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Design and Development of a Digital Library System Using PHP For Optimizing Library Services at SMK Negeri 1 Luragung

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ABSTRACT

This study aims to develop a PHP-based digital library system as a solution to the conventional library service problems at SMK Negeri 1 Luragung. The existing manual processes for borrowing and returning books make it difficult to track collections accurately and reduce overall operational efficiency. To address these issues, this research adopts a Research and Development (R&D) model using the ADDIE approach, which consists of five systematic stages: Analysis, Design, Development, Implementation, and Evaluation. At the analysis stage, library needs and user problems were identified. The design stage involved creating system flowcharts, database structures, and interface mockups. During development, a web-based application was built using PHP and MySQL with key features such as member management, book collection management, borrowing and returning modules, and QR code integration for faster transactions. The system was then implemented and tested with actual users. The evaluation was carried out using the Usability (USE) Questionnaire, focusing on usefulness, ease of use, ease of learning, and user satisfaction. The results showed significant improvements in accessibility, transaction efficiency, and overall user experience. Based on these findings, the developed system is considered feasible and highly suitable for implementation as a digital solution for school library management.

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1. Introduction

In modern education, libraries play a vital role as centers of information and learning resources for both students and teachers. A library is not merely a place for storing books, but also serves as a medium for developing students' insights, creativity, and character. Especially at the vocational high school (SMK) level, libraries can become key supporters in equipping students with literature relevant to their areas of expertise. The school is also considered a second home for students, where they spend a significant amount of their

effective time; therefore, it must provide not only physical comfort but also psychological well-being. Psychological comfort is essential for students to foster a positive perception of the school environment [1]. Education that emphasizes literacy development is crucial to creating students who are not only academically intelligent but also possess critical and creative thinking skills [2]. However, at SMK Negeri 1 Luragung, library services are still conducted manually. Recording book borrowing and returns is still done manually using notebooks or simple Excel files. This method presents various challenges, such as disorganized data, difficulty tracking books, late returns, and the risk of losing collections.

These problems are further exacerbated by the absence of a real-time monitoring system, which often leads to errors in book circulation. For instance, a student from one class can directly hand over a borrowed book to another student without going through the official return process to the library. Another issue faced is the limitation of resources and budget, which prevents the library from using a paid digital system on an ongoing basis. In an interview with the librarian, it was revealed that a paid digital library system had been used previously, but the high subscription cost caused it to be discontinued. Currently, library management has reverted to manual methods, which are unable to meet the demands of a modern and efficient service.

In this context, library digitalization becomes a promising solution. The digitalization of libraries is carried out to meet the increasingly complex information needs of library users, in terms of both quality and quantity [3]. Utilizing information technology such as web-based information systems allows for automated and better-organized collection management, transaction recording, and information access [4]. A digital library system offers numerous benefits, such as time efficiency, ease of access for users, and improved accuracy in data recording [5]. All available data have undergone evaluation, organization, archiving, and storage processes, and can be accessed via standalone computers or an internet network [6]. Therefore, this study aims to design and develop a PHP-based digital library system that addresses the various challenges faced by SMK Negeri 1 Luragung.

The primary goal of this study is to create a lightweight, easily accessible system that meets the needs of its users, including librarians, teachers, and students. This system is expected to support online book borrowing and return processes, simplify collection searches, and provide a user-friendly interface [7]. A digital library is considered significant based on usability criteria, which include measures of search, navigation, form layout, contrast and scan ability, optimization, help, usage of windows, and speed and errors [8]. With a digital library system specifically designed for the needs of secondary schools, it is hoped that students' literacy culture will improve, and the library's role as a learning center will be further optimized.

Several recent studies have focused on developing and implementing digital library systems in schools to enhance literacy and access to learning resources. The use of open source platforms such as Senayan Library Management System (SLiMS) and Koha has become increasingly popular due to their flexibility, scalability, and zero licensing cost [5]. SLiMS is widely used in Indonesian schools and universities because it supports catalog management, member registration, and online circulation. Meanwhile, Koha provides more advanced bibliographic and MARC-based cataloging capabilities suitable for larger institutions [7].

