Web-Based Application Development for Circulation Services: Integrating Digital Receipt and Reminder Message Features

Pengembangan Aplikasi Berbasis Web Pada Layanan Sirkulasi: Integrasi Fitur Struk Digital dan Pesan Pengingat

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Abstract

Background: Delays in book returns, manual management practices, and limited access to borrowing information, along with suboptimal communication strategies, have reduced the quality of circulation services and hindered the optimal use of library collections. Based on these issues, developing a web-based circulation system equipped with digital receipt delivery and automated reminder messages is considered essential to improve service performance and ensure better utilization of library resources. Purpose: This study aims to develop a system that delivers digital receipts and automated reminder messages to help reduce delays in book returns. Method: This research employed a Research and Development (R&D) method using the ADDIE model (analysis, design, development, implementation, and evaluation). The study applied descriptive quantitative analysis with Likert scales and validation percentages, complemented by qualitative analysis from expert and respondent feedback. Result: The validation results indicated scores of 91% from material experts, 90% from media experts, and 96% from field trials, classifying the application as highly valid and feasible for use. The media evaluation also demonstrated that the application performs effectively, is user-friendly, and contributes to the enhancement of library service quality. Conclusion: The development of a web-based circulation service application using the ADDIE model has resulted in a system integrated with digital receipt and automated reminder features. These features assist users in managing their borrowing activities more efficiently and punctually. Validation results from experts and field trials confirmed that the application is highly valid, user-friendly, and feasible for implementation in school library services.

Keywords: Web-Based Application; Circulation Services; Digital Receipt; Reminder Message

Abstrak

Latar Belakang: Keterlambatan pengembalian buku, praktik pengelolaan manual, dan keterbatasan akses terhadap informasi peminjaman, ditambah dengan strategi komunikasi yang kurang optimal, telah menurunkan kualitas layanan sirkulasi dan membatasi pemanfaatan koleksi perpustakaan secara maksimal. Untuk mengatasi permasalahan tersebut, pengembangan sistem sirkulasi berbasis web yang dilengkapi dengan fitur pengiriman struk digital dan pesan pengingat otomatis menjadi hal yang penting. **Tujuan:** Penelitian ini bertujuan untuk mengembangkan sistem yang mampu mengirimkan struk digital dan pesan pengingat otomatis guna meminimalkan keterlambatan pengembalian buku. **Metode:** Penelitian ini menggunakan metode Research and Development (R&D) dengan model ADDIE (analisis, desain, pengembangan, implementasi, dan evaluasi). Data dianalisis secara kuantitatif deskriptif menggunakan skala Likert dan persentase validasi, serta dilengkapi analisis kualitatif berdasarkan masukan dari ahli dan responden. **Hasil:** Hasil validasi menunjukkan skor 91% dari ahli materi, 90% dari ahli media, dan 96% dari uji coba lapangan, yang menunjukkan bahwa aplikasi termasuk kategori sangat valid dan layak digunakan. Evaluasi media juga menunjukkan bahwa aplikasi memiliki kinerja yang baik, mudah digunakan, serta mendukung peningkatan kualitas layanan. **Kesimpulan:** Pengembangan aplikasi layanan sirkulasi berbasis web dengan model ADDIE menghasilkan sistem yang terintegrasi dengan fitur struk digital dan pesan pengingat. Fitur ini membantu pengguna dalam mengelola aktivitas peminjaman secara lebih efisien

dan tepat waktu. Hasil validasi dari para ahli dan uji coba lapangan menegaskan bahwa aplikasi sangat valid, mudah digunakan, dan layak diterapkan pada layanan perpustakaan sekolah dan tepat waktu. Hasil validasi dari para ahli dan uji coba lapangan menegaskan bahwa aplikasi sangat valid, mudah digunakan, dan layak diterapkan pada layanan perpustakaan sekolah.

Kata Kunci: Aplikasi Berbasis Web; Layanan Sirkulasi; Struk Digital; Pesan Pengingat

I. INTRODUCTION

Background. School libraries serve a crucial role as key learning support systems for both students and teachers. Based on data from the Ministry of Education, Culture, Research, and Technology, in 2023 there were 13,529 vocational high school libraries in Indonesia (Data Center and Technology Information, 2024). This indicates that school libraries are essential facilities that help students meet their information needs for studying and completing academic tasks. Togarman (2023) explains that through the use of school libraries, students will learn to identify their information needs, then search for and find relevant information sources, and ultimately access and apply the information accordingly.

