Design of a Web-Based Academic Information System for Mestika Abadi School (Chong Ren School) Using the Waterfall Method

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Abstract

The development of information technology, particularly the internet, has brought significant changes in various fields, including education. Mestika Abadi School (Chong Ren School) in Medan still uses manual methods in managing academic data. This creates several obstacles such as time inefficiency, the risk of recording errors, and less than optimal communication between the school, students, and parents. This study aims to design and build a web-based school academic information system that can replace manual processes, using the Waterfall method in its software development. This method was chosen because it has clear and structured stages, including needs analysis, system design, implementation, testing, and maintenance. The results of this study indicate that the developed system is able to improve the efficiency of school academic administration.

Keywords : *School Academic Information System, Website, Waterfall, Digitalization, Academic Management*

1. Introduction

The internet is currently developing rapidly, as information is becoming increasingly easy to obtain. Currently, the internet is not only used as an information medium, but is also used in almost all areas of life, one of which is education. One medium used to disseminate information for organizations, whether business or education, is the use of website-based information systems as information technology that utilizes the internet [1][2].

Media that can be used to accommodate various types of information that can be accessed anytime and anywhere is the definition of a website. [3]. School websites are currently trending in the world of education and are receiving very positive attention and responses from various parties. In the context of school digitalization, the implementation of the Independent Curriculum provides an opportunity for schools to integrate technology into the learning process. By utilizing websites, schools can present teaching materials, extracurricular activities, and other important information interactively, supporting more flexible and tailored learning to students' needs, and increasing parental involvement in their children's education [3] .

Mestika Abadi School (Chong Ren School) is located in Medan city which still borrows a monastery located at Gg. P Jl. Benteng, RT. Environment 22/RW. Environment 22, Rengas Pulau, Medan Marelan District, Medan City, North Sumatra and is a Buddhist school that teaches character, moral ethics and good manners [4] . At Mestika Abadi School / Chong Ren School, not only does it teach theory, but the teachers instill an attitude of wisdom and love so that children grow into responsible, empathetic individuals and have high integrity [5] . The problems found are related to academic management which is still conventional. Academic administration processes, such as recording student data, assessments, attendance, to making educational reports, are still carried out manually, namely through the use of semi-computerization using recording media such as books and application software such as Microsoft Word , Microsoft Excel and Supersheet. This often creates the risk of recording errors, delays in the process, and difficulties in accessing data quickly and accurately. Furthermore, the limitations of this manual system also hinder efficient communication between teachers, students, and parents, ultimately impacting the effectiveness of monitoring student academic progress. This conventional academic system is not only time-consuming but also requires higher operational costs and increases the workload of administrative staff. Implementing an integrated digital system can be a solution to improve efficiency and accuracy in the academic process.

One way to develop information systems is through software engineering. Software engineering is a discipline that focuses on the systematic development, management, and maintenance of software. This process includes requirements analysis, design, development, testing, and maintenance. In the context of academic information systems, software engineering is important to meet the needs of users such as students, teachers, and parents. Various development methods, such as Waterfall, Agile, Spiral, and V-Model, are used to ensure

quality and efficiency. The Waterfall method is linear and structured, while Agile is more flexible for frequently changing requirements. Spiral combines planning and risk management, while the V-Model emphasizes continuous testing. By applying software engineering principles and choosing the right method, developers can produce functional and maintainable solutions [7] .

This study uses the Waterfall method in developing the proposed academic information system. The Waterfall method is a linear and sequential software development model, where each stage must be completed before proceeding to the next stage. The stages in this method include needs analysis, system design, implementation, testing, and system maintenance. The advantage of the Waterfall method is its clear and orderly structure, making it easier for schools to process data, store data, and so on. With this approach, the needs and objectives of the system can be identified well at the outset, thereby reducing the possibility of significant changes mid-development. Each stage has complete documentation, making it easier for the development team to understand the process and maintain the quality of the system. In addition, this method is suitable for use in projects that have clear needs from the start and do not change much. The order and good documentation in the Waterfall method also facilitate the process of maintaining the system in the future [8] .

