

Optimizing Educational Institutions: Web-Based Document Management

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Abstract.

Documents, which consist of written or printed materials, play a crucial role in educational activities. Private schools in Tangerang still face challenges in efficiently storing, accessing, and managing educational documents. Manual document storage consumes a significant amount of time and physical space. Therefore, a technology-based solution is required to address this issue. This research aims to develop a web-based Document Management System (DMS) that allows teachers and school staff to easily manage, store, and access educational documents digitally. The software development method employed is the Waterfall model, involving a series of stages ranging from needs analysis to testing and implementation. The outcome is a web based DMS application accessible to teachers in the school. This application enables teachers to view, upload, edit, and download teaching materials effortlessly. Additionally, teachers can manage their teaching schedules and user access rights. The usability of DMS has been tested through User Acceptance Testing (UAT), and users have provided positive feedback on the application. This web based DMS effectively addresses the issues related to document storage in schools, enhancing the efficient management of educational documents, reducing dependence on physical documents, and increasing productivity in the learning process. Consequently, this DMS holds great potential as a valuable tool in the educational context of the school.

Keywords: Document management system, waterfall and website.

I. INTRODUCTION

The advancement of information technology has influenced the way documents, defined as written or printed materials used as evidence or reference, are managed in various life contexts [1]. Private high schools in Tangerang, as significant educational institutions, generate and continuously use documents. However, these schools are still using traditional methods of document management, such as physical files, folders, or filing cabinets, leading to significant challenges [2]. One of the primary problems is the extensive physical space required for storing these physical documents, which is both inefficient and costly. Valuable space that could be used for more effective educational purposes is allocated for this storage. Another issue is the additional operational costs needed to maintain and secure these physical documents. These costs include storage space maintenance, physical security, document upkeep, and storage equipment such as filing cabinets. All of these additional costs can reduce the resources that should be allocated for educational purposes in the school. The use of physical documents also negatively impacts document accessibility. Teachers, students, parents, or administrative staff face difficulties in accessing the necessary information. This can hinder the efficiency of various administrative processes and teaching activities in the school. Furthermore, there is a high risk of document damage. Physical documents are vulnerable to various factors such as humidity, extreme temperatures, hazards like fires, or even human mishandling. Document damage can result in the loss of crucial information, disrupting school operations and teaching activities. In an increasingly digitally connected education era, it is vital to seek a more modern and efficient solution for document management in the school environment. Therefore, schools face issues related to traditional document storage.

To address these problems, schools need a solution that enables effective document storage, reduces the risk of damage, and offers easier access. One emerging solution is the development of a web-based Document Management System (DMS) application [3]. DMS aims to simplify and optimize document management by transitioning documents into a digital format [4]. DMS not only serves as document storage but also provides an efficient workflow for document management, retrieval, processing, printing, and distribution [5]. With DMS implementation, teachers and administrative staff at the school are expected to access teaching-related documents more quickly, efficiently, and with a lower risk of damage [6]. Thus, this research aims to design and develop a web based DMS that aligns with the school's needs [7]. The use of

DMS in document management will enhance efficiency, reduce the risk of damage, and support the development of a more efficient and technologically oriented education environment in this high school [8]. Consequently, DMS will offer significant benefits in addressing traditional document management issues and supporting modern and efficient educational development within the school environment [9]. In the development of the web-based Document Management System (DMS) for schools, the Waterfall method is employed [10]. This method consists of a series of linear stages involving analysis, planning, design, implementation, testing, deployment, and maintenance [11]. With this approach, each stage must be completed before moving on to the next, ensuring quality and alignment with user needs. Waterfall provides good structure and documentation, making thorough planning a key element of success in the development of this DMS [12].

II. METHODS

The Waterfall method is a critical aspect of designing a web-based Document Management System (DMS) solution for schools. The Waterfall method is one of the traditional approaches in software development that involves a series of sequential stages [13]. Here is an explanation of developing a website using the Waterfall method in the context of this research:

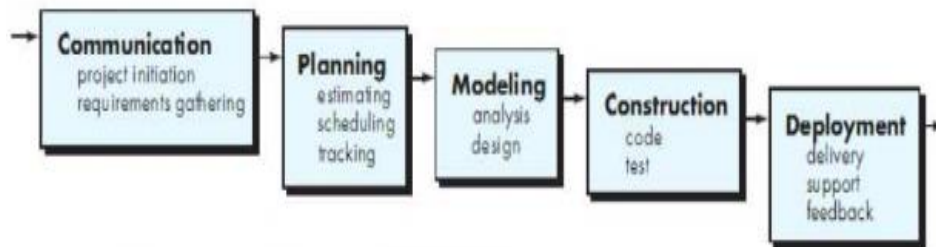


Fig 1. Stages in the Waterfall Method

- a. The first stage in developing a web-based Document Management System (DMS) for the school is the Communication stage [14]. In this phase, it commences with data collection through questions or questionnaires distributed via Google Form to the school's teachers. The questionnaire distribution process is the initial step to comprehend the needs and requirements that the DMS must fulfill. The outcome of this communication phase is the requirement definition or criteria that will serve as a guide in building the system.
- b. The next stage is Planning. In this stage, the primary input is the estimated time based on the requirement definition obtained from the previous communication stage. The planning process involves estimating the time needed to complete the development of the DMS application. The result of this planning stage is the work schedule that will be used to monitor and manage the DMS development [15].
- c. The Modeling stage is the next step in DMS development. The input in this stage is the requirement definition used as the basis for application design. The design process involves creating UML (Unified Modeling Language), which includes Use Case diagrams, Activity diagrams, sequence diagrams, class diagrams, and user interface design. The output of this stage is the UML document that will guide the development process [16].
- d. The Construct stage involves implementing the user interface design prepared earlier. The input at this stage is the user interface design that has been created. The construction process involves adding functions to the user interface using the PHP programming language to enable the application to run in a browser. After the prototype application is completed, testing is conducted using the black-box method to ensure the quality and performance of the application. The output of this stage is the programming code that implements DMS features [17].
- e. Finally, the Deployment stage involves implementing the DMS website that has been built. The input at this stage is the ready-to-use website. School teachers can access DMS features after logging in using the provided username and password. Additionally, this stage involves conducting a survey

using questionnaires via Google Form to obtain responses and feedback from application users [18]. The output of this stage is the conclusion based on questionnaire survey results, which will be used for evaluation in the user acceptance test (UAT) of the developed DMS [19].

III. RESULT AND DISCUSSION

Based on the results of interviews with the school, several issues related to accessing teaching materials, downloading teaching materials, and scheduling changes have been identified. These problem details are documented to provide a clear picture of the challenges faced. Table 1 lists the proposed requirements identified to enhance the learning process at the school. Thus, information plays a crucial role in detailing and planning the solutions to be proposed in the development of the Document Management System (DMS).

Table 1. Problem Analysis and Requirement

| No | Problem Analysis | Requirement |
|----|--|---|
| 1 | Teachers face difficulties in accessing the materials they teach. | Teachers have the ability to easily access and view the materials they teach. |
| 2 | Teachers also struggle with efficiently downloading teaching materials. | Teachers have the facilities to efficiently and quickly download the materials they teach. |
| 3 | The current process of changing teaching schedules requires improvement. Teachers need a more structured mechanism to view schedules and request schedule changes. | Teachers can comfortably view their teaching schedules and request schedule changes if necessary. |

The design phase in the system development is a crucial stage that involves various essential activities. In this phase, Unified Modeling Language (UML) design takes the central focus, which includes creating use case diagrams, activity diagrams, and class diagrams [20]. The Use Case diagram is used to visually illustrate the interactions and relationships between actors and the developed application, in line with the previously defined requirements [21]. This helps in identifying various use cases or functions that users will perform in the application context. In Figure 2, the development of the web-based Document Management System (DMS) for schools reveals a detailed set of use case diagrams. The first use case is the Login Website, which serves as the initial step to access the DMS system. Subsequently, Uploading Teaching Materials allows teachers to manage and share teaching materials digitally. Viewing Teaching Materials provides quick and flexible access to uploaded materials. Additionally, "View Teaching Schedule" enables teachers to efficiently plan their teaching activities.



Fig 2. Use Case Diagram Document Management System (DMS)

Use The Request Teaching Schedule Change use case facilitates communication between teachers and schedule coordinators, allowing for the submission of schedule change requests. Adding Teaching Materials is a crucial step in managing evolving educational resources, while Deleting Teaching Materials maintains system organization by removing irrelevant materials. "Editing Teaching Materials" allows teachers to update existing materials. Furthermore, Managing Teaching Schedule enables teachers and school staff to organize and modify teaching schedules as needed. The User Access Management use case gives administrators control over user access rights, ensuring security and order. Lastly, Logout marks the final step in a user's session, maintaining data and information security. This entire series of use cases serves as a vital guide in the development of the DMS system that will effectively meet user needs. In addition to UML, this design phase also involves creating a Class Diagram to structure the application's database, including entities, attributes, and relationships between entities.