In order to support these functions, school libraries require an effective service system, particularly circulation services. Circulation services are a key component in sustaining library operations, and the success of a library can be measured by how effectively these services are implemented and utilized (Apriyanto, 2014). The core activities within circulation services include borrowing, returning, and collection management. However, borrowing and returning processes frequently encounter challenges, particularly delays in book returns. The main cause of the delay is users' lack of awareness of the importance of discipline and responsibility in borrowing practices. As a result, the decrease in the library's book collection forces the library to continuously procure new items, resulting in financial losses for the institution (Farriza, 2024).

Problems. Delays in returning borrowed books remain a persistent challenge in library circulation services. Such delays are often associated with users' lack of awareness and discipline in managing loan transactions, including negligence in keeping receipts or borrowing slips containing critical information, such as due dates. When this information is inaccessible, users are more likely to return books late, which in turn reduces the overall availability and optimal use of collections.

The issue is further compounded by systemic limitations within the circulation management process. In many cases, library operations still rely on hybrid systems that combine automated and manual procedures. Technical constraints often prevent the full registration of collections, particularly fiction books, resulting in some part of the circulation process being managed manually. This condition increases the potential for errors, inefficiencies, and difficulties in tracking borrowing records. Additionally, users do not have direct access to their loan information because borrowing records are stored within the library, making it difficult for them to monitor return deadlines independently. The consequences of these problems are evident in circulation data, which consistently show that late returns account for nearly half of total borrowing transactions each year.

Figure 1.
Library Circulation Graph
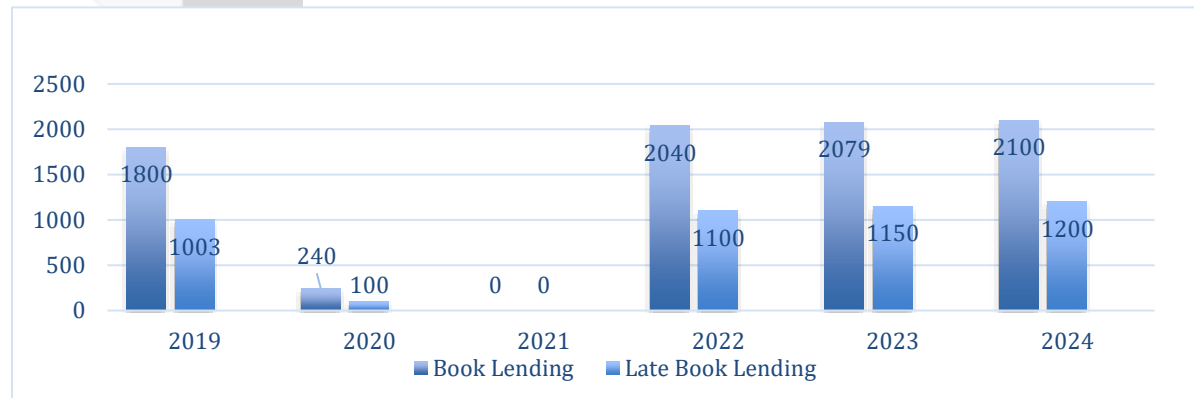
Source: Study's Data, 2025

Figure 2.
Date On Late Fines
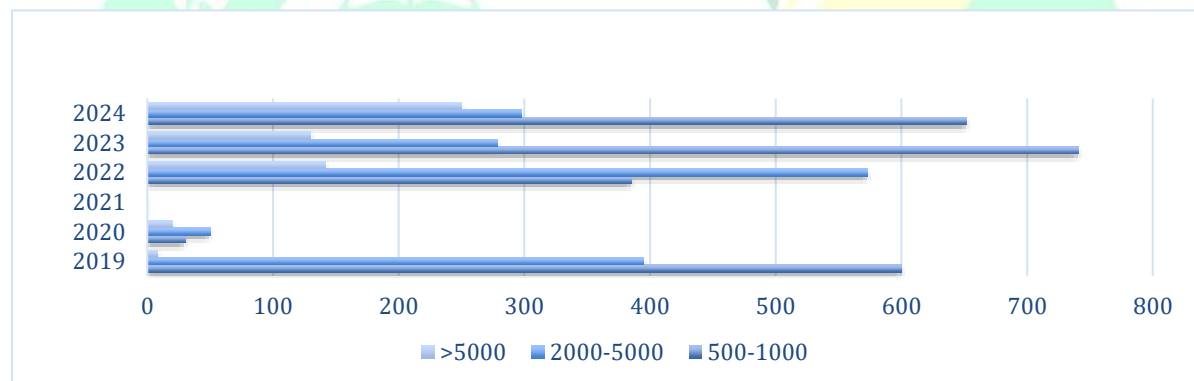
Source: Study's Data, 2025