2. Research Method

Below, Figure 1 shows the stages of the Waterfall method implemented in the development of the school information system in this study.
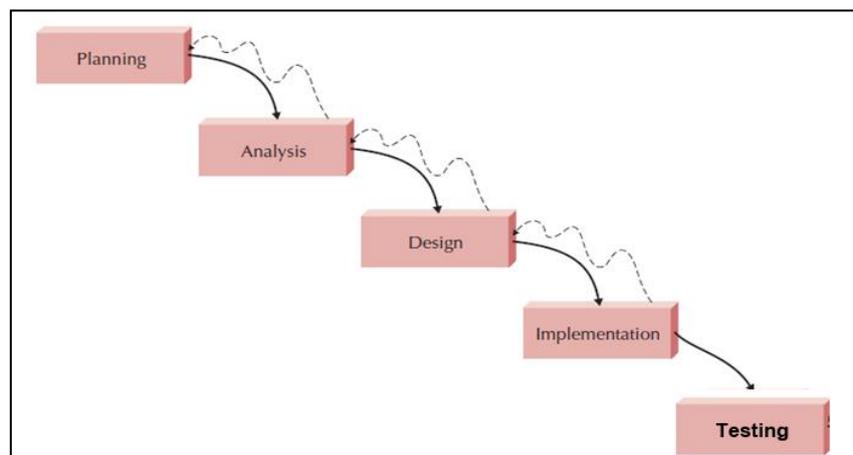

Fig. 1: Stages of Analysis of the Proposed Method

1. Planning.
   a. At this stage, initial planning is conducted regarding the needs for developing a school information system. The initial planning results identified the following needs:
      1) List of main user needs, such as attendance system, grade management, student administration, and communication between school parties (teachers, students, and parents).
      2) The need for easy access via mobile or desktop devices.
      3) The need for integration with existing systems, such as school or library financial systems.
   b. This involves identifying user needs, development objectives, and the project scope to ensure all stakeholders have a shared understanding. The analysis of development objectives yields the following:
      1) Create a system that can improve the efficiency of school administration.
      2) Reduce human error in manual recording processes.
      3) Facilitate real-time access to information for teachers, students, and parents.
      Project scope analysis results:
      1) Focus on managing student data, class schedules, academic grades, and attendance.
      2) Involves developing a user-friendly user interface (UI/UX).
      3) Does not include the development of IoT-based systems (e.g. RFID for attendance), but can be integrated in the future.
2. Analysis.
   a. This stage aims to analyze system requirements in depth by identifying the required functions and features.
   b. Involves collecting data from users and related parties, as well as conducting analysis of current manual processes.
3. Design.
   a. At this stage, a technical solution for the school information system is designed based on the analysis results.
   b. The design includes system architecture, user interface, and database design to ensure the system runs as required.
   The system prototype design is illustrated using Balsamiq Mockup 3 covering the entire interface design.
4. Implementation.
   a. The implementation stage is carried out by realizing the design that has been made into a functional system form.
   b. This process includes coding, software installation, and system integration with existing data.
5. Testing.
   a. The developed system is tested to ensure that all features work properly according to requirements.
   b. This stage also includes testing for bugs, system performance, and validation of the final results to ensure they meet the expected specifications.

3. Results

The results of this research include the development of a web-based information system for the Mestika Abadi (Chong Ren School) school using the Waterfall method. The following is a complete overview of the school information system at Mestika Abadi School for user visitors:

1. Homepage
   This page contains a school slideshow, teacher attendance information, and school-related announcements. Figure 2 shows the home page.
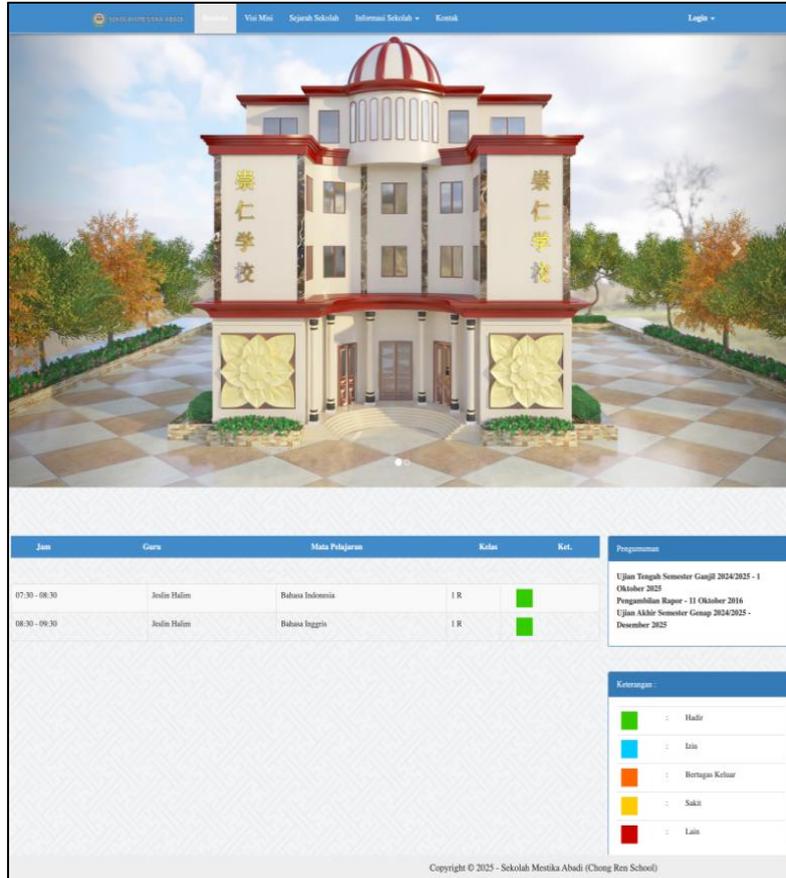

