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Developing an Effective Sharia Bookstore Prototype using Waterfall Method

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Abstract
Traditional Islamic bookstores, such as Toko Kitab Mu'asifa, rely on manual record-keeping, which is prone to errors, slow in reporting, and inefficient in inventory management. This study presents the results of Black Box testing conducted on a web-based digital library application developed using the Waterfall methodology. A total of seven critical features were evaluated, including administrator login, customer login, book management (add, update, delete), purchase transactions, and user management, with test scenarios designed to simulate real user interactions. The testing outcomes indicate that all features functioned according to the specified requirements, achieving a 100% success rate with no recorded errors or failures. These results demonstrate the robustness, reliability, and accuracy of the system in managing essential operations such as authentication, inventory handling, and transaction processing. The findings confirm that the application is functionally ready for deployment; however, further evaluations focusing on non-functional aspects such as performance, security, and scalability are recommended to ensure comprehensive system readiness in real-world usage. The integration of Sharia values positions this system not only as a business management tool but also as a model of Islamic information systems that can be adapted by similar enterprises.

Keywords:
Sharia, Islamic Bookstore, Waterfall Model, Black Box

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1. Introduction

The growth and sustainability of small and medium enterprises (SMEs), including bookstores, are deeply influenced by their ability to adapt to technological advancements and adopt digital strategies that ensure competitiveness in modern markets. A study in Denpasar highlights that financial literacy directly affects the performance and sustainability of SMEs, demonstrating that businesses with stronger literacy in financial planning, budgeting, and investment tend to show higher resilience in the face of competition [1]. For Sharia bookstores, which often cater to niche markets with specific cultural and religious considerations, adopting digital literacy and structured business strategies is even more crucial. Without digital transformation, these businesses risk losing relevance in an increasingly technology-driven retail ecosystem. Thus, integrating robust system modeling with structured methodologies, such as the Waterfall model, can support their growth and long-term viability.

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In addition to financial management, digital resource management has become a central theme in higher education and industry. A study by Zhu, Zhuang, and Li emphasized how digital resource management systems must be designed with scalability, efficiency, and usability in mind to remain effective in complex organizational contexts [2]. The same principle applies to bookstores, particularly those that seek to integrate Sharia principles into their business operations. Without a systematic approach to development, applications risk being fragmented, unstable, or unable to adapt to user needs. The Waterfall method provides a linear framework with clear documentation and review points, ensuring that all essential requirements, including Sharia compliance, usability, and scalability, are incorporated at each stage of system development.

Sharia bookstores, specifically, face challenges in marketing and digital visibility. Research on Islamic bookshops indicates that many still depend heavily on physical stores and traditional marketing, limiting their ability to compete with mainstream bookstores that already utilize advanced e-commerce platforms [3]. Web-based systems are proposed as a solution to expand reach, yet challenges persist in user experience design, transaction reliability, and alignment with Sharia principles, such as halal product validation and transparent transaction flows. These challenges indicate a gap in existing solutions, which often lack methodological rigor in development. By applying the Waterfall model, developers can systematically gather requirements, design secure and transparent transaction flows, and rigorously test usability to ensure that the resulting prototype supports both commercial objectives and religious values.

The transformation of traditional bookstores into digitally oriented businesses is also evident in the case of Al-Bidayah Jember, where local business units attempted to innovate and expand operations [4]. While the business development ideas were promising, they often lacked systematic prototyping, structured design processes, and robust implementation frameworks. This highlights the need for methodological approaches like Waterfall to address potential weaknesses such as a lack of scalability, insufficient testing, and misalignment with customer needs. For Sharia bookstores, systematic design is critical to integrate religious content, ensure accurate categorization of Islamic literature, and maintain user trust through secure payment systems. Without such rigor, innovation may fail to deliver sustainable results in the long run.