The consequences of these problems are evident in circulation data, which consistently show that late returns account for nearly half of total borrowing transactions each year. Although delays temporarily decreased during the COVID-19 pandemic due to the shift to online learning, the numbers have risen significantly since the reopening of face-to-face learning activities. These delays also contribute to the accumulation of overdue fines. Most fines range between IDR 500–1,000 and IDR 2,000–5,000, while fines exceeding IDR 5,000 have become increasingly frequent, particularly in recent years.

Communication strategies used in circulation services have also proven less effective. Notifications or reminders about return deadlines are often delivered indirectly or through intermediaries, resulting in low levels of compliance among students. Consequently, the persistent occurrence of delays indicates that the issue is not only rooted in individual negligence but also to structural constraints of circulation management, limited user access to information, and ineffective communication practices.

This situation suggests that without a more integrated and technology-driven solution, circulation services will continue to face recurring inefficiencies. Therefore, developing a system that integrates digital receipts and automated reminders is necessary to address the root causes of delays and enhance the reliability of library services.

Previous Literature Review. Research on digital receipt systems and automated notifications has advanced across two main areas. Augustine et al., (2024) developed a secure web application for generating digital receipts with integrated digital signatures, emphasizing RSA-based security, SSL/TLS encryption, and user authentication to protect data and prevent document tampering. Meanwhile, previous studies in library settings have focused on automated reminder systems to reduce late returns. Rosadi and Sa'adah (2022) implemented a WhatsApp reminder sent on the due date, while Novitasari (2023) showed that persuasive messages delivered one to two days before the deadline successfully motivated users, with 95% feeling encouraged to return their books on time. Amanda (2019) also introduced an email-based reminder system for overdue returns and fines, though it did not include early reminders three days before the due date.

State of The Art. Previous studies demonstrate that technology-driven reminder systems hold significant potential and highlight the need for more contemporary and integrated solutions. These may include the integration of digital receipts within circulation services, the automation of reminder messages sent three days prior to the due date, and the enforcement of fines for unreturned books or outstanding penalties. Furthermore, these systems should leverage current communication channels, such as WhatsApp and email, to ensure effective user engagement.

Purpose. The purpose of this study is to develop a web-based application for circulation services with digital receipt and reminder message features, which is expected to reduce delays in book returns.

II. METHODS

This research employs the Research and Development (R&D) approach. The selected model for this product development is the ADDIE method (Analysis, Design, Development, Implementation, and Evaluation), developed by Molenda and Reiser (2003). The ADDIE model is widely used to describe a systematic approach to instructional development. The following section presents the ADDIE development model.

Figure 3.
ADDIE Stages.

Source: Molenda, 2003

Based on these considerations, the researcher selected the ADDIE model because of its clear stage structure, its flexibility to accommodate revisions during the process, and its suitability for research and development purposes. This model facilitates the creation of products that are systematic, effective, and academically accountable.

This research and development employed three data collection techniques: observation, interviews, and questionnaires. The questionnaire used a Likert scale as the measurement instrument. The Likert scale is a form of measurement method used in research to assess a person's response to an event or a social phenomenon. (Noviana, 2024). There were four answer choices on the questionnaire, which were tailored to the specific questions presented.