However, both systems require relatively high technical expertise and hosting infrastructure, which may pose challenges for smaller schools with limited resources. Therefore, the PHP based digital library system developed in this study focuses on simplicity, lightweight operation, and ease of customization making it more suitable for secondary education institutions such as SMK Negeri 1 Luragung.

2. Research Method

2.1. Development Model

This study uses the Research and Development (R&D) model to present a technology-based solution for library management at SMK Negeri 1 Luragung. The conventional library at this school still relies on manual recording, which often affects the efficiency of services to students and other users. To address this challenge, a PHP-based digital library system was designed and developed to improve administrative efficiency, meet user needs, and encourage students' interest in utilizing the library as a learning resource.

The Research and Development (R&D) model is a research model used to produce a particular product and test the effectiveness of that product [9]. To produce a particular product, needs analysis research is conducted, and to test the effectiveness of the product so that it can function properly, the final result of this study will produce a product that is feasible for use. This R&D is used to conduct effectiveness testing and efficiency testing [10]. Effectiveness testing is used to prove whether the model is able to achieve the established objectives or not [9].

PHP (Hypertext Preprocessor) is a server-side programming language widely used to build dynamic web applications [11]. PHP can interact with databases, process forms, manage sessions, and display variable content based on user requests. The initial stage begins with a needs analysis, which is conducted through observation, interviews, and documentation studies to identify the features required by users (admin and students). The results of this analysis are then poured into system design.

2.2. Development Procedure

The development procedure in this study follows the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation [12]. This model provides a structured framework to ensure that the PHP-based digital library system is developed effectively and meets user needs at SMK Negeri 1 Luragung. In the Analysis stage, interviews with library staff identified several issues in the conventional system, such as manual loan recording, unorganized book collections, and the absence of digital support. These findings led to the formulation of a system designed to simplify transactions, accelerate book circulation, and improve information access for students and teachers.

The Design and Development stages involved creating flowcharts using draw.io to visualize the system process, which was then implemented using PHP, a dynamic web programming language [13]. The system includes key features such as book loan and return management, member card printing, and e-book access. The interface was designed to be user-friendly, emphasizing ease of navigation and accessibility [14].

Finally, the Implementation and Evaluation stages were conducted after the system was completed. Trials were carried out with students, teachers, and library staff to assess usability aspects ease of use, usefulness, and satisfaction through questionnaires. The evaluation results showed that the system successfully improved information search, transaction efficiency, and overall user satisfaction.

2.3. Data Collection Techniques

Data collection techniques are methods used by the author to obtain the necessary information for the research. In this study, the techniques used include observation, interviews, and questionnaires. Observation, or direct observation of the location and library management processes at SMK Negeri 1 Luragung, was used to obtain initial data that served as the foundation for system design [15]. This observation helped the author identify key elements that needed to be improved or enhanced in order to achieve greater efficiency in library management.

Next, interviews were conducted to gather in-depth information from the library staff [16]. An interview is a meeting between two individuals to exchange information and ideas through question-and-answer interactions, which are then constructed into meaningful content on a specific topic [9]. The results of the interviews were used as a basis for designing a library system that meets user needs.

Meanwhile, a questionnaire was used as a tool to measure the effectiveness of the system using a Likert scale. A questionnaire is a data collection method conducted by providing written questions or statements to respondents [17]. In this study, the questionnaire was used to evaluate the extent to which the PHP-based digital library system was able to address the limitations of the conventional system and its feasibility for implementation in the school environment.

2.4. Research instruments

Research instruments are essential and strategic elements in the entire research process, as they serve as tools for collecting and measuring the necessary data [18]. In this study, the author used two main types of instruments: functionality testing and usability testing instruments. Functionality is one of the aspects in the ISO 9126 testing standard that assesses the extent to which software can perform the required functions accurately when operated under specific conditions [19]. The purpose of functionality testing is to evaluate whether the key features in the digital library system such as login and security, member and book data management, e-book access, and borrowing and return transactions work properly according to user needs. The functionality validation was carried out by IT experts and library staff using a Yes (functional) and No (not functional) scale. The results of this test serve as a basis to determine whether the system is ready to use or still needs improvements in certain aspects.