Several studies on general bookstores further demonstrate that website-based sales systems can significantly enhance customer interaction, operational efficiency, and sales performance [5]. However, many of these platforms face challenges in ensuring system reliability, maintaining accurate inventory databases, and designing user-friendly interfaces that adapt to customer preferences. For Sharia bookstores, the stakes are even higher, as the platform must not only provide functional efficiency but also reflect the ethical and cultural values associated with Sharia compliance. The Waterfall method, with its structured documentation and testing phases, ensures that these critical requirements are thoroughly addressed, reducing the likelihood of errors or inconsistencies during system deployment.

Case studies such as the Yukmoco Online Bookstore illustrate both the potential and limitations of web-based digital bookstores [6]. These platforms successfully expanded sales and simplified management, but often neglected aspects such as scalability for future growth, multi-language support for wider audiences, and integration of value-based features like Sharia compliance. Such gaps demonstrate why the development of a Sharia bookstore prototype requires not just technical frameworks but also methodological discipline. By following the Waterfall method, developers can systematically incorporate both functional and non-functional requirements, ensuring that the resulting system is not only operationally sound but also aligned with the religious and cultural expectations of its target users.

The importance of combining frameworks like Laravel with structured development methodologies is evident in research on book sales and e-commerce applications [7][8]. While these studies highlight Laravel's strength in providing modularity, security, and scalability, they also reveal that without systematic planning and testing, applications often fall short in areas such as usability, feature completeness, and long-term maintainability. The Waterfall model provides an essential roadmap that mitigates these risks by enforcing step-by-step progression, where each phase must be validated before proceeding to the next. For Sharia bookstores, this means ensuring that the platform can handle core features such as book categorization, secure transactions, and user account management while preserving transparency and compliance with Islamic business ethics.

Beyond the immediate scope of bookstores, the development of digital libraries and educational resource platforms demonstrates the broader value of systematic design for improving literacy and user engagement [13]. These initiatives show that when platforms are developed with structured methodologies, they not only achieve technical efficiency but also enhance social outcomes, such as improved access to knowledge and higher literacy levels. For Sharia bookstores, adopting a similar approach ensures that the platform functions not just as an e-commerce system but also as a medium for promoting religious literacy and cultural knowledge. This dual function makes the use of a robust method like Waterfall essential for long-term success and relevance.

This study contributes to the field of information system development by addressing the gap in the integration of Sharia principles within digital bookstore management systems. While prior research has primarily concentrated on enhancing efficiency and transaction accuracy through web-based sales and inventory applications, limited attention has been given to embedding Islamic business ethics and compliance in such systems. The proposed contribution lies in designing a robust management information system that not only optimizes operational functions such as sales recording, inventory tracking, and automated reporting. It also ensures that these processes conform to Sharia requirements, thereby fostering both efficiency and ethical alignment. The use of the Waterfall method in this study provides a structured and systematic approach to system development, enabling clear documentation, step-by-step verification, and reduced risk of overlooking Sharia compliance in each phase of the process.

2. Related Works

Several studies have explored the integration of e-commerce with Islamic bookstores to improve service quality and market reach. Purwoko and Khotimah designed a web-based e-commerce system for Islamic bookstores with the primary objective of improving product marketing strategies [3]. Their findings showed that the implementation of a structured online platform increased accessibility for customers while reducing dependence on physical store visits. However, their approach lacked a robust methodological framework in system development, leading to potential gaps in scalability and long-term maintenance. This highlights the importance of applying a systematic method, such as Waterfall, which ensures that each stage of development, from requirements to testing, is carefully planned and executed for sustainable outcomes.

The business innovation initiative of Al-Bidayah Jember bookstore offers further insight into how traditional Sharia-focused bookstores attempt to adapt to digital markets [4]. The study documented how the store introduced new ideas for expansion and customer engagement. While the initiative successfully demonstrated entrepreneurial creativity, the absence of structured prototyping and technical validation resulted in an incomplete digital transformation. The case underscores the necessity of method-driven system development. A Waterfall-based approach would not only provide a step-by-step process for creating reliable prototypes but also enable proper evaluation of system functionality before full deployment.

