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Digital Transformations in Vocational High School: A Case Study of Management Information System Implementation in Banda Aceh, Indonesia

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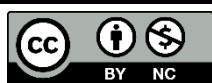
Vocational education

Usability testing

Educational technology

Abstract

This study examines the digital transformation in vocational education through the implementation of a Management Information System (MIS) in Banda Aceh, Indonesia. Focused on enhancing educational administration and decision-making, the study provides insightful analysis on the integration of MIS in State Vocational High School (SMK), specifically SMKN 1 and SMKN 3 in Banda Aceh. A purposive sampling method was employed for usability testing. The questionnaire-based usability test revealed high reliability and positive user responses across multiple indicators. Data analysis affirmed the system's high user satisfaction, effectiveness, and ease of use. Despite limitations, the study highlights the significant potential of well-designed MIS in improving operational efficiency and user satisfaction in educational settings. Future research directions include expanding the sample size, conducting longitudinal studies, incorporating qualitative methods, and exploring the impact on educational outcomes, to enhance the generalizability and depth of understanding regarding the role of MIS in education.



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1. Introduction

In recent years, education worldwide has experienced a significant digital transformation [1, 2]. This shift has made technology a key factor in developing learning environments. The adoption of digital tools and systems is now closely linked with advancements in education, providing new opportunities to improve efficiency, accessibility, and effectiveness [3, 4]. One notable innovation in this evolving landscape is the integration of Management Information Systems (MIS) in educational settings [5]. These systems are revolutionizing how institutions manage and disseminate information, marking a major step forward in educational technology.

Building on the digital transformation in education, the MIS stands out as a key component. This comprehensive system enhances educational administration by leveraging data for better decision-making and resource management [6]. It integrates various functions like managing student records, supervising teacher activities, and streamlining overall school administration, thereby creating a more efficient, data-driven educational environment [7, 8]. This integration signifies a significant stride in the application of technology within the educational sector.

In the digital era, the significance of embracing technology in education cannot be overstated [9]. The dynamic nature of the global job market and the evolving needs of learners necessitate educational systems that are agile, responsive, and technologically adept. To ensure students are equipped with 21st-century skills, educational institutions must strategically integrate digital tools that crucial for creating a learning environment that aligns with the demands of the modern world [10].

Recognizing the transformative impact of digital solutions in education, our research specifically investigated the creation and implementation of the MIS at a vocational school in Banda Aceh, Indonesia. We conducted this study at two state vocational high schools (SMKN), namely SMKN 1 and SMKN 3 in Banda Aceh.

This study aims to contribute to the ongoing discourse on digital transformation in education, with a specific focus on the development and implementation of a MIS at vocational high schools in Banda Aceh, Indonesia. To evaluate the effectiveness and user-friendliness of the developed system, we carried out comprehensive usability testing involving both students and teachers. This important phase of our study allows us to gather valuable feedback on the practicality, accessibility, and overall user experience of the MIS.

In the subsequent sections, this paper is organized as follows: Section 2 provides a detailed overview of the methodology employed in this study. Section 3 presents the results obtained and initiates a comprehensive discussion. Finally, Section 4 encapsulates the key findings and brings the paper to a conclusion.

2. Materials and Methods

2.1. Methodology

In the implementation of the MIS for vocational schools in Banda Aceh, Indonesia, we adopted the Waterfall Methodology [11]. The Waterfall Model is a traditional and linear approach to software development that progresses through a series of distinct phases. Each phase in the Waterfall Model must be completed before moving on to the next, making it a structured and systematic method.

2.1.1. Field Analysis

The initial phase of our study incorporated a comprehensive field analysis, including on-site visits to SMKN 1 and SMKN 3 Banda Aceh, Indonesia. SMKN 1 specializes in a diverse set of skill competencies, prominently focusing on Accounting and Financial Institutions, Office Automation and Management, Online Business and Marketing, Travel Business, Graphic Design, and Computer and Network Engineering. This institution is committed to shaping students with a versatile skill set that spans various domains. On the other hand, SMKN 3 concentrates on skill competencies related to the hospitality sector, beauty industry, catering services, and fashion. The diverse skill offerings at SMKN 3 reflect its dedication to providing a well-rounded vocational education that aligns with the evolving demands of the local industry. The primary objective was to gain a deep understanding of the existing processes, challenges, and specific requirements within the local vocational education system.

