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RESEARCH ARTICLE

Design and Implementation of Laboratory Equipment Information System: A Case Study at SMK 1 Sigli

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Abstract
This research discusses the design and implementation of an information system for laboratory equipment management at SMK 1 Sigli, specifically in the Fashion Design department. Manual management of laboratory equipment often leads to inefficiencies and errors in data recording. To address these issues, a computer-based system was developed using Microsoft Visual Basic and Microsoft Access, replacing the previously used Microsoft Excel-based system. The system automates several processes, such as data entry, equipment tracking, and report generation, improving operational efficiency. A needs analysis was conducted with laboratory managers to ensure the system design met the operational requirements. The development process included creating a user-friendly interface and an organized database structure. As a result, the system enables real-time monitoring of equipment, reduces errors, and speeds up decision-making related to maintenance and procurement. Feedback from laboratory staff indicates that the system successfully improves the accuracy and efficiency of equipment management. This research provides a practical solution that can be applied to other schools facing similar challenges in laboratory resource management.

Keywords
Information System; Laboratory Equipment Management; Visual Basic; Microsoft Access; SMK 1 Sigli; Fashion Design, Automation.

1 | INTRODUCTION

The rapid advancement of information technology has significantly impacted various sectors, including education. Technology plays a crucial role in improving the efficiency and effectiveness of data management, particularly when it comes to managing laboratory equipment in schools. In vocational education institutions like Vocational High Schools (SMK), proper management of laboratory tools is essential for supporting learning activities, especially in specialized fields like Fashion Design. In many schools, the management of laboratory equipment is still handled manually, which often leads to inefficiencies, inaccuracies, and challenges in tracking the tools. These issues can disrupt the learning process and affect the quality of education. By integrating information systems, schools can automate many of these tasks, making data handling faster and more accurate. For SMK, implementing a computerized system for managing laboratory equipment can improve operational efficiency. Tasks such as tracking equipment, managing inventory, and generating real-time reports become easier, ensuring that the necessary tools are available when needed. This transformation enhances the overall learning environment, making the educational experience more effective. Adopting such a system is vital for improving the quality of vocational education in schools.

Manual management of laboratory equipment at SMK 1 Sigli often leads to various issues. The manual process can cause confusion in tracking the condition of the equipment, inaccurate record-keeping, and low efficiency. Research indicates that manual systems increase the potential for human error and slow down operational speed (Setiawan, 2020). Therefore, implementing a computer-based information system becomes an effective solution, as it can automate various processes and improve data management accuracy (Ramadhan *et al*., 2020). The use of an information system allows for better tracking of laboratory equipment, reducing errors and improving overall efficiency. By automating data entry and real-time monitoring, such systems ensure that all equipment is accounted for and properly maintained. This leads to a more organized and efficient environment, ultimately enhancing the learning process. In vocational schools like SMK 1 Sigli, adopting such a system is crucial to improving administrative operations and supporting educational activities. The ability to quickly retrieve accurate data enables better decision-making and streamlines daily tasks. As a result, the shift from manual processes to a computer-based system significantly contributes to both the operational efficiency and the quality of education provided.

By implementing software such as Microsoft Visual Basic and Microsoft Access, laboratory equipment management becomes more efficient and organized. Previous studies have explored the use of Visual Basic in information technology to handle data more easily and accurately. The system assists with data entry, tracking equipment conditions, and generating reports that are accessible quickly, making the entire process more efficient (Kalwar *et al*., 2022). A well-designed user interface greatly influences the ease of use and effectiveness of the system, enabling users to update data more quickly and accurately (Suwanda *et al*., 2023). The clear and intuitive interface ensures that users can perform tasks with minimal training, leading to smoother operations and better management of laboratory resources. With real-time updates and immediate access to essential information, the system significantly reduces time spent on manual data entry and tracking. As a result, adopting this system enhances accuracy, efficiency, and productivity in managing laboratory equipment. The shift from manual methods to a computerized system not only meets the operational needs of educational institutions but also improves the overall teaching environment by providing the necessary tools and resources for effective instruction.