Fig. 2: Home/Login Page

2. Teacher Return Attendance Form Page.
   This page contains a form for recording teacher absences, where the administrator enters the teacher's ID card number to record the teacher's time of departure. Figure 3 shows the teacher absence form page.

Fig. 3: Teacher Return Attendance Form Page

3. View Values Page.
   This page displays a list of student grades for each subject. Figure 4 shows the grades view page.
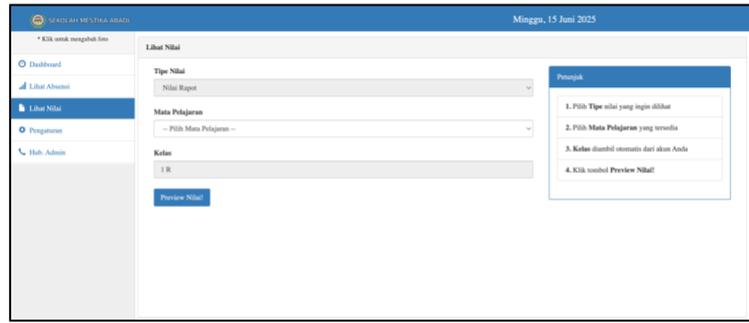
Fig. 4: View Values Page

4. Manage Values Page Short Version.
    This page contains a form for selecting the class and subject for which grades will be entered. To proceed with entering grades, click the "View Grades" button. Figure 5 shows a short version of the manage grades page.
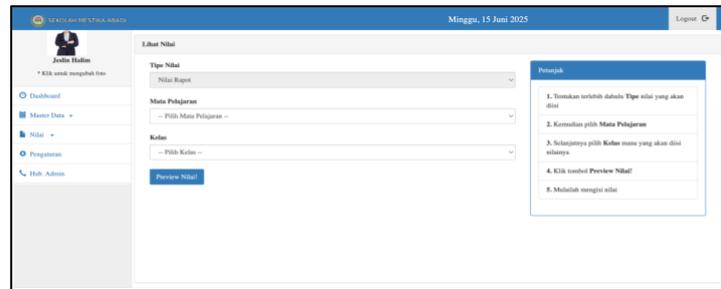

Fig. 5: Manage Values Page Short Version

5. Short Version Value Input Page.
    This page contains detailed grades according to the previously selected class and subject. To enter a grade, simply press the + icon and enter the grade number. Figure 6 shows a shortened version of the grade input page.
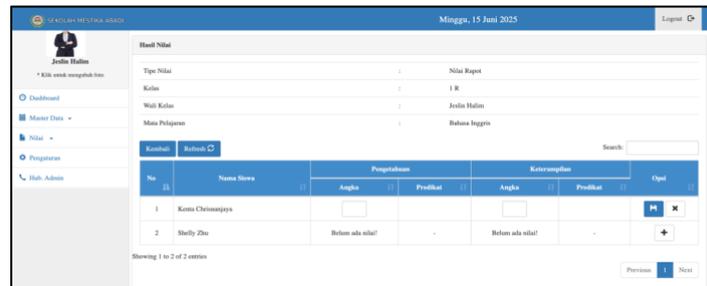

Fig. 6: Short Version Value Input Page

4. Discussions

The development of the web-based academic information system for Mestika Abadi School (Chong Ren School) was carried out using the Waterfall method , a sequential system development method through five main stages: **Planning, Analysis, Design,** Implementation, and Testing **.** This method was chosen because it provides a clear structure and is suitable for projects with pre-defined needs. The following is a description of each stage along with an estimated completion time:

1. Planning – 1 Week
    This stage is the initial step in system development. Its purpose is to determine the direction and objectives of the system, as well as the scope of the project. Activities carried out in this stage include:
    a. Identifying problems faced by schools in managing student data, teachers, schedules, grades, and reports.
    b. Determine the features to be built into the system, such as login, admin dashboard, data management, and reports.
    c. Develop a project schedule and divide tasks among the development team.
        The estimated time for this planning stage is 1 week **,** because the process is conceptual and focuses on initial planning without technical implementation.
2. Analysis – 2 Weeks
    After planning, an analysis of the system's requirements is conducted, both from a user perspective and from a school workflow perspective. Some key activities at this stage include:
    a. Observation of the current manual work processes in schools.
    b. Interviews with administrative staff, teachers, and principals to explore system requirements in detail.
    c. Preparation of System Requirements Specification Documents as a reference for the next stage.
    The analysis stage takes 2 weeks because it is necessary to understand the functional and non-functional requirements thoroughly so that the system being developed truly meets user expectations.