Our team visited schools to interact directly with the stakeholders involved in the education process. Through interviews, surveys, and observation, we gathered valuable insights into the daily operations, pain points, and aspirations of the users. This user-centric approach aimed to ensure that the MIS would be tailored to the specific needs and preferences of the vocational education community in Banda Aceh.

2.1.2. System Design

Based on the insights gathered during the field analysis, the system design phase was a crucial step in translating identified requirements into a tangible and user-friendly MIS. During this phase, we utilized the design and

prototyping tool Figma to create a comprehensive blueprint for the system [12].

The design process involved creating a blueprint that outlined the MIS's architecture, functionalities, and user interactions. Special attention was given to aligning the system design with the specific nuances of vocational education in Banda Aceh. This included features tailored to vocational skill tracking, student progress monitoring, and seamless communication channels between stakeholders. The design aimed to enhance the overall educational experience and address challenges unique to vocational training institutions.

2.1.3. System Development

The system development phase involved the actual implementation of the MIS based on the designed specifications. During this phase, the development team actively engaged in coding the system components, establishing the database structure, and integrating features based on the design specifications. The goal was to create a functional MIS that seamlessly aligned with the identified needs and requirements of vocational schools in Banda Aceh.

2.1.4. System Testing

The system testing phase played an important role in validating the robustness and reliability. This comprehensive approach encompassed both unit testing, focusing on individual components, and integration testing, evaluating the seamless collaboration of different modules. During unit testing, rigorous scrutiny was applied to user interfaces, database interactions, and specific functionalities, with an emphasis on code verification and boundary testing to ensure the correct functioning of each isolated component. Integration testing shifted the focus to holistic assessments, examining how various components worked together as a cohesive system. System-wide testing involved the simulation of real-world scenarios, allowing for a comprehensive assessment of user interactions, usability, and overall system performance under diverse conditions.

2.1.5. Implementation

Upon successful testing, the MIS was implemented in SMKN 1 and SMKN 3 Banda Aceh. This encompassed the installation of the MIS, configuration of system settings, and the provision of necessary training sessions for end-users to familiarize themselves with the system's functionalities. As part of our commitment to user-centered design, feedback mechanisms were established to gather insights from students, teachers, and

administrators during the initial stages of implementation. This iterative approach allowed for real-time adjustments, ensuring that the MIS aligned seamlessly with the daily operations and requirements of the vocational schools.

2.1.6. Maintenance

Post-implementation, the maintenance phase focused on continuous monitoring, updates, and addressing any issues that arose during the initial use of the MIS. This iterative process aimed to ensure the system's sustainability and adaptability to evolving educational requirements. Regular and systematic monitoring allowed for the identification of potential challenges or areas requiring enhancement, ensuring a proactive response to the evolving needs of the educational environment. Updates and patches were implemented judiciously to address any reported issues and to enhance the system's functionality. An integral aspect of this phase involved soliciting feedback from end-users, including students, teachers, and administrators, fostering an environment of collaborative refinement. This iterative process aimed not only to rectify immediate concerns but also to refine and adapt the MIS to the dynamic landscape of educational requirements. By prioritizing sustainability and adaptability, the maintenance phase sought to contribute to the long-term success of the MIS, ensuring its continued effectiveness and alignment with the evolving educational landscape in Banda Aceh.

2.2. Usability Testing

To conduct usability testing, we employed purposive sampling to select our participants, focusing on those who are directly engaged with the MIS. Our sample included 15 students, 5 teachers, and 5 administrators from each SMKN 1 and SMKN 3, with total 50 samples. This diverse group was chosen to provide a broad perspective on the system's usability across different user types. We implemented an online usability testing approach using Google Forms for the questionnaire administration. We also provided written instructions and created video tutorials as user guidance. To ensure a comprehensive grasp of the MIS functionality, participants were granted access to a dummy system, allowing them to interact with and navigate through the interface in a simulated environment.

Our questionnaire consisted of 16 statements, each aiming to capture various aspects of the system's usability and user satisfaction [13]. We employed a Likert scale for responses, with a range from 1 (strongly disagree) to 5 (strongly agree). This scale enabled participants to express their level of agreement or

Table 1. Questionnaire statements.