In addition to functionality, usability testing was also conducted to measure the level of ease, usefulness, and user satisfaction in using the digital library system. The usability assessment refers to the USE Questionnaire approach developed by Lund [20], which includes three aspects: Usefulness (the extent to which the system helps improve efficiency and information access), Ease of Use (ease of navigation and interaction with the system), and Satisfaction (overall user satisfaction). This usability instrument was distributed in the form of a questionnaire using a Likert scale to students and teachers as the primary users of

the system. The questionnaire results were analyzed to assess the feasibility of the system in enhancing digital library services.

Additionally, another instrument used was an interview sheet. The interviews were conducted in two stages: the observation stage and the research stage. In the observation stage, or data collection phase which involves full attention to the research object [15], interviews were held with library staff to explore the limitations of the conventional system and identify key needs, such as recording and monitoring book collections. In the research stage, interviews were conducted to further explore required features such as digital search and the use of QR codes in transactions. The data obtained from these interviews served as a reference for designing system features that align with the actual needs of users in the field and support the effectiveness of school library services.

2.5. Data Analysis Techniques

Data analysis is a crucial stage in research because once the data is collected, an analytical process is required to process, interpret, and conclude the relevant information [21]. The data analysis technique greatly depends on the type of problem and the research design used [10]. In this study, the analysis was carried out through two main approaches: functionality and usability. Functionality analysis aims to evaluate the extent to which the main features of the digital library system operate according to user expectations. This testing was conducted by IT experts using the Guttman scale, a scale that provides definitive answers such as “Yes or No” or “True or False” [22]. To assess the success of feature implementation, the following formula was used:

$$x = \frac{I}{P} \times 100\% \quad (1)$$

Then, based on the formula, the data will be processed into percentage form. The following is the feasibility percentage table based on the Guttman scale:

Table 1. Eligibility Percentage

Percentage (x)	Criteria
81 – 100%	Very Feasible
61 – 80 %	Feasible
41 – 40 %	Fair
21 – 40 %	Less Feasible
0 - 20 %	Not Feasible

Usability analysis was conducted to assess the extent to which the system enhances ease of access and service efficiency for users. The aspects analyzed include Ease of Use, Usefulness, and User Satisfaction [23]. The assessment was carried out using the Likert scale, a common method for measuring an individual's attitude or perception toward a social phenomenon [24]. Respondents gave scores ranging from 1 to 5 on various aspects of the system. The collected data was analyzed using the following formula:

$$Score\ Percentage\ \frac{Total\ Score}{Maximum\ Score}\ x\ 100\% \quad (2)$$

After obtaining the percentage of responses, the researcher analyzed the response patterns to assess the extent to which the system meets usability aspects, such as ease of use, usefulness, and user satisfaction. The percentage results were grouped into specific categories for easier interpretation, referring to the interpretation guidelines from [25] and presented in the following table:

Table 2. Eligibility Percentage Usability

Percentage (x)	Criteria
81 – 100 %	Very Feasible
61 – 80 %	Feasible

41 – 40 %	Fair
21 – 40 %	Less Feasible
0 – 20 %	Not Feasible

With this approach, the test results can be interpreted objectively to determine the extent to which the digital library system meets usability criteria in the context of its implementation at SMK Negeri 1 Luragung.

3. Result and Discussion

3.1. Description of Digital Library System Testing

In the development process of the digital library system at SMK Negeri 1 Luragung, a series of testing phases were carried out to ensure that the system functions properly according to its design and user requirements. This testing includes several stages, starting from technical aspects to user experience. The second stage involved functionality testing by IT experts, who evaluated technical aspects of the system such as the reliability of login features, member and book data management (CRUD), collection search, and transaction history. This evaluation aimed to ensure that all core features could operate without errors or system failures during use.

The third stage was testing by library experts to assess the feasibility of the system from a library management operational perspective. The evaluation covered the accuracy of book information, functionality of e-books, efficiency of QR code usage, and the ease of managing collections and members. The final stage of testing was user testing, divided into small and large groups. The users involved were students and teachers who directly interacted with the system to assess aspects such as comfort, ease of navigation, and feature effectiveness. The evaluation was conducted using a questionnaire with a Likert scale to measure the system's usability level from the perspective of end users.