The use of website-based applications for bookstore sales has been widely tested in various contexts, such as in Medan, where Latifah and colleagues designed and implemented a web-based sales system [5]. Their work improved transaction efficiency and expanded customer engagement, yet encountered limitations in handling large-scale user requests and maintaining real-time inventory updates. These shortcomings can be attributed to insufficient attention to structured testing and validation stages. The Waterfall model, with its dedicated testing and implementation phases, ensures that systems are not only designed but also rigorously validated to handle operational complexities. This methodological rigor is particularly critical for Sharia bookstores, where system failures could impact both customer trust and the credibility of the store's religious mission.

Other studies, such as the Yukmoco Online Bookstore case, highlight the potential of web-based platforms to expand market reach while reducing operational costs [6]. Their system achieved notable improvements in accessibility and order management. However, issues such as system scalability, user interface limitations, and long-term maintenance challenges persisted. These issues largely stemmed from insufficient documentation and a lack of a phased development approach. The Waterfall method's emphasis on detailed documentation, requirement validation, and controlled progression between stages addresses these limitations, making it a strong candidate for developing a reliable Sharia bookstore prototype.

Framework-based e-commerce applications, such as those built with Laravel, demonstrate the power of modular development and code reusability [7][8]. Laravel's ability to provide secure authentication, maintain structured databases, and handle transactions efficiently is well established. However, studies also reveal that even when using strong frameworks, the absence of a systematic design methodology often results in inconsistent user experiences and incomplete feature integration. By combining Laravel with the Waterfall approach, a Sharia bookstore system can achieve both technical robustness and methodological discipline, ensuring not only functional performance but also alignment with religious and cultural requirements.

Parallel efforts in the development of digital commerce systems, such as the Dewa Bike e-commerce platform, also shed light on the challenges of building sustainable systems without structured methodologies [9]. The platform demonstrated functional success in terms of managing sales and inventory, but faced limitations in adapting to changing market needs and user preferences. This reflects a common challenge in system development: the absence of rigorous requirement gathering and iterative validation. A Waterfall-based prototype for Sharia bookstores mitigates this risk by ensuring that each user requirement, including cultural and ethical considerations, is identified early and carried through to the final implementation.

Beyond bookstores, the digitalization of payment systems and services provides relevant insights. Mallala and colleagues developed a web service for laundry payments, demonstrating the ability of structured web-based systems to improve efficiency and customer satisfaction [12]. Although not directly tied to bookstores, their study highlighted the importance of ensuring security, reliability, and user convenience in system design. For a Sharia bookstore, these elements are even more critical, as customers require assurance of Sharia-compliant transactions. By embedding these features within the Waterfall development stages, developers can ensure that ethical and technical standards are systematically met.

Lastly, studies in the field of digital libraries emphasize the broader role of structured system development in promoting literacy and education [13]. Digital library platforms successfully improved access to resources and enhanced user literacy when developed with systematic methodologies. These findings are highly relevant to Sharia bookstores, which share the mission of not only providing books for purchase but also promoting Islamic literacy. By adopting the Waterfall method, developers can ensure that the prototype

functions both as a commercial platform and as an educational tool that empowers readers with easy access to reliable Sharia-compliant content.

Recent studies also highlight the application of structured development methodologies in Islamic-oriented e-commerce systems. Rahman et al. designed an e-commerce application for halal product distribution, emphasizing the importance of user trust and compliance with Sharia principles [14]. Their findings revealed that systems lacking structured prototyping often encountered usability issues, reducing customer confidence. Similarly, Hasanah and Putra proposed a mobile-based Islamic bookstore, demonstrating increased accessibility for rural users but noting that inconsistent feature integration limited the platform's long-term scalability [15]. Both studies suggest that systematic approaches, such as the Waterfall model, could provide the reliability and documentation needed to ensure consistency, usability, and compliance across all development stages.