ID	Statements
S1	I am satisfied with using this system.
S2	It is easy to use this system.
S3	I can quickly complete tasks and scenarios using this system.
S4	I feel comfortable using this system.
S5	The system's interface is very user-friendly.
S6	I believe I can become productive quickly using this system.
S7	Error messages in this system provide clear instructions for fixing issues.
S8	Whenever I encounter errors in using the system, I can easily and quickly resolve them.
S9	The information provided with this system is clear.
S10	It is easy to find the information I need.
S11	The information is effective in helping me complete tasks and scenarios.
S12	The sequence of displayed information is clear.
S13	The system interface is enjoyable.
S14	I like using the system interface.
S15	This system has all the data management functions and displays information I expect.
S16	Overall, I am satisfied with the existence of this system.

Table 2. Results of reliability test.

Number of Items	Cronbach's Alpha		Conclusion
	Estimation Value	Minimum Value	
16	0.980	0.700	Reliable

disagreement with each statement, providing a comprehensive understanding of their experience with the system. The statements are presented in Table 1. These statements are carefully crafted to measure the user's satisfaction, ease of use, effectiveness in task completion, and overall experience with the MIS interface.

To assess the reliability of our usability questionnaire, we conducted a reliability test using Cronbach's Alpha. This statistical test is designed to measure the internal consistency of the questionnaire, ensuring that the items on the questionnaire are closely related as a group and thus reliable for our study [14].

2.3. Data Analysis

We commenced our analysis with descriptive statistics, which provided a fundamental understanding of the data. This involved calculating measures of central tendency such as mean, median, mode, alongside measures of variability like standard deviation, range, and variance. These statistics offered us a comprehensive overview of the data's general characteristics, highlighting any significant patterns or anomalies.

Next, we explored frequency distribution, which allowed us to visualize how often each value in our dataset occurred. This analysis was crucial in identifying common trends and patterns within the data, lending insight into the most prevalent values and any potential outliers.

Finally, we conducted a correlation analysis to examine the relationships between different variables in our

dataset. This analysis helped us to identify any statistically significant associations between variables. We calculated the Pearson correlation coefficient for pairs of variables, providing a measure of the strength and direction of their linear relationship. This part of the analysis was instrumental in understanding the interconnectedness of various factors and their combined impact on the outcomes of our study.