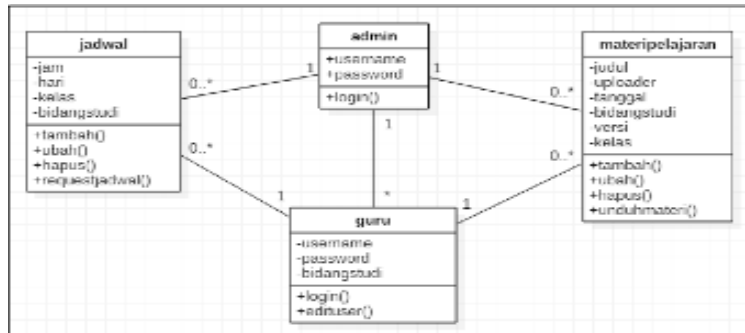


Fig 3. Class Diagram Document Management System (DMS)

In Figure 3, the Class Diagram is an essential tool in the application's design as it visualizes and explains the relationships between various classes within the system. In this application, there are four key classes: schedule, admin, teacher, and teaching materials. The relationships between these classes play a specific role in the application's operation. The schedule class is closely related to the teacher class as teaching schedules must be associated with the teachers conducting the classes. The "admin" class has a connection with the teacher class because administrators need to manage teacher information, including access rights settings. The teacher class is related to the teaching materials class as teachers are entities responsible for managing teaching materials. Lastly, the teaching materials class is linked to the "schedule" class because the teaching materials uploaded by teachers must be connected to the teaching schedules. Using the Class Diagram, developers can visually understand the complexity and interactions among classes within the system, ensuring that the application functions according to the desired needs and goals.

Finally, user interface design becomes a crucial focus, involving the creation of visual designs and application layouts that meet user needs and pre-existing requirements. The user interface plays a key role in the user experience; therefore, it needs to be carefully designed to ensure that users can interact with the application easily and efficiently. Throughout this entire design phase, all detailed elements serve as essential guidelines to ensure that the application's development aligns with the established plan and fulfills user needs.

| JADWAL MENGAJAR | | | | | | |
|---|-------------|----------------------------|----------------------------|----------------------------|----------------------------|--------------|
| Matematika Bahasa Indonesia Bahasa Inggris Agama PKN Sejarah Indonesia Seni Budaya Bahasa Arab Penjasles Biologi Fisika Kimia Ekonomi Geografi Sosiologi TIK | | | | | | |
| No. Jam | Senin | Selasa | Rabu | Kamis | Jumat | Bidang Studi |
| 1 | 07.00-09.00 | - | - | Kelas 11 MIA Harun Zein | - | Biologi |
| 2 | 08.00-09.00 | Kelas 12 MIA Harun Zein | - | - | Kelas 11 MIA Harun Zein | Biologi |
| 3 | 08.00-10.00 | - | Kelas 12 MIA Harun Zein | - | - | Biologi |
| 4 | 09.00-11.00 | - | - | - | - | Biologi |
| 5 | 10.00-11.00 | Kelas 10 MIA Harun Zein | - | - | - | Biologi |

Fig 4. Teaching Schedule Page

Figure 4 is a crucial element in this application as it contains information about teachers' teaching schedules in the school. On this page, teachers have the ability to view their teaching schedules clearly, including the time, subjects, and classes they will be teaching. Moreover, teachers also have the option to make schedule changes if necessary. This feature is vital as it can help teachers efficiently organize their teaching schedules with greater flexibility. Thus, Figure 4 provides a comprehensive overview of teachers' teaching schedules, enabling them to better manage their schedules according to the school's needs.



| Index. | Judul Buku | Penulis | Tanggal | Versi | Kelas | Bidang Studi | Aksi |
|------------------|-----------------------|-----------------|------------|-------|--------|--------------|----------|
| 1.110.02.06.2016 | Logaritma Bab 1 | Widya Wijayanti | 2020-07-07 | 2 | 10 MIA | Matematika | Download |
| 1.100.01.09.2016 | Buku Guru Matematika | Widya Wijayanti | 2020-07-07 | 1 | 10 MIA | Matematika | Download |
| 1.102.02.03.2017 | Buku Guru Matematika | Admin | 2020-07-08 | 1 | 11 MIA | Matematika | Download |
| 1.102.01.10.2017 | Buku Guru Matematika | admin | 2020-07-08 | 1 | 12 MIA | Matematika | Download |
| 1.102.06.11.2017 | Buku Siswa Matematika | admin | 2020-07-08 | 1 | 12 MIA | Matematika | Download |

Fig 5. Subject Materials Page

The teaching materials page, as seen in Figure 5, is one of the critical features in this application that facilitates the interaction between teachers and teaching documents. On this page, schoolteachers can easily view various teaching materials available. Teachers have the option to download these materials, ensuring quick and practical access to educational resources. Furthermore, this page allows teachers to contribute by uploading new teaching materials if they have updated versions or additional materials. This is a highly useful feature for keeping teaching materials up-to-date and maintaining relevant educational resources. With this teaching materials page, teachers can efficiently manage and access various teaching materials as per the school's learning requirements. The Construct phase is a crucial step in the development of this application, where, in addition to implementing the previously designed user interface, the application undergoes testing [22]. Testing is performed using the Black-Box method, which focuses on testing the application from a functional perspective without considering its internal structure [23]. The results of the Black-Box testing serve as vital guidance in ensuring that the application has been built well and functions as expected. It also helps in detecting and rectifying potential issues or errors before the application is used by end-users. With Black-Box testing, developers can ensure the quality and reliability of the application before it is released into the production environment, thus maintaining the quality of service provided to end-users.