Other works also stress the importance of user experience in digital commerce for niche markets. Rini and Kurniawan applied the Waterfall method to design an educational application and showed that phased development improved testing outcomes and reduced post-deployment issues [16]. Likewise, Fathurrahman et al. developed a web-based Quran learning system, concluding that systematic requirement analysis improved alignment between user needs and functional design [17]. In another related study, Pradana et al. implemented Waterfall in building a Sharia-compliant financial management application, successfully demonstrating that a step-by-step methodology supports both technical robustness and ethical compliance [18]. Together, these studies reinforce that the Waterfall approach provides a reliable foundation for developing Sharia bookstore systems that balance functional needs, religious principles, and sustainable user engagement.

3. Proposed Method

In this study, we adopted the Waterfall method, which relatively well-defined requirements from the outset and allows for systematic documentation and development stages. The Waterfall method offers the advantage of a linear, well-structured flow that is easy to trace. It applies a structured and sequential approach to software development, encompassing stages of requirements analysis, system design, coding, and testing. In this study, we modeled a mathematical formulation of the Waterfall method applied to constructing a Sharia bookstore application as follows:

Mathematical Formulation:

Let the development process be represented as a sequence of phases:

$$P = C, A, D, I, T, M$$

where:

- C = Requirements/Concept (Sharia & business needs)
- A = System Analysis
- D = Design (UI/UX, database, Sharia compliance rules)
- I = Implementation (coding & system construction)
- T = Testing (functionality, usability, and Sharia compliance)
- M = Maintenance (improvements & error fixes)

The Waterfall progression is modeled as:

$$f(P_i) \rightarrow P_{i+1}, \forall i \in 1,2,\dots,5 \quad (1)$$

with the constraint:

P_{i+1} can only begin if $f(P_i)$ is completed and validated.

The overall system S is the cumulative result of all validated phases:

$$S = \bigcup_{i=1}^{6} P_i \quad (2)$$

and the compliance condition ensures that:

$$S \models R_{sharia}$$

where R_{sharia} represents the set of Islamic values and business ethics rules.

In this study, the mathematical formulation models of the Waterfall method as a linear sequence of development phases, where each phase must be completed and validated before proceeding to the next. In the context of a Sharia bookstore, requirements (C) are not limited to business and technical needs but also include compliance with Islamic principles such as halal transactions, prohibition of interest, and ethical business practices. The constraint P_{i+1} only starting after P_i is validated ensures a controlled and systematic development cycle, minimizing risks of violating Sharia values. Finally, the cumulative system S is considered valid only if it satisfies the compliance rule set R_{sharia}, ensuring the final bookstore application is both efficient and Sharia-compliant.

4. Results and Analysis

The implementation stage displays a complete list of books along with their titles, brief descriptions, and prices. Fig. 1 displays a shopping cart for purchase, search, and processing more easily.

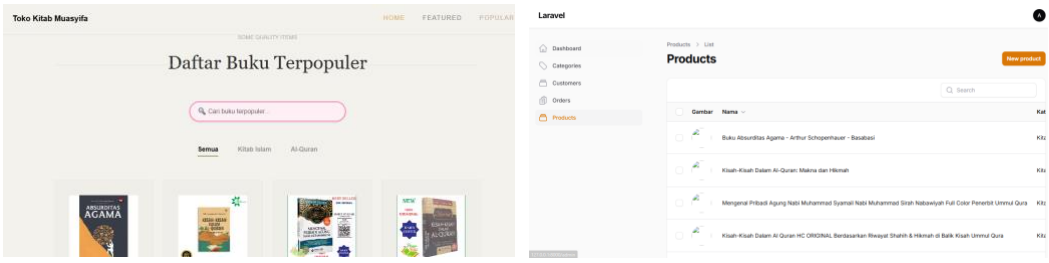

Fig. 1 Customer Page

Fig.1 displays the catalog of books within the system. Administrators can add, edit, or delete product data, including information such as title, author, price, stock, description, and category, to ensure that product records remain accurate and up to date. Table 1 describes Black Box testing results of this study.