3.2. System Development Results Based on ADDIE Procedures

The ADDIE method was used as a guideline in developing the PHP-based digital library system. ADDIE is an acronym for five stages: Analysis, Design, Development, Implementation, and Evaluation [12]. These stages ensure that the system is designed and developed systematically so that it can be implemented effectively. The following are the development results based on each stage of the ADDIE model:

A. Analysis

In the analysis stage, the researcher identified user needs and existing problems at SMK Negeri 1 Luragung related to library services. Based on the results of observations and interviews, it was found that the processes of borrowing, returning, and recording books were still conducted manually. This led to limited access, delayed record-keeping, and the potential for data loss. Therefore, a digital library system is needed to automate all of these processes.

B. Design

In the design stage, the author prepared and implemented the design of the digital library system in the form of a flowchart to illustrate the system's workflow comprehensively—starting from the login process, member data management, borrowing, to transaction history. A flowchart, or flow diagram, is a visual representation that illustrates the process or sequence of steps within a system in a systematic and structured manner [26]. The flowchart presented below was created using the draw.io platform and serves as the main reference in the system development process, ensuring that each function operates in a structured manner and meets user needs. The following is the flowchart design:

1. Flowchart Login

The Login Flowchart illustrates the sequence of procedures involved in the system's authentication process. It begins when the user accesses the login page and enters their credentials, consisting of a username and password. The system then performs an initial validation to ensure that all required fields have been filled in correctly. If any field is empty, an error message is displayed, prompting the user to complete the missing information. Once the input is complete, the system verifies the credentials by comparing them with the data stored in the database. If the username and password match an existing account, the user is granted access and redirected to the system dashboard according to their authorization level. However, if the credentials are incorrect, the system issues a warning message and the user must attempt the login process

again. This flowchart provides a clear and structured representation of the authentication mechanism, supporting system analysis, testing, and development.

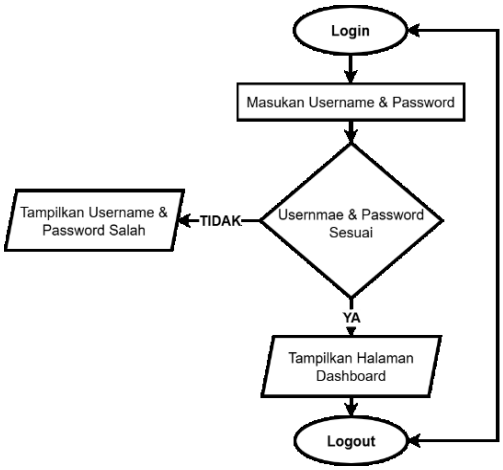

Figure. 1. Flowchart Login

Figure 1. *Flowchart Login* illustrates the sequence of processes that occur when a user attempts to access the system. The flowchart begins with the user entering their username and password on the login page. The system then performs validation by checking whether the inputted data matches the information stored in the database. If the credentials are correct, the user is granted access and redirected to the main dashboard. However, if the login data is incorrect or incomplete, the system displays an error message and prompts the user to re-enter their credentials. This flowchart helps visualize the logic and structure of the login process clearly and systematically.