The first step in designing this system is to conduct a clear needs analysis by coordinating with laboratory managers and users. Collecting this information is essential to ensure that the developed system meets the existing operational needs. Following this, the system design, including the user interface and database structure, can be developed with an emphasis on accessibility and data maintenance (Moselhi, 2011). A user-friendly interface and well-organized database are critical to ensuring that the system is easy to navigate and that data can be updated quickly and accurately. Comprehensive system testing is required to ensure that the system functions as expected and addresses the issues faced by laboratory managers. Testing will help identify any potential flaws in the system and allow for necessary adjustments before implementation. It is crucial that the system meets the operational demands of the laboratory, making tasks such as equipment tracking, data entry, and reporting more efficient. Once the system has been tested and adjusted, it can be deployed, providing the laboratory with a more reliable and effective method for managing equipment. The successful implementation of the system will improve the accuracy, efficiency, and overall management of laboratory resources, benefiting both users and administrators alike.

With proper evaluation, the use of a system based on Microsoft Visual Basic and Access will help improve the accuracy of record-keeping and tracking, as well as accelerate decision-making related to the management of laboratory equipment (Sugiharto *et al*., 2021). This system provides a streamlined and efficient method for monitoring equipment, making it easier to track the condition, availability, and usage of each item. By automating various aspects of the management process, it reduces the risk of human error and ensures that data is updated in real-time, allowing for more reliable reporting. The implementation of this system can significantly enhance the efficiency of laboratory equipment management at SMK 1 Sigli. It allows for quicker and more accurate tracking of assets, which leads to better

inventory control and improved resource allocation. The system also provides valuable insights into equipment usage patterns, helping to make informed decisions about maintenance, replacements, and purchases. By automating tasks such as data entry and report generation, the system minimizes administrative workloads, giving staff more time to focus on other critical tasks. As a result, the overall management process becomes more efficient, reducing delays and improving the overall quality of laboratory operations at the school.

This research aims to provide practical solutions for the issues related to laboratory equipment data management at SMK 1 Sigli. It also explores how information systems can be used to improve efficiency in other educational institutions with similar needs. By adopting a computerized system, laboratory equipment management can be streamlined, reducing errors and enhancing operational efficiency. The results are expected to serve as a reference for other schools seeking to implement technology for better resource management. The use of an efficient system ensures more accurate tracking and reporting, enabling quicker decisions regarding equipment maintenance and usage. Furthermore, the study emphasizes the importance of tailoring technological solutions to meet the specific needs of educational institutions, making sure the system addresses operational challenges and improves overall productivity. Ultimately, the research aims to support better management of resources in vocational schools.

2 | BACKGROUND THEORY

Information Systems (IS) play a key role in managing laboratory equipment in educational institutions, especially in vocational schools (SMK), by addressing challenges caused by manual processes. Manual management often results in inaccurate record-keeping, difficulties in tracking equipment conditions, and delays in retrieving data, which disrupt the smooth running of practical sessions (Syafrizal *et al*., 2021). A computer-based information system, designed through careful needs analysis, user interface design, and database structure, offers an effective solution to improve both the accuracy and efficiency of laboratory inventory management (Darmanto *et al*., 2022; Wali, 2020). By automating tasks, such a system ensures real-time updates, simplifies equipment tracking, and speeds up report generation. The approach reduces human error and enhances productivity, allowing staff to interact with the system with ease. The system's ability to provide accurate, organized data enables better decision-making and streamlines the management process. Adopting a computer-based information system improves operational efficiency, supporting better management practices and enhancing the overall educational experience in vocational schools (Mahendra *et al*., 2022).

In the needs analysis phase, involving users and laboratory managers directly is essential to define the problems and system requirements. Studies have shown that a participatory approach from stakeholders helps create a system that is more relevant and easier to operate (Suardinata & Prasetyo, 2023; Wali, 2017). The approach ensures the system aligns with actual user needs and effectively addresses existing challenges in operations. The design phase includes developing an intuitive user interface and an organized database structure, which speeds up data entry, monitoring, and updates compared to manual methods (Triyanto, 2019). A well-designed interface enhances the user experience, making it simpler for staff to interact with the system, while an efficient database ensures that data is processed and stored accurately. The streamlined process minimizes the risk of errors and significantly reduces time spent on administrative tasks. Focusing on the users' needs and ensuring the system is easy to navigate results in a more effective solution that aligns with the laboratory's operational goals. The approach leads to better management of laboratory resources, improving overall efficiency and ensuring smoother operations in the long run (Wali, 2018).