3. Design (Designing) – 2 Weeks

    At this stage, technical design is carried out based on the analysis results. The goal is to create a blueprint for the system to be built. Key activities include:
    a. Designing the user interface (UI) for login page, dashboard, student data management, teacher, schedule, and grades.
    b. Creating an Entity Relationship Diagram (ERD) to design system databases.
    c. Create a process flow diagram (flowchart) and system navigation structure.

    This stage is estimated to take 2 weeks **,** because the design must be prepared carefully to avoid errors during implementation.

4. Implementation – 3 Weeks

    The implementation phase is the process of translating the design into a real system using programming languages and web technologies. Some tasks at this stage include:
    a. Frontend development using HTML, CSS, and JavaScript.
    b. Backend development using PHP and MySQL database integration.
    c. Creation of modules such as student data management, teacher data management, class schedules, grades, academic reports, and user authentication.

    The implementation duration is 3 weeks **,** as it involves system coding and integration between components.

5. Testing – 2 Weeks

    Once the system is complete, testing is performed to ensure that all functions operate as required and are error-free. The testing phases include:
    a. Unit Testing to test each function/method separately.
    b. Integration Testing to ensure modules work in an integrated manner.
    c. User Acceptance Testing (UAT) by the school to ensure the system is suitable for use.

The time allocated for testing is 2 weeks **,** so that all features can be thoroughly tested and improvements made if bugs or inconsistencies are found.

5. Conclusion

The following describes the conclusions from the website that was built in this research, namely:
1. The research results show that the Waterfall method can be effectively and gradually applied to the development of a web-based school information system and can provide solutions to the digitalization needs of data management and communication at Mestika Abadi School. This method allows the development team to understand the system thoroughly, minimizes the risk of changes mid-development, and produces a stable and functional system.
2. This website can replace manual processes for managing academic data, such as student, teacher, curriculum, assessment, and report cards. With a web-based system, information is easier to access and manage, increasing efficiency and minimizing the risk of administrative errors.

References

[1] K. Liong and M. D. Firmansyah, "Perancangan dan Implementasi Website Profil Sekolah di Sekolah Advent Mission Sagulung Menggunakan Wordpress dan MySQL," *J. Ilm. Betrik*, vol. XIII, no. 3, 2022.

[2] Andi, R. Purba, and R. Yunis, "Application of Blockchain Technology to Prevent The Potential Of Plagiarism in Scientific Publication," 2019, doi: 10.1109/ICIC47613.2019.8985920.

[3] M. D. Firmansyah and H. Herman, "Perancangan Web E- Commerce Berbasis Website pada Toko Ida Shoes," *J. Inf. Syst. Technol.*, vol. 4, no. 1, pp. 361–372, 2023, doi: 10.37253/joint.v4i1.6330.

[4] M. Utami, E. Dwika Putra, V. Handoyo, R. Arif Ma'ruf, F. Agnesa Putra, and Herianto, "Perancangan Sistem Informasi Profil Sekolah Berbasis Website Pada Sdn 4 Kota Bengkulu," *JPMTT (Jurnal Pengabdi. Masy. Teknol. Terbarukan)*, vol. 3, no. 1, pp. 1–5, 2023.

[5] J. H. Sitorus and W. Yusnaeni, "Perancangan User Interface Sistem Informasi Akademik Sekolah Dasar (Siakad) Menggunakan Metode Waterfall," *Simpatik J. Sist. Inf. dan Inform.*, vol. 1, no. 2, pp. 98–107, 2021, doi: 10.31294/simpatik.v1i2.671.

[6] R. Y. Pratama, "Analisa Dan Perancangan Sistem Informasi Akademik," *OKTAL J. Ilmu Komput. dan Sci.*, vol. 3, no. 18, pp. 1–10, 2024, [Online]. Available: https://journal.mediapublikasi.id/index.php/oktal/article/view/3299.

[7] F. Hasanah and R. Untari, *Buku Ajar Rekayasa Perangkat Lunak*. Sidoarjo: UMSIDA Press, 2020.

[8] L. W. Widianti and M. I. Darussalam, "Penerapan Metode WaterFall dalam Digitalisasi Sistem Pelayanan Publik Pemerintah Kantor Kecamatan Pamulang," *J. Ilm. Komputasi*, vol. 22, no. 1, pp. 57–70, 2023, doi: 10.32409/jikstik.22.1.3329.