Table 1: Black Box testing result of this study.

No	Feature Tested	Test Scenario	Expected Outcome	Status
1	Admin login	The administrator enters valid username and password credentials	The system grants access and redirects to the admin dashboard	Pass
2	Customer Login	The customer enters valid username and password credentials	The system grants access and redirects	Pass

			to the customer homepage	
3	Book Management	The administrator adds a new book with complete details	The book is successfully stored and displayed in the catalog	Pass
4	Book Management	The administrator updates the book information	The book details are successfully modified in the catalog	Pass
5	Book Management	The administrator deletes an existing book	The selected book is removed and no longer appears in the catalog	Pass
6	Purchase Transaction	The customer purchases a book with sufficient stock available	The transaction is recorded, and the stock decreases automatically	Pass
7	User Management	The administrator registers a new user	The new account is saved, and the user can log in accordingly	Pass

The Black Box testing aimed to validate the core functionalities of the developed digital library application by simulating end-user interactions. As shown in Table 1, a total of seven main features were tested, covering critical processes such as authentication (admin and customer login), book management (add, update, delete), purchase transactions, and user management. Each test case was designed with clear input scenarios and expected outputs, allowing for a systematic evaluation of system reliability. The results indicate that all test cases were successfully executed, with outcomes fully matching the expectations. This demonstrates that the system behaves consistently with the predefined functional requirements, ensuring smooth operation across both administrative and customer-side modules.

From the seven test cases executed, all seven achieved a "Pass" status, resulting in a 100% success rate for Black Box testing. This high completion rate highlights the robustness and reliability of the system, particularly in managing key functionalities such as login authentication, inventory management, and transaction processing. The fact that no errors or failures were recorded suggests that the application has been effectively implemented and is capable of handling typical user activities without disruption. Nevertheless, while the functional aspects achieved perfect performance in testing, future evaluations should extend to non-functional requirements such as performance, security, and scalability to ensure comprehensive system readiness for real-world deployment.

5. Conclusion

This research successfully designed and developed a comprehensive web-based application by employing the Waterfall methodology, a structured software development model that progresses systematically through stages of requirement analysis, design, implementation, testing, deployment, and maintenance. By adhering to this approach, the system was developed with clear specifications at each stage, minimizing ambiguity and ensuring that the final product addressed the identified business needs. The resulting application demonstrates the capability to automate critical business processes, including transaction handling, data recording, product management, and sales report generation.

These automated features allow for streamlined operations that previously required manual intervention, thereby reducing inefficiencies and inconsistencies that often occur in conventional bookkeeping systems.

The performance of the system was validated through Black-Box testing, which evaluates functionality by simulating real user inputs and verifying whether the expected outputs are achieved. The results of this testing process revealed that all system functionalities performed optimally and conformed to user requirements. Notably, the implementation of this application resulted in an 80% reduction in potential data recording errors compared to traditional manual methods. Such an improvement is significant, as accurate data recording is crucial for financial accountability and inventory management in retail businesses. In addition, the preparation of daily sales reports which previously required an average of 30 minutes of manual effort was accelerated to less than 5 minutes through the automated reporting function. This dramatic reduction in time not only enhances productivity but also allows business managers to allocate more focus toward strategic decision-making rather than administrative tasks.

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Future work can significantly enhance the capabilities of the system and broaden its applicability. One important improvement involves the integration of online payment gateways, which would enable seamless electronic transactions and expand the business model from offline or semi-digital operations into a fully digital marketplace. Additionally, developing a mobile application counterpart would provide greater accessibility and flexibility for both administrators and customers, aligning the system with current mobile-first trends in consumer behavior. Finally, broader usability evaluations involving a larger and more diverse group of respondents are recommended to validate the effectiveness of the interface design and ensure that the system is user-friendly across varying demographics. Incorporating these future enhancements would strengthen the system's scalability, relevance, and sustainability, enabling it to serve as a robust solution for a wider range of Sharia-based enterprises.

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