The implementation of a computer-based system using software such as Microsoft Visual Basic 6.0 and Microsoft Access 2007 enables the integration of various components into a single, connected platform. The system not only streamlines data processing but also provides real-time reporting features that support accurate decision-making (Wati *et al*., 2023; Alfaris *et al*., 2022). By offering real-time data updates and easy report generation, the system ensures that laboratory managers and staff can access the most current information, improving operational efficiency and decision-making. Studies have shown that laboratory inventory systems, particularly those based on web or mobile platforms, help reduce human errors and decrease the time spent searching for data. The situation leads to faster operational processes and enhances the smooth flow of activities in vocational school laboratories (Ramdan *et al*., 2019). The automated approach simplifies administrative tasks, making data updates, access, and management quicker and more accurate than manual methods. By adopting such systems, schools can improve resource management, minimize errors, and create a more efficient environment for teaching and learning. Transitioning to automated data management is crucial for enhancing the overall performance and technological capabilities of educational institutions (Wali *et al*., 2023).

The implementation of information systems in laboratories aligns with the trend of improving asset management quality in educational institutions. The advantages of computer-based systems, which provide accurate and easily accessible data, have enhanced administrative effectiveness and supported optimal practical activities. The fact is illustrated in studies related to laboratory inventory management and equipment maintenance (Kristiyanto *et al*., 2021;

Wijayanto *et al*., 2022). By streamlining data processing and improving data accuracy, these systems enable better monitoring and management of resources, ensuring that laboratory tools are always available and in good condition for students and instructors. As a result, the shift from manual to computerized systems not only simplifies operational tasks but also has the potential to improve the quality of vocational education. Efficient management of laboratory equipment leads to better resource allocation, reducing downtime and ensuring that learning materials are always ready for use. The transformation allows educational institutions to focus more on enhancing teaching quality while maintaining smooth operations. By adopting information systems, schools can address the challenges of manual management, improve the accuracy of their inventory records, and ultimately create a more effective learning environment that benefits both educators and students (Wali, 2020).

The adoption of computer-based information systems (IS) in vocational schools (SMK), particularly in laboratory equipment management, is a strategic step to enhance data accuracy, administrative efficiency, and support better operational decision-making. Several studies have demonstrated that integrated information systems, designed through a participatory approach, can overcome the challenges of manual management, leading to significant improvements in learning quality (Setiawan *et al*., 2021; Mahendra *et al*., 2022). By automating processes such as data entry, tracking, and reporting, these systems reduce human error and improve the overall management of laboratory resources. The automation not only makes the operations more efficient but also ensures that equipment is maintained properly and available when needed, directly benefiting both instructors and students. Moreover, the ability to access accurate and real-time data supports faster and more informed decision-making regarding equipment maintenance, replacements, and procurement. The transformation from a manual to a computerized system allows educational institutions to allocate resources more effectively and streamline daily tasks. Ultimately, the implementation of such systems contributes to a more organized and productive learning environment, enhancing the overall educational experience and ensuring that the school's resources are managed efficiently (Wali, 2017).

With the system, laboratory managers can easily track available equipment, monitor its status in real-time, and generate accurate and timely reports. It reduces dependence on manual record-keeping, which is prone to errors, and speeds up the management and monitoring processes. By automating tasks like data entry and updates, the system ensures that information about equipment is always current, improving both efficiency and accuracy. In addition, the system assists in decision-making regarding equipment maintenance and procurement, allowing for more informed and quicker actions (Alfaris *et al*., 2022). The ability to evaluate the condition and inventory levels of equipment enables managers to make better decisions on repairs, replacements, and purchases. When implemented properly, the system enhances the overall management of laboratory tools, creating a more organized workflow. As a result, the educational process becomes more effective, with instructors and students able to focus on teaching and learning rather than operational issues. The streamlined management ultimately supports a more efficient and productive learning environment (Wali, 2018; Wali *et al*., 2023).

3 | METHOD

This research focuses on the design and implementation of a computer-based system for laboratory equipment management at SMK 1 Sigli. The research methodology involves several key stages, from feasibility studies to system development and testing.