Table 1.
Likert Scale Score

Value	Indicator
5	Very Agree
4	Agree
3	Neutral
2	Disagree
1	Very Disagree

Source: Sugiyono (2019:93)

In Table 1, the scoring for each response is as follows: 'Very Agree' = 5, 'Agree' = 4, 'Neutral' = 3, 'Disagree' = 2, and 'Very Disagree' = 1. The obtained scores are then calculated using a predetermined percentage formula, based on the data analysis technique described by Saputro and Arikunto (2018). The formula is as follows:

$$P = \frac{\Sigma_X}{\Sigma_{Xi}} x100$$

Explanation:
Σ_X = Total score obtained from all items
Σ_{Xi} = Total ideal score
P = Percentage of validity
100 = Percentage constant

The percentage scores were then converted into the following assessment criteria:

Table 2.
Percentage Score

Percentage	Category
81–100%	Highly Feasible
61–80%	Feasible
41–60%	Fairly Feasible
21–40%	Less Feasible
0–20%	Not Feasible

Source: Arikunto (2010:282)

Table 2 shows that if the percentage reaches 81-100%, the media is categorized as "very suitable" for use in learning. A percentage of 60-80% indicates that the media is 'suitable', a percentage of 41-60% means that the media is "fairly suitable", and a percentage of 2-40% indicates that the media is "less suitable". Finally, if the percentage is below 20%, the developed media is considered "unsuitable."

III. RESULTS AND DISCUSSION

The results of research and development using the ADDIE model, which consist of five stages: analysis, design, development, implementation, and evaluation in developing a web-based circulation service application equipped with digital receipt and reminder message features for school libraries are as follows.

Analysis. The initial stage of the research and development involved conducting an analysis of problems and needs. The results of the analysis are presented as follows: based on observations and interviews with librarians, it was found that the circulation service still operates using a hybrid system both manual and digital so that borrowing and returning processes are still continued to be handled manually. Transactions are recorded in handwritten ledgers, as has been practiced for many years. This manual approach has a number of limitations, one of which is the absence of borrowing receipts that users can refer to when needed. This condition may lead to issues such as users being unaware of the book's due date because there are no official records for verification, which often leads to delays in returning books. Following the problem analysis, an information system is required to support a fully digital circulation process, particularly for book collections that have not yet been recorded in the automation system. The system is designed to automatically record borrowing and returning activities and to provide digital receipts accessible to users at any time. Furthermore, it should feature an automated reminder function that sends notifications prior to the due date and additional alerts when the user has exceeded the return period, including fine-related information.

Design. Based on the problem analysis and requirements described above, a web-based circulation service application with digital receipt and reminder message features was individually developed by the researcher. The following section presents the design of the information contained in the digital receipt and reminder messages.

Figure 4.
Digital Receipt Design

Source: Study's Data, 2025

Figure 4 shows the digital receipt designs for borrowing, returningEach design presents key transaction details in a clear, receipt-like format. The borrowing and return receipts highlight the loan period, return date, and transaction status, while short notes guide users to access the full document via the provided link. The illustration demonstrates how the system delivers essential circulation information efficiently through digital media.

Figure 5.
Reminder D-3 Before Due Date

Hello (borrower's name)!!

The book you borrowed, *(book title)*, is due on *(return date)*.

Please finish reading it soon

and please return it on time!!

Source: Study's Data, 2025

Figure 5 illustrates the design of an early reminder message that the system sends three days before the due date. The layout highlights a concise, friendly notification style intended to alert users about an approaching deadline in a clear and motivating manner.

Figure 6.
Reminder D-3 Before Due Date (in Bahasa)

Halo (nama peminjam)!! Halo (nama peminjam)!!

Buku yang kamu pinjam *(judul buku)* sudah lewat dari tanggal pengembalian *(tanggal jatuh tempo)*. Saat ini denda yang kamu terima (Rp.500). Yuk segera kembalikan!

Source: Study's Data, 2025

Figure 6 shows the Indonesian version of the reminder message generated three days before the due date. The design adopts a more direct communication style, emphasizing urgency to ensure users are aware of the overdue status and the need for immediate action.

Development. Each stage was designed to ensure that the developed system not only operates effectively but also meets the practical and informational needs of the school library. The final product developed by the researcher consists of three main components: (a) a web-based application interface; (b) a digital receipt; and (c) reminder messages.