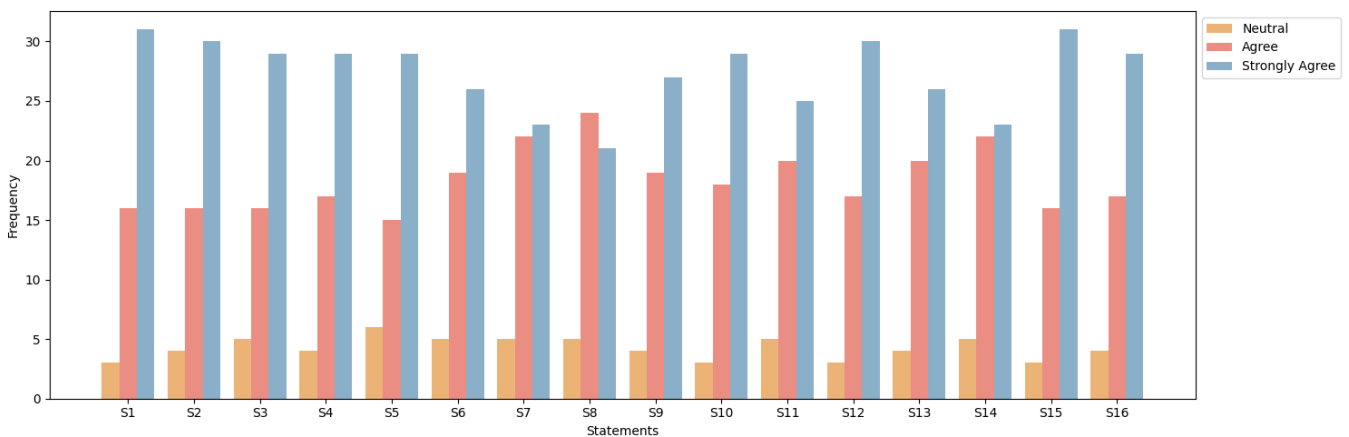
3. Results and Discussion

3.1. Reliability Test

The reliability of the questionnaire was evaluated using Cronbach's Alpha, a widely recognized measure of internal consistency. The standard benchmark for reliability in such tests is a Cronbach's Alpha value greater than 0.7 [15]. This threshold indicates a high level of internal consistency among the questionnaire items, implying that the indicators used are reliable and measure the intended construct effectively. Based on the reliability test results, as detailed in Table 2, the Cronbach's Alpha value for the 16 statements in our questionnaire is estimated to be 0.980. This value significantly exceeds the minimum standard coefficient of 0.700. It can be conclusively stated that the questionnaire is highly reliable. The Cronbach's Alpha value of 0.980 indicates a very strong internal consistency among the questionnaire items. This high level of reliability ensures that the responses to the questionnaire are consistent and dependable, providing robust data for our analysis of the MIS's usability in educational institutions. The results affirm the

Table 3. Descriptive statistics.

Statements	Mean	Median	Mode	Std. Dev	Min	Max
S1	4.56	5	5	0.61	3	5
S2	4.52	5	5	0.65	3	5
S3	4.48	5	5	0.68	3	5
S4	4.5	5	5	0.65	3	5
S5	4.46	5	5	0.71	3	5
S6	4.42	5	5	0.67	3	5
S7	4.36	4	5	0.66	3	5
S8	4.32	4	4	0.65	3	5
S9	4.46	5	5	0.65	3	5
S10	4.52	5	5	0.61	3	5
S11	4.4	4.5	5	0.67	3	5
S12	4.54	5	5	0.61	3	5
S13	4.44	5	5	0.64	3	5
S14	4.36	4	5	0.66	3	5
S15	4.56	5	5	0.61	3	5
S16	4.5	5	5	0.65	3	5

**Figure 1.** Frequency distributions for each statement.

questionnaire's effectiveness in accurately capturing user perceptions and experiences with the MIS.

3.2. Results of Data Analysis

In the descriptive statistics presented in Table 3, the analysis of the usability questionnaire reveals a predominantly positive response towards the MIS across all statements. The mean scores, mostly above 4.4, indicate high user satisfaction. The median and mode values frequently peak at 5, reflecting a consensus on the system's effectiveness and ease of use. Standard deviations range from 0.61 to 0.71, suggesting a uniformity in responses with minimal variation. The minimum score of 3 and a maximum of 5 across all statements further highlight that even the lowest ratings are moderately positive, indicating no significant negative feedback. This uniformity in high scores across various measures points to a well-received and effective MIS in educational settings.

The frequency distribution presented in Figure 1

illustrates the responses for each statement. A visual inspection suggests that for nearly all statements, 'Strongly Agree' (rating of 5) is the most frequent response, indicating a very positive reception of the MIS by the users. Statements S1, S2, S3, S4, S5, S9, S10, S12, S15, and S16 show a particularly high frequency of '5' ratings, reinforcing the notion that users are generally satisfied and find the system user-friendly and effective. Ratings of '4', which indicate agreement but not as strongly, also have a significant presence across all statements, suggesting that while most users are satisfied, there is a subset of users who see room for improvement. The '3' ratings, which suggest neutrality, appear less frequently. This indicates that there are fewer respondents who are indifferent or have a neutral stance towards the system.

The correlation matrix presented in Figure 2 visualizes the pairwise correlations between different statements based on users' responses. Each cell in the matrix represents the Pearson correlation coefficient between