1) Feasibility Study
   The initial step involves gathering and documenting data to understand the existing manual system used for equipment management. A feasibility study was conducted to evaluate whether the existing system could be replaced or improved with a new, more efficient system. This study takes into account the factors that affect the ability of the system to meet the intended objectives.
2) Preliminary Plan
   The next stage includes conducting a preliminary study to understand the system's scope, the type of information required, and the expected outcomes. This phase also provides an initial assessment of the costs and time required for implementation. The goal is to clarify user expectations and define the system's operational requirements.
3) System Analysis
   This phase involves gathering detailed requirements from all system components, including users, software, and hardware. Data was collected through interviews and direct consultations with laboratory staff to determine the specifications for the software and hardware components required for system development.
4) System Design
   The system design phase focuses on creating an intuitive user interface and structuring the database to ensure smooth data entry, monitoring, and updates. A detailed design of the system’s structure was created, which included the login form, main menu, user management, and inventory tracking for laboratory equipment.

5) System Implementation
After designing the system, it was developed using Microsoft Visual Basic 6.0 for the user interface and Microsoft Access 2007 for database management. The system was then tested for functionality and ease of use, ensuring that it meets the needs of laboratory managers and users.
6) Testing and Evaluation
The system underwent thorough testing to evaluate its functionality, user interface, and database management capabilities. Feedback from laboratory staff was collected to ensure the system's effectiveness in improving the accuracy and efficiency of equipment management. The final phase included evaluating the system's impact on daily operations and its ability to improve decision-making related to equipment maintenance and procurement.

4 | RESULTS AND DISCUSSION

4.1 Reults

4.1.1 System Development

System development refers to the process of changing, replacing, or reorganizing an existing system into a new one, either partially or entirely, to improve the current system in use. In a dynamic organization, system development is a crucial step aimed at improving the mechanisms or work systems within the company. The goal is to integrate all aspects into a unified system or set of regulations. The focus of this development is on transforming an old, conventional system into a more modern and integrated system, utilizing computerized tools that make data processing easier and generate high-quality information. This improved system plays an essential role in decision-making at the managerial level within the organization. After gathering data and documenting facts, system analysts assess the current system's functionality. Following this, a feasibility study is conducted to determine whether the organization or institution can proceed to the next phase of system development. This study provides an overview of the key factors that will influence the system's ability to meet the intended objectives. The initial phase of system analysis involves conducting a preliminary study to understand the type, scope, and general understanding of the information technology system project. This phase provides an initial system framework, including cost and time estimates. The objectives are to clarify user expectations and define the system's operational requirements. The analysis phase focuses on gathering requirements from all system components, including users, software, and hardware. Information is collected through direct interviews with users, and specifications for software and hardware to support the system's development are defined. The design phase aims to meet user needs by providing a clear plan for the system that will be developed and implemented. Database design is a key component of this stage, focusing on new data processing approaches that fulfill all user requirements. The system's structure includes elements like the login form, main menu, and exit menu.This stage involves setting up the system for operation. The implementation process also involves replacing the old system with the new one. A strategic approach is required to ensure a successful transition from the old system to the new system.

4.1.2 System Design

The information system designed for SMK 1 Sigli includes features for fast data entry, which significantly improves the workflow within the institution. The design of the system aims to enhance the information management procedures involved in data processing. This system for managing laboratory equipment in the Fashion Design department was developed using Microsoft Access 2007 and Microsoft Visual Basic 6.0, replacing the previously used Microsoft Excel 2007. The steps in creating the system include several important phases. The first step is to create the program folder. This is done by right-clicking on Start, selecting Explorer, navigating to Drive "D", creating a new folder, and naming it "Aplikasi Alat Laboratorium Tata Busana." The second phase involves creating a project in Microsoft Visual Basic 6.0. After opening the program and selecting New Project, the user selects the Standard EXE option and clicks "Open." The next step is the creation of the database. The database is created by selecting the "add_inss" option from the menu, followed by selecting the Visual Data Manager. In the VisData window, a new database, "DBAlat Laboratorium Tata Busana.mdb," is created. The necessary fields for the database are defined, and after all fields are added, the table is built. The database consists of two tables and five form objects, with the table structure for the Admin and Equipment Data shown below. For instance, the Admin Data Table contains fields such as "Kode_Admin" (Primary Key), "Username," and "Password." The Equipment Data Table includes fields like "Nomor," "Nama Ruang," and several other fields related to the condition of various equipment such as sewing machines and irons. Form design includes several types, such as the Login Form, which serves as protection for program access. If the username and password match, the main menu is displayed, providing access to all available menu options for the user.

