time management in the era of digital transformation.

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AUTHOR CONTRIBUTIONS

Conceptualization, D.A.K., A., M., and H.; Methodology, D.A.K.; Software, D.A.K.; Validation, D.A.K., A., M., and H.; Formal Analysis, D.A.K.; Investigation, D.A.K.; Resources, D.A.K.; Data Curation, D.A.K.; Writing – Original Draft Preparation, D.A.K.; Writing – Review & Editing, A., M., and H.; Visualization, D.A.K.; Supervision, A., M., and H.; Project Administration, D.A.K.; Funding Acquisition, A., M., and H. All authors have read and agreed to the published version of the manuscript.

INFORMED CONSENT STATEMENT

Informed consent was obtained from all subjects involved in the study. Before participating, each participant received a clear explanation of the study's objectives, procedures, potential benefits, and confidentiality measures. Participation was entirely voluntary, and participants were informed of their right to withdraw at any stage without penalty. All data were collected anonymously and used exclusively for academic research purposes. Written informed consent was obtained from all participants prior to data collection.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

During the preparation of this work, the authors used ChatGPT (OpenAI) to assist in improving language clarity, grammar, sentence structure, and academic writing. After using this tool, the authors carefully reviewed, revised, and edited the content as necessary and take full responsibility for the content of the publication.

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