2. Flowchart Book

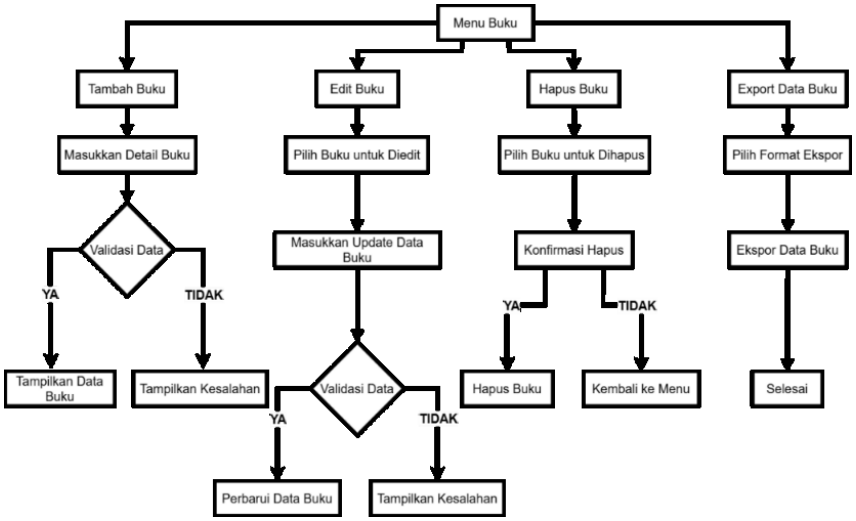

Figure. 2. Flowchart Book

Figure 2. Flowchart Book illustrates the overall process involved in managing book data within the digital library system. The flow begins when the user selects the book menu, which provides access to features such as adding, viewing, updating, or deleting book records. When adding a book, the system prompts the user to input details such as title, author, publisher, and category. The system then validates the entered data to ensure completeness and correctness. If the data is valid, it is saved into the database;

otherwise, an error message is displayed. This flowchart helps visualize the workflow of book management and ensures that each step is executed systematically.

3. Flowchart Borrowing

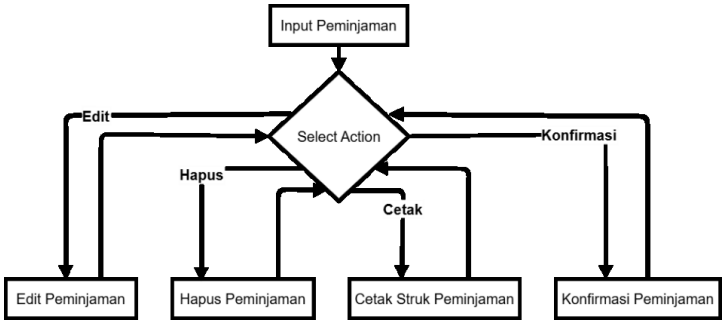

Figure. 3. Flowchart Borrowing

C. Development

The development stage is the process of implementing the design of the digital library system by building the main features using PHP and MySQL. This system is presented in a responsive and user-friendly web interface, supporting services such as member registration, book search, borrowing, and transaction tracking. Before being tested by users, the system is first evaluated by IT experts for technical aspects and by library experts for operational suitability. The results of this initial evaluation ensure that the system is ready for large-scale trials.

Based on the validation test results of the functionality aspect by IT experts, it was found that all features in the system functioned according to the designed objectives. This conclusion was obtained through calculations using the following formula:

$$x = \frac{I}{P} \times 100\% \quad (3)$$

Calculation

I (Total Score) = 15
P (Number of items tested) = 15

$$x = \frac{15}{15} \times 100\%$$
$$= 100\%$$
$$x = 100\%$$

Based on the validation results using a questionnaire instrument on the functionality aspect, it can be concluded that the web-based digital library system has met the functional feasibility standards. Therefore, this product is declared "Highly Feasible" (All features are fulfilled very well) based on the percentage. Meanwhile, the results of the validation test on the functionality aspect by the Library Expert were obtained through calculations using the following formula:

$$x = \frac{I}{P} \times 100\% \quad (4)$$

Calculation

I (Total Score) = 10
P (Number of items tested) = 10

$$x = \frac{10}{10} \times 100\%$$
$$= 100\%$$
$$x = 100\%$$

Based on the validation results using a questionnaire instrument on the functionality aspect, it can be concluded that this product is declared "Highly Feasible" (All features are fulfilled very well).

1. Admin View

Figure. 4. Dashboard Admin

Figure 4. Dashboard Admin displays the main control panel used by administrators to manage the digital library system. Through this dashboard, admins can monitor system activity, access menus for managing users, books, and transactions, and quickly navigate to key features. It provides a centralized interface for efficient administrative operations.

Figure. 5. Transactions Management

Figure 5. Transactions Management illustrates the interface used to manage borrowing and returning activities within the digital library system. This menu allows administrators to record new transactions, verify return dates, monitor overdue books, and update transaction status. It ensures organized tracking and improves the accuracy and efficiency of library service operations.