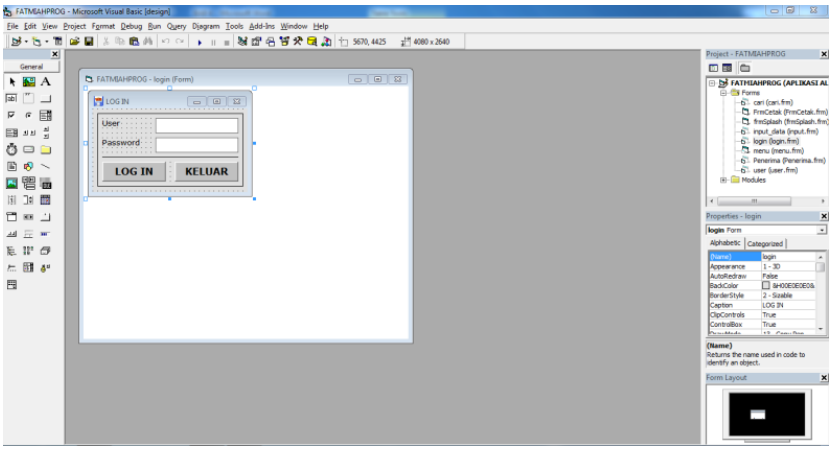

Figure 1. Login Form

The main menu is designed to serve as the entry point for accessing all the submenus within the program. It acts as the central navigation interface, allowing users to seamlessly move between different sections of the system. The form includes multiple menu options, each crafted to offer users quick access to the system's features. The layout of the main menu form is structured with various components, such as a toolbar and an image list, to enhance navigation and visual clarity. The toolbar provides convenient shortcuts for accessing key features, while the image list is used to display icons that represent different actions. The status bar, located at the bottom, displays helpful information, ensuring users are informed of the system's current status. This design allows for efficient and intuitive navigation, ensuring that all submenus are easily accessible. By organizing the interface in this way, the main menu form enhances the user experience, making it simpler for users to interact with the system and find the tools they need. The design prioritizes functionality and ease of use, supporting smooth transitions between different parts of the application.

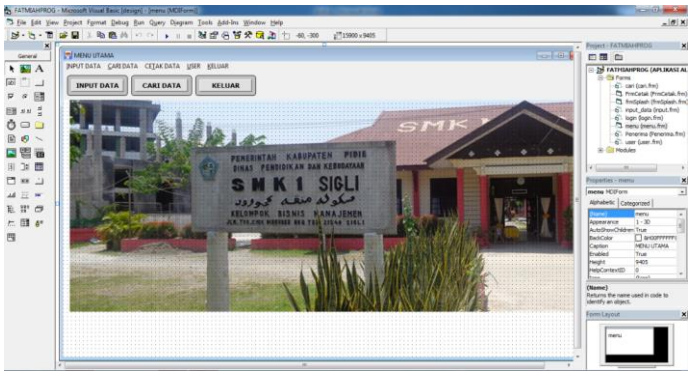

Figure 2. Main Menu Form

The user form is designed to input data related to users or operators of the Laboratory Equipment Management System for Fashion Design. It allows users to enter and manage essential user details effectively. The form includes labels for fields such as "Input User Data," "Name," and "Password," as well as textboxes for data entry. Command buttons such as "New," "Save," "Delete," and "Exit" are provided to perform different actions. The design ensures that all fields are easily accessible, offering a smooth experience when entering or updating information. The simple interface facilitates efficient management of user data, ensuring the system remains user-friendly. The laboratory equipment form is created to handle data related to the Fashion Design department's tools. It includes fields like "Number," "Room Name," and various equipment such as sewing machines, presser machines, and irons. The form consists of textboxes for data input and command buttons like "New," "Save," "Cancel," "Edit," "Delete," and "Print." These features allow for efficient tracking and management of the equipment, helping keep everything organized and up-to-date.

The search form helps users quickly find specific laboratory equipment data. It features search options like "Search By Equipment Number" or "Search By Equipment Name," with corresponding textboxes for input. The command buttons, including "Clear," "Display," and "Exit," make the search process easy and efficient. This design streamlines the search experience, making it simple to locate necessary equipment details. The output report for laboratory equipment uses 12 text objects, providing a clear layout to display the relevant data. The report is

structured to present all necessary information in a way that is easy to interpret, helping with decision-making and the efficient management of laboratory equipment.