Figure 7.
User Interface

Source: Study's Data, 2025

Figure 7 illustrates the User Interface of the Circulation Services application, designed to help users easily access various library features. The (1) Home section directs users to the main page, which serves as the entry point to all features and provides general information along with key highlights for easier navigation. Next, (2) About offers a description of the library, including its vision, mission, and profile, helping users understand the role and purpose of the library within the educational environment. The (3) Services menu displays the range of available services— such as circulation, reference, and digital support—allowing users to identify and select the services they need. The core feature is found in (4) Circulation, where users can borrow, return, and renew library materials in a more structured manner with systematic record-keeping. Through (5) Login, library members can access personalized services by entering their registered account credentials, ensuring secure and role-appropriate access. For new users, the (6) Onboarding Guide provides step-by-step instructions to help them understand how to use the system effectively. Additionally, the (7) Search Bar serves as a functional tool that enables users to find books quickly and efficiently, supported by the (8) Search Icon, an interactive button that activates the search function. Overall, this interface is designed to be user-friendly, informative, and supportive of smooth circulation service operations.

Figure 8.
Digital Receipt by WhatsApp and Email
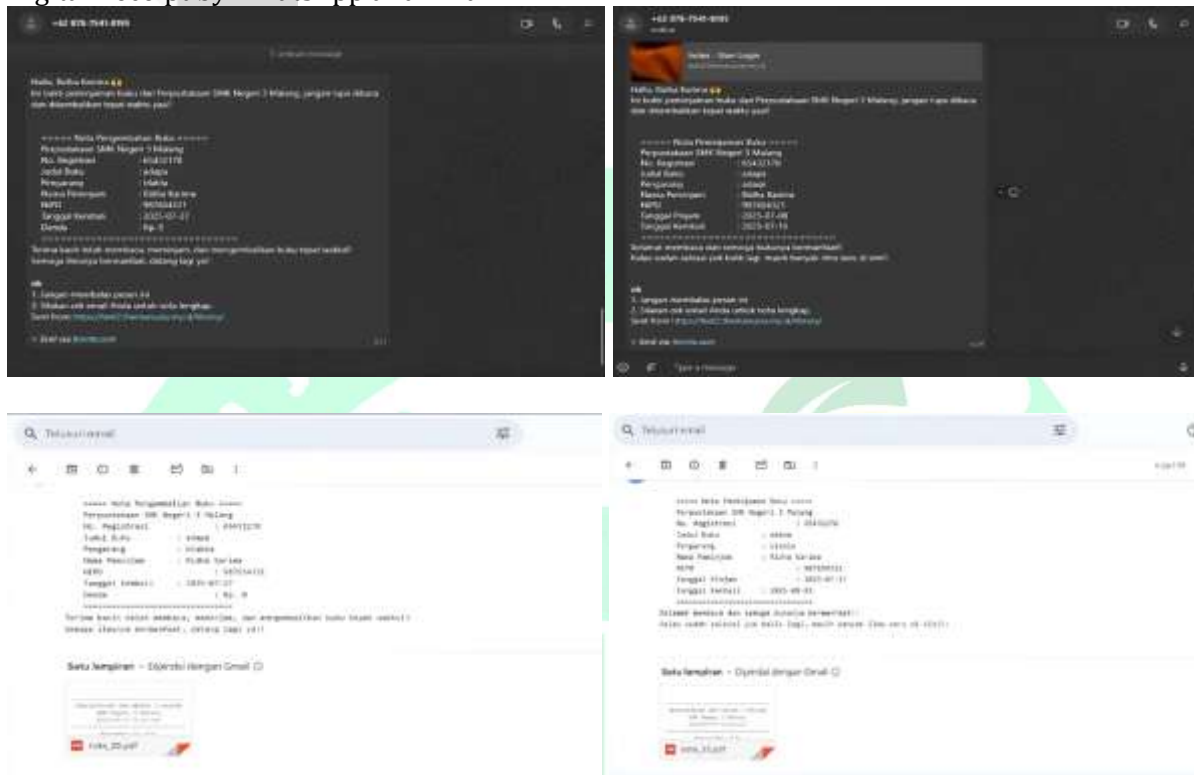
Source: Study's Data, 2025

Digital receipts are one of the outputs of the product developed by the researchers, which function as official proof of circulation service transactions. This receipt is issued after a book is borrowed, returned, or renewed. The main purpose of this feature is to provide clear and well-documented transaction information particularly regarding the book's due date so that borrowers can return materials on time and minimize delays. The following are examples of digital receipts for borrowing, returning, and renewing books.