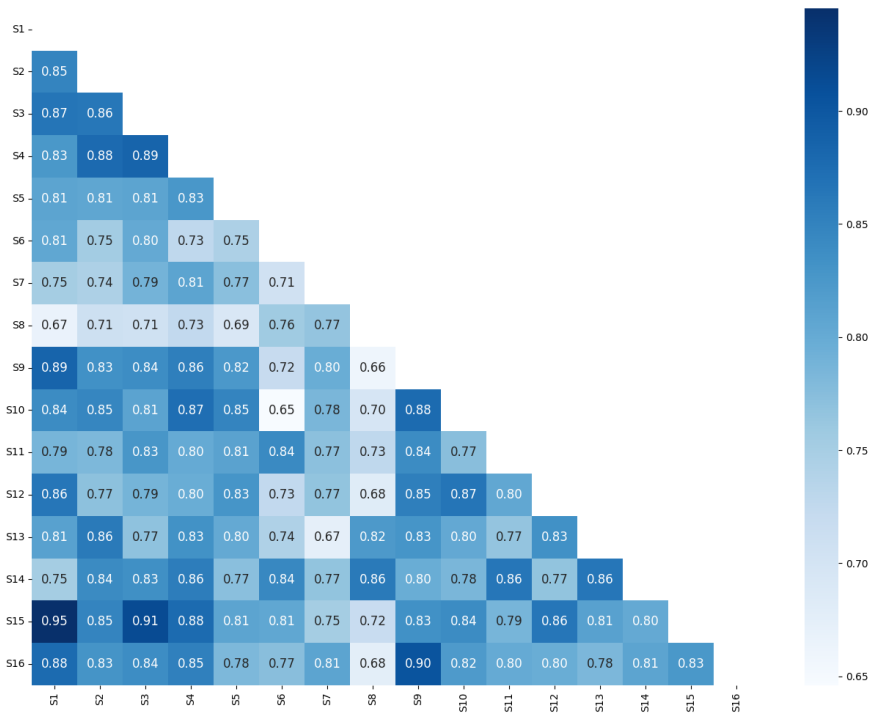


Figure 2. Correlation matrix for each statement.

two statements, ranging from 0.65 to 0.95, where 1 would mean a perfect positive correlation and 0 no correlation. The highest correlation is between S15 and S1 (0.95), suggesting that users who are satisfied with the system overall (S1) are also highly likely to agree that the system has all the data management functions and displays information they expect (S15). This indicates a strong relationship between overall satisfaction and perceived completeness of the system. The lowest being 0.65 between S10 and S7, but even the weakest correlation is relatively strong, indicating that there are commonalities in how users perceive different aspects of the system. There are no negative values, meaning there are no inverse relationships where an increase in agreement with one statement corresponds with a decrease in agreement with another.

The overall results from the descriptive statistics, frequency distribution and correlation matrix, collectively indicate a highly positive reception of MIS by its users in educational settings. The consistent high mean scores, with a median and mode often at the scale's peak, reflect a general consensus on the system's efficacy and usability. The minimal variation in responses, as suggested by the tight standard deviations and the absence of low ratings, points to a uniformly positive user experience. The high usability scores suggest that well-designed MIS can significantly enhance user satisfaction and operational efficiency. However, the study is not without limitations. The use of purposive sampling may limit the generalizability of the results, as the participants

may not represent the entire population of MIS users. Additionally, the study focused on a limited number of institutions, which may affect the applicability of the findings across different educational contexts.

Future studies could expand the research to include a larger and more diverse sample to increase the generalizability of the results. Longitudinal studies could also provide insight into how user satisfaction with MIS evolves over time. Moreover, incorporating qualitative methods could give a deeper understanding of user experiences and identify specific features that enhance or detract from usability. Finally, exploring the impact of MIS integration on educational outcomes would be a valuable area of research, providing evidence on the system's effectiveness in supporting educational objectives.

4. Conclusions

The study's conclusion underscores the successful development and implementation of a MIS in vocational schools in Banda Aceh, Indonesia. The systematic approach, encompassing field analysis, user-centric design, development, rigorous testing, and thoughtful implementation, culminated in a MIS that was highly commended by its users - both students and teachers. The usability testing, conducted with a purposive sample of participants, revealed high satisfaction levels and efficiency in system use, as indicated by the robust Cronbach's Alpha value and favorable descriptive statistics. Despite some limitations in sample

representativeness and scope, the study demonstrates the substantial benefits of integrating well-designed MIS in educational settings. It highlights the potential of MIS to enhance administrative efficiency, streamline educational processes, and improve overall learning experiences. The findings encourage further exploration into the long-term impact of MIS on educational outcomes and suggest the possibility of expanding research to broader contexts for more generalized insights.

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