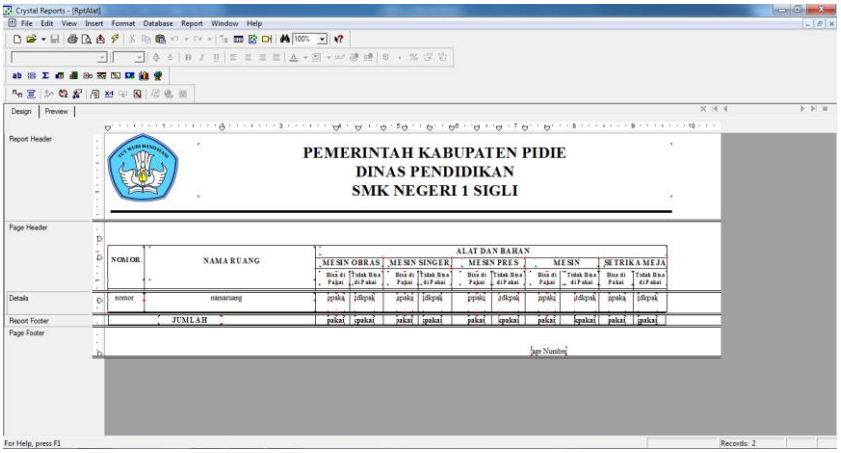

Figure 3. Laboratory Equipment Report for Fashion Design

The Laboratory Equipment Report for Fashion Design at SMK Negeri 1 Sigli outlines the available tools and materials in the laboratory. It includes various equipment such as sewing machines (Mesin Obaji and Mesin Singer), pressing machines (Mesin Press), and ironing tables (Meja Setrika). The report specifies the quantity of each item, ensuring that the laboratory is properly equipped for hands-on training. This inventory enables effective management of the lab, providing students with the necessary tools for design and production work. The detailed list ensures that all required equipment is available for student use during practical sessions.

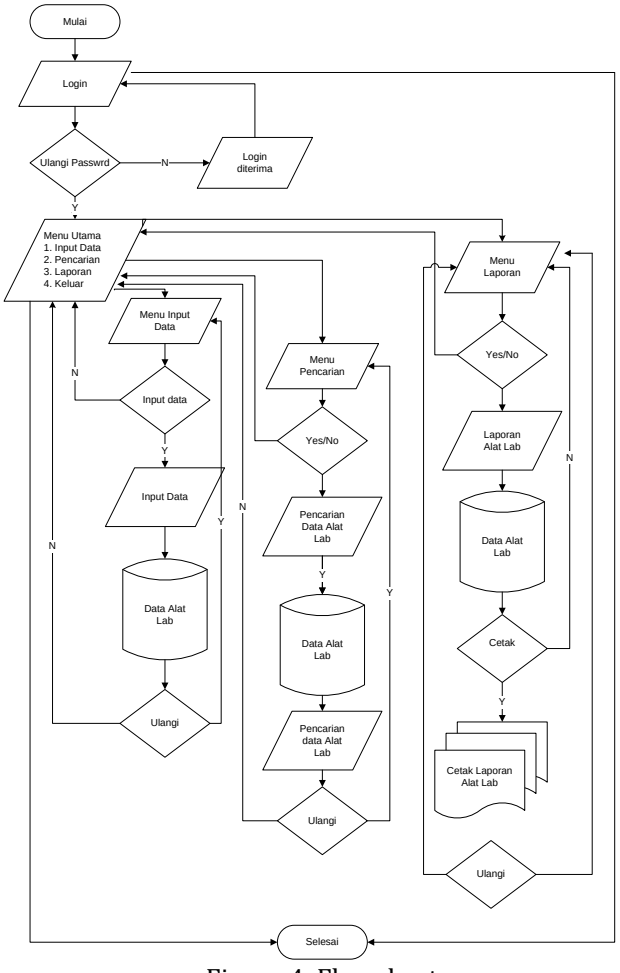

Figure 4. Flowchart

The flowchart outlines a system for managing laboratory equipment data. Users begin by logging in with their credentials. If the login is incorrect, they are prompted to try again. After a successful login, the main menu offers four options: Data Input, Search, Report Generation, and Exit. In the Data Input section, users can enter new equipment information into the system. The Search section allows for quick retrieval of stored equipment data. If results are found, they are displayed. The Report Generation section enables users to create and print reports about the laboratory equipment. This process ensures smooth data entry, retrieval, and reporting within the system.