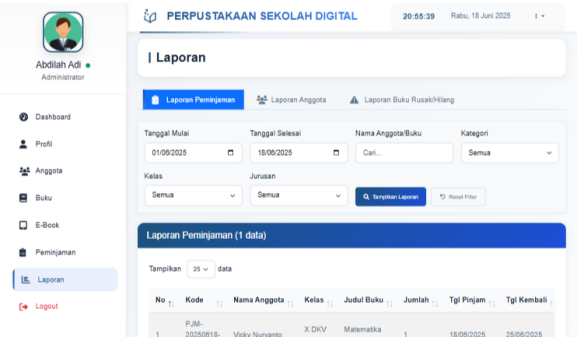

Figure. 6. Report Management

Figure 6. Report Management shows the interface used to generate and manage various library reports. Through this menu, administrators can view transaction summaries, borrowing statistics, user activity, and book availability. The feature helps streamline data monitoring, supports decision-making, and ensures that all library operations are documented accurately and efficiently.

2. User View

Figure. 7. User Home Page

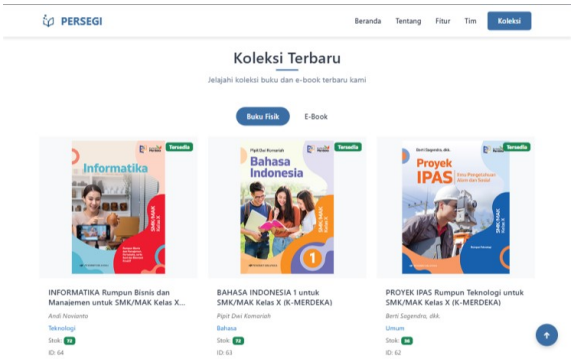

Figure. 8. Book Catalog View

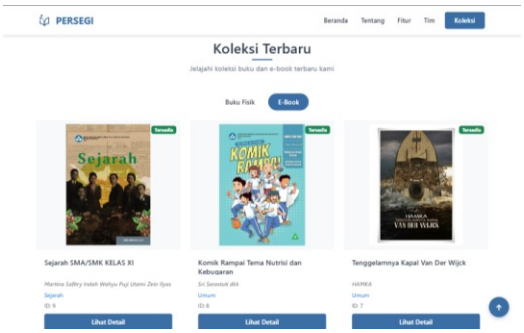

Figure. 9. Ebook Catalog View

D. Implementation

At the implementation stage, the digital library system was tested through two stages of usability testing, namely in small and large groups involving students, teachers, and library staff at SMK Negeri 1 Luragung. The purpose of this trial was to assess the ease of use of the system in providing digital library services. Questionnaires were also distributed to collect user experience data as a basis for further system evaluation and development.

The initial trial was conducted on a small group of 24 respondents consisting of students and teachers at SMK Negeri 1 Luragung. The goal was to evaluate the comfort, ease of use, and feature relevance of the system. Respondents used the system directly and filled out a Likert scale based usability questionnaire. The response results were analyzed to assess the feasibility and effectiveness of the system on a limited scale, as shown in the following table:

Table 3. Small Group Functionality Testing Results

Scale	Total	Score	Result
Very Feasible	85	5	410

Feasible	192	4	768
Fair	57	3	171
Less Feasible	0	2	0
Not Feasible	5	1	5
Total Score			1354

The total score was then calculated to assess the extent to which the system improves accessibility and service efficiency. The following is the final result of the usability test in the small group:

(5)

$$X = \frac{Total\ Score}{Maximum\ Score}\ x\ 100\%$$

$$X = \frac{1354}{1680}\ x\ 100\%$$

$$X = 80{,}6\%$$

Based on the results, the system achieved a Feasible category in the small-group usability test.. A follow-up trial was conducted on a larger group consisting of 50 respondents from students and teachers at SMK Negeri 1 Luragung. The purpose was to evaluate the convenience, ease of use, and relevance of the system features. The responses were analyzed to assess the system's feasibility and effectiveness on a broader scale, as shown in the following table:

Table 4. Large Group Functionality Testing Results

Scale	Total	Score	Result
Very Feasible	265	5	1325
Feasible	375	4	1500
Fair	56	3	168
Less Feasible	4	2	8
Not Feasible	0	1	0
Total Score			3001

The total score will then be calculated to measure the extent to which the system can improve accessibility and service efficiency for users. The following presents the final stage of usability testing on the large group:

(6)

$$X = \frac{Total\ Score}{Maximum\ Score}\ x\ 100\%$$

$$X = \frac{3001}{3500}\ x\ 100\%$$

$$X = 85.74\%$$

Based on the results, the test percentage score of 85.74% falls into the "Very Feasible" category and meets the usability aspect.