Table 2. Result of Black-Box

| No | Testing Case | | Result | |
|-----------------------------|--|---|-------------|--------|
| | Process Description | Expected Results | Success | Failed |
| 1 | The login page is used to access the system, where users input their user credentials. | On the login page, the success criteria are as follows: if both the Username and Password fields are empty, the system will display a notification to fill in both fields; if the entered Username and Password do not match the registered data, the application will reject the login process; whereas, if the entered Username and Password are correct, the user will successfully log into the system. | 20% | - |
| 2 | The Teaching Schedule page is where teachers can easily and flexibly view and manage their teaching schedules. | The Teaching Schedule page allows teachers to efficiently manage their teaching schedules by uploading new teaching materials, making changes as necessary, and downloading required teaching materials. | 20% | - |
| 3 | The Teaching Materials page allows teachers to upload, edit, and download teaching materials efficiently. | On this page, teachers can efficiently manage learning resources by uploading new teaching materials, making necessary changes, and downloading required teaching materials. | 20% | - |
| 4 | The Account page, users manage account information. | Users can smoothly manage account information, including updating personal data and changing passwords if necessary. | 20% | - |
| 5 | The Logout page, users exit the system for security and privacy. | Users can smoothly exit the system or end their session, maintaining the security and privacy of their accounts. | 20% | - |
| Total in Percentages | | | 100% | |

In Table 2, positive test results on various pages within the system indicate excellent performance. The Login Page, Teaching Schedule Page, Teaching Materials Page, Account Page, and Logout Page have all successfully met user expectations and business requirements. This indicates that the system has been well designed and developed, providing efficient and functional tools to users. Teachers can easily manage their teaching schedules and teaching materials, while other users can flexibly handle their account information. Users can also smoothly log out of the system to maintain security and privacy. With these positive User Acceptance Test (UAT) results, the system is ready for broader implementation, offering significant benefits to users and better support for school operations. During the deployment phase, User Acceptance Testing (UAT) was conducted to gather feedback from users. This testing involved 20 teachers from various fields of study at the school, using a Likert scale to evaluate the system. The indicators assessed included the ease of understanding the Document Management System's interface, the simplicity of feature usage steps, the comprehension of feature functions and usability, the system's ability to support sharing teaching documents, the system's ability to manage and store subject documents, and whether users would use the application again.

Table 3. Result of UAT

| No | Indikator | Presentasi |
|-----------------------------|--|---------------|
| 1 | The Document Management System interface is easy to understand. | 98,2% |
| 2 | The steps for using the features are easy to understand. | 96,4% |
| 3 | The functionality and usability of the features are easy to grasp. | 91,1% |
| 4 | The Document Management System can help with sharing teaching documents. | 100% |
| 5 | The Document Management System can assist in managing and storing subject documents. | 94,6% |
| Total in Percentages | | 96,06% |

The UAT results show that the total percentage obtained is 94.6%. This falls within the 75% - 100% range on the Likert scale, indicating that users have given positive assessments of this web-based Document Management System. Teachers consider the system to be excellent and are ready to actively use it. With these positive UAT results, it can be concluded that the application effectively meets user needs and expectations and is ready for implementation in a school environment with confidence that it will provide significant benefits in supporting the teaching and document management processes.

IV. CONCLUSION

In the development of the web-based Document Management System (DMS) for the school using the Waterfall approach, the entire project stages were executed systematically. The Communication phase allowed for gathering teacher requirements through questionnaire distribution. Subsequently, the Planning phase generated time estimates and work schedules that served as the development's foundation. In the Design phase, UML and user interface design were depicted to visualize the system. The Construction phase involved the implementation of functions and black box testing. The User Acceptance Test (UAT) during the Implementation phase demonstrated that the system effectively met user expectations. This is reflected in the excellent acceptance rate, reaching 94.6%. The UAT results confirm that the web based DMS is ready for use in the school. The system provides user-friendliness, valuable functions, and effective support for the teaching process. With these conclusions, it successfully offers an efficient and effective solution for managing educational documents in the school.

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