4.2 Discussion

System development involves transforming existing systems to meet current needs and improve performance. In an organization, it is essential to enhance workflows and integrate various components into one cohesive system. Modernizing outdated systems into computerized ones is key to improving data processing, which in turn helps generate more accurate information for decision-making. Research by El-Omari and Moselhi (2011) shows how automation enhances efficiency by integrating data acquisition technologies in construction projects, a principle that also applies to system development in other fields. The development process begins with collecting data about the existing system, which is followed by an assessment to determine its strengths and weaknesses. A feasibility study is then conducted to evaluate whether the organization can proceed with the development. Setiawan (2020) emphasizes that this step is critical in determining whether the new system can meet the organization's goals. The analysis phase focuses on gathering requirements from all system components, including users, software, and hardware. This ensures that all aspects of the system align with user needs. The design phase follows, where the system's structure and database layout are outlined to meet those needs. The final implementation phase involves replacing the old system with the new one, requiring a strategic approach to ensure a smooth transition.

The system designed for managing laboratory equipment at SMK 1 Sigli's Fashion Design department uses Microsoft Access 2007 and Visual Basic 6.0. It replaces the previous Microsoft Excel 2007 system, improving both workflow and data entry speed. As seen in Ramadhan *et al*. (2020), tools like Visual Basic for Applications (VBA) significantly enhance system design by simplifying data management tasks. The design process begins by setting up the program folder and creating a new project in Visual Basic 6.0. A database is created using Visual Data Manager in Microsoft Access, where tables such as Admin Data and Equipment Data are defined. The Admin Data table contains essential user information, while the Equipment Data table stores details about laboratory tools, such as sewing machines and irons. User interface design is a key feature of the system, ensuring easy navigation and accessibility. The Login Form secures the system, allowing only authorized users to access it. After logging in, users can access the Main Menu Form, which serves as the hub for all system functions. The main menu includes a toolbar for quick access to frequently used features and an image list to enhance navigation. This design ensures that users can easily transition between different sections of the system. The User Form and Laboratory Equipment Form simplify the management of user and equipment data. These forms allow users to enter, update, or delete data easily. The Search Form provides an efficient way to find specific equipment by searching based on parameters like equipment number or room name, improving user experience and operational efficiency. The system also generates Output Reports that display relevant laboratory equipment data. These reports are designed to be clear and easy to interpret, supporting decision-making and helping manage the laboratory's resources more effectively. The design approach follows principles outlined by Kalwar *et al*. (2022) on the importance of user-friendly interfaces, ensuring that the system is efficient and effective in its role.

5 | CONCLUSIONS AND FUTURE WORK

The implementation of the laboratory equipment management system at SMK 1 Sigli has successfully transformed the management process from manual methods to an automated, computer-based approach. The system, built using Microsoft Visual Basic and Microsoft Access, has streamlined key tasks such as data entry, equipment tracking, and report generation. By automating these tasks, the system has improved the efficiency of laboratory operations, reduced human errors, and ensured more accurate records. Real-time monitoring allows for faster decision-making regarding equipment maintenance and procurement, contributing to better resource management and supporting the educational process. User feedback confirms that the system is easy to navigate and effective in meeting the operational needs of the laboratory. The interface is simple to use, reducing the need for extensive training, while the database structure is organized to make information easily accessible. The system has also reduced administrative workloads, allowing laboratory staff to focus on more critical tasks. However, there are opportunities for further enhancement. One area for improvement could be the integration of a mobile application, providing remote access to equipment data and facilitating easier management. Implementing automated maintenance reminders and usage tracking would enable a more proactive approach to

managing equipment. Additionally, expanding the reporting features to include predictive maintenance data or detailed usage analysis could provide valuable insights for decision-making. Future work should also explore the potential to adapt the system for use in other vocational schools, expanding its reach and impact. By continuing to refine and develop the system, schools can further optimize resource management and improve the quality of education provided to students.

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