E. Evaluation

The evaluation stage in the ADDIE procedure aims to assess the feasibility and effectiveness of the digital library system. Functionality testing was carried out by IT experts and librarians to ensure that all core features functioned properly. Usability testing was conducted in two stages, involving 24 respondents (small group) and 50 respondents (large group), using a Likert scale questionnaire. The results showed that the system was rated as "Feasible" (80.6%) by the small group and "very Feasible" (85.74%) by the large group, indicating that the system is feasible for use and supports the improvement of library services.

3.3. Discussion

This study was motivated by the suboptimal library management at SMK Negeri 1 Luragung, which still relied on manual record-keeping, resulting in inefficient administration and a high risk of errors. To

address this issue, a web-based digital library system was developed using PHP and MySQL, following the Research and Development (R&D) approach through the ADDIE model. The system includes core features such as member data management, physical and e-book collections, borrowing and return transactions, and membership card printing. Functionality testing by IT experts and librarians yielded a perfect score (100%), indicating excellent functional feasibility.

Usability testing was conducted on two user groups: a small group (24 respondents) and a large group (50 respondents), using a Likert scale questionnaire to assess usefulness, ease of use, and user satisfaction. The results showed the system was categorized as "Feasible" (80.6%) by the small group and "Very Feasible" (85.7%) by the large group. Additional features such as QR code integration, e-book access, and borrowing history were also included. User feedback suggested improvements in the interface and adding more storybook collections. Overall, the system proved to be effective, user-friendly, and capable of enhancing digital library services at SMK Negeri 1 Luragung.

3.4 Comparative Analysis with Existing Open Source Systems

When compared to existing open-source solutions such as SLiMS and Koha, the developed PHP-based digital library system demonstrates several contextual advantages. SLiMS and Koha offer comprehensive modules for cataloging, circulation, and reporting; however, their setup and maintenance often require advanced configuration skills such as server management and MARC21 metadata standards.

In contrast, the proposed PHP-based system was designed to be lightweight and easily deployed on basic hosting environments commonly available to schools. It provides essential library functionalities such as member and book management, borrowing transactions, e-book access, and QR code-based circulation without unnecessary complexity. Furthermore, teachers or IT students can independently update or maintain the system without relying on professional developers.

Although this system does not yet match the advanced cataloging features of SLiMS or Koha, it offers superior accessibility and adaptability for small-scale educational institutions. Thus, it can be considered a simple yet practical alternative to large open-source platforms in resource-limited school environments.

4. Conclusion

This study aims to design and develop a PHP-based digital library system as a solution to improve the effectiveness, efficiency, and ease of library services at SMK Negeri 1 Luragung. The system was developed using the Research and Development (R&D) method, applying the ADDIE model, which includes five key stages: analysis, design, development, implementation, and evaluation. The implementation results in a web-based system with main features such as admin login, member and book data management, borrowing-returning transactions, membership card printing, e-book access, and borrowing history. Functional testing by IT experts and librarians obtained a perfect score of 100%, indicating that the system functions stably and meets technical and procedural aspects.

Usability testing was conducted with two groups of end users to assess feasibility and user-friendliness. The small group, consisting of 24 respondents, gave a usability score of 80.6%, categorized as “Feasible”, while the large group of 50 students gave a score of 85.7%, categorized as “Highly Feasible.” Additional features such as QR code-based quick borrowing, direct e-book access, and automated borrowing history tracking significantly enhanced the practicality and efficiency of the library services compared to previous manual methods. Overall, the developed system meets all research objectives by providing a feasible, user-friendly, and effective digital platform that optimizes library services in the school environment.

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