Figure 9.
Reminder Day-3 Before Due Date

Source: Study's Data, 2025

Figure 10.
Overdue Reminder
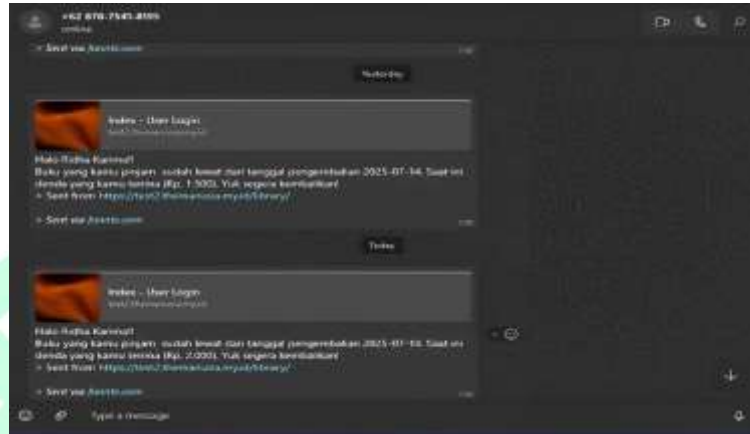
Source: Study's Data, 2025

Reminder messages are sent three days before the due date. If the book has not been returned, the system resends the notification, including information about the applicable fine. Additional reminders are then automatically delivered to the library member. After the system development stage was completed, the next step was the implementation of validation testing to obtain data on the product's level of validity. The validation process employed structured assessment instruments, specifically questionnaires that had been previously designed and validated. The evaluation at this stage involved two categories of experts, namely media and material specialists, to ensure that the product met both technical and content-related standards.

The validation conducted by the media expert utilized the Heuristic Evaluation method proposed by Nielsen (1990). The expert, an information technology specialist experienced in developing and assessing digital applications, focused on usability principles to determine whether the system met essential design and interaction standards. The evaluation resulted in a validity percentage of 90.7%, which is categorized as very valid. These findings indicate that the system has fulfilled the required usability and technical feasibility criteria, making it suitable for advancement to the next stage of implementation.

In addition to media validation, the material expert evaluation covered three core dimensions. The first dimension concerned the circulation service aspect, assessed using the service indicators formulated by Khoirunnisa (2023). The second dimension evaluated the digital receipt component to ensure compliance with the Information and Electronic Transactions Law (UU ITE) and the 2009 Supreme Court Regulation (PERMA), confirming its alignment with legal and procedural requirements. The third dimension focused on the reminder message feature, assessed based on the indicators developed by Anam et al. (2018). Across these three dimensions, the product achieved an average validity score of 91%, indicating a high level of validity. This demonstrates that the system content aligns with academic standards, practical service needs, and legal frameworks, making it appropriate for further implementation.

Implementation. At the implementation stage, this study employed a small-scale field test. The trial involved 15 students as participants. During the trial, the students, acting as library users, used the product to perform borrowing, returning, and renewal activities. Upon completing these activities, each user received a digital receipt as a valid proof of the transaction.

The borrowing period was set for seven days. Three days after the return deadline had passed, users automatically received reminder messages. After using the product, participants were requested to complete a questionnaire about their experience with the system.

Evaluation. The evaluation stage was the implementation process with student participants. A total of 15 respondents were involved in this stage. After the product was tested and used, the researcher obtained various suggestions and feedback from respondents regarding both the strengths and weaknesses of the system. These suggestions serve as valuable input for further research and future product development. Through this evaluation process, it is expected that the developed product can deliver maximum benefits and be considered feasible for broader implementation within the library context.

The following are the results of data analysis based on the validation conducted by media experts, material experts, and the field test:

Table 3.

Result Score

Source: Study's Data, 2025

No	Expert	∑	Max	%	Category
1.	Ahli Media	68	75	90,7%	Sangat Valid
2.	Ahli Materi	105	115	91%	Sangat Valid
3.	Uji Lapangan	1443	1500	96%	Sangat Valid

Based on the overall evaluation, the product developed in this study is categorized as **very valid** and therefore feasible for use. Furthermore, it is expected to significantly improve circulation services while simultaneously reducing issues related to overdue book returns.

Discussion. Based on the results of the development process and the conducted trials, it can be concluded that the web-based application integrating digital receipts and reminder messages significantly improves library circulation services. By enabling users to perform self-service borrowing and by providing features such as digital receipts and automated reminder messages, the system successfully addresses the primary issue of overdue returns, which often limits the optimal use of library collections, valuable national assets. This web-based application facilitates independent borrowing experiences, accelerates circulation services, and offers easy access to borrowing and return information through the integration of digital receipts and reminder messages.

Validation by media experts confirmed that the product is categorized as "very valid." This is attributed to the user interface design, which maintains consistency in both layout and navigation across all sections, incorporates intuitive icons, and employs a clean design that highlights relevant information. The simplicity of the structure and the ease of navigation are crucial in ensuring that users, particularly students, can quickly understand core functions such as borrowing, returning, and accessing automatically generated digital receipts. Furthermore, reminder messages are delivered seamlessly through WhatsApp and email without requiring intervention, thereby enhancing efficiency and ensuring timely notification to users.

The validation conducted by material experts further strengthened the content validity. The material evaluation achieved an average score of 90%, which is categorized as "very valid." The development of the system was aligned with the circulation service dimensions proposed by Fatmawati (2013), namely Service Affect and Information Access. The system provides an easy-to-use interface, supports independent access, and ensures real-time availability of borrowing and return information.

The digital receipt feature was designed to meet the principles of transaction authenticity and legal compliance as stipulated in the Information and Electronic Transactions Law (UU ITE) and Supreme Court Regulation (PERMA) No. 1 of 2019, by recording complete, accurate, and well-documented transaction data. Additionally, the reminder message feature strengthens user discipline by providing automated notifications prior to and after the due date, thus reducing the occurrence of overdue returns.

The results of the small-scale field test involving 15 student respondents achieved a score of 96%, also categorized as "very valid." This indicates that the developed product is highly valid and feasible for application in supporting digital-based circulation services. The trial demonstrated that the system not only accelerates the circulation process but also contributes to the adoption of modern library practices in line with the increasing need for technological integration in educational environments.

Overall, the findings of this study are consistent with previous research automated notification systems in library circulation services. Rosadi and Sa'adah (2022) found that WhatsApp-based return notifications were effective in reducing overdue returns in school libraries, while Kasus and Jenawi (2013) developed a library application featuring SMS-based reminders. Although these studies employed different media notifications, both emphasized the importance of automated reminders in enhancing the efficiency of circulation services. The present study strengthens these findings by introducing a system that not only delivers automated reminders but also integrates digital receipts as verifiable proof of digital transactions.

Considering the development outcomes and validation data demonstrating a high degree of reliability, the web-based circulation service application developed in this study exhibits strong potential in fostering user responsibility for borrowed collections. The digital receipt feature ensures that users receive immediate and well-documented proof of transactions, while the reminder messages, automatically delivered through WhatsApp and email, serve as consistent reminders of return deadlines. Together, these features enhance access to information and promote user awareness of timely return obligations. With its practical, contextually relevant digital approach, this system strengthens library circulation services and supports the cultivation of a more disciplined literacy culture within the school library environment.

IV.   CONCLUSION

Based on research outcomes and validation results, it can be concluded that this product was developed through the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The use of this model ensured a structured and iterative process, resulting in a product that is practical, accessible, and aligned with the operational needs of school library environments. The developed application integrates two essential features—digital receipts and reminder messages—that function complementarily to enhance the efficiency of circulation services. The digital receipt feature enables the secure storage of valid transaction records in digital form, while reminder messages assist borrowers in adhering to return deadlines, thereby reducing overdue cases. Together, these features foster user independence and accountability in managing borrowing activities. Furthermore, validation conducted by media and material experts, supported by field testing, confirmed that the product meets the expected standards of quality, usability, and applicability for implementation in school library services. The finding consistently indicated that the product is highly valid and feasible for implementation. These results demonstrate that the application is appropriate for use in school library services and has the potential to create a more practical, efficient, and user-oriented circulation system.

V. ACKNOWLEDGMENTS

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