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KutaBaca: Developing and Implementation of an Offline Digital Library System to Enhance Literacy in the Low-Connectivity Environment of Wiyata Tech Village Purwakarta

LIPTIA VENICA[1], REISA AULIA SODIKIN[2], NINA HERLINA[1], ULVA ELVIANI[2], AULIA AUFA ZAHRON[1], MUHAMMAD RANDY KURNIAWAN[1], ARIEL DWIKA NUGRAHA[1], DEWI INDRIATI HADI PUTRI[1]

[1]Department of Mechatronics and Artificial Intelligence, Universitas Pendidikan Indonesia
[2]Department of System and Information Technology Education, Universitas Pendidikan Indonesia
Email: liptiavenica@upi.edu

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ABSTRACT

Achieving Quality Education (Sustainable Development Goals, or SDGs, Point 4) remains a significant challenge in rural areas characterized by low digital infrastructure. Specifically, Kutamanah Village in Purwakarta faces critical literacy issues, with its primary school's literacy rate tragically categorized as 'red,' compounded by a low regional Quality Education Index score of 46.70. This research aims to address this digital and literacy gap through the systematic development and implementation of KutaBaca, an Offline Digital Library system. Utilizing a Research and Development (R&D) methodology based on the Software Development Life Cycle (SDLC) model, the system was designed with a local server and an internal wireless network, allowing students and teachers to access a vast collection of e-books and learning modules without relying on an external internet connection. Evaluation focused on rigorous Functional Testing and a System Usability Scale (SUS) assessment involving 30 students and 7 teachers. The results demonstrate a 100% functional success rate and an overall average SUS score of 83.1 ('Excellent'). This confirms that KutaBaca is a reliable, user-friendly, and replicable technological innovation, effectively increasing access to information and serving as a sustainable solution to boost literacy and support SDGs 4, 10, and 17 in low-connectivity regions.

Keywords: *Offline Digital Library, Literacy Enhancement, Low-Connectivity, Sustainable Development Goals (SDGs), Intranet, Education Application, CodeIgniter*

1. INTRODUCTION

The pursuit of Quality Education (Sustainable Development Goals/SDGs Point 4) is a core component of global sustainable development. However, this goal faces wide challenges in Indonesia, particularly in rural areas marked by limited digital **infrastructure (Sutopo & Wahyudi, 2021)**. The situation is critically reflected in Purwakarta Regency, where the overall SDGs Desa achievement score remains low at 46.70. This score is significantly influenced by deficiencies in infrastructure and a low Quality Education Index (below 50), which directly impacts the quality of community literacy and learning **(Report, n.d.)**. This lack of basic infrastructure, including limited internet access and modern educational technology facilities, systematically widens the digital gap and hinders progress toward Reduced Inequalities (SDGs Point 10) **(Kemendikbudristek, 2022)**.

This national challenge is acutely experienced and most urgent in Kutamanah Village, Sukasari District, Purwakarta Regency. The village is not only geographically challenging and characterized by severe internet signal limitations, but also suffers from a serious literacy crisis. Based on direct observation and teacher reports from SDN 1 Kutamanah, the primary school in the village, the student literacy rate has been categorized as 'red' **(Hariro et al., 2024)**. This status signifies that a majority of students have not achieved basic functional literacy skills. Compounding this, the school relies entirely on physical textbooks as its sole learning resource, lacking any computer support or adequate internet connectivity. This condition highlights a severe barrier to improving digital literacy and the overall quality of education. Furthermore, the challenges in Kutamanah align with national issues observed in 3T (Underdeveloped, Frontier, and Outermost) regions, where technology-based educational access is low. A 2023 Bappenas report shows that only 64% of schools in 3T areas have adequate access to digital technology. Locally, only 42% of elementary schools in Purwakarta Regency possess a computer laboratory **(Bappenas, 2023)**. This systemic issue widens the educational quality gap between urban and rural areas, and the limited literacy and access to quality information in Kutamanah Village is a national impediment to educational equity (SDGs Point 10).

In this study, an offline digital library is defined as a self-contained digital information system in which all learning resources are locally stored on a server and accessed through an internal network without requiring real-time internet connectivity during daily use. Unlike conventional online digital libraries that depend on continuous external internet access, offline digital libraries are specifically designed for low-connectivity environments, enabling uninterrupted access to educational materials regardless of network availability. This approach ensures that learning activities remain stable, cost-efficient, and inclusive, particularly in rural and underserved regions where internet access is unreliable or unavailable **(Lwoga, 2016; Purbo, 2020)**

The development of an offline digital library is not intended to replace existing online collections, but rather to bridge the accessibility gap caused by infrastructural limitations. In contexts such as Kutamanah Village, unstable internet signals, high connectivity costs, and limited digital infrastructure prevent effective utilization of online learning platforms. As a result, relying solely on online digital libraries may exacerbate educational inequality **(Sutopo & Wahyudi, 2021)**. By adopting an offline system architecture, KutaBaca enables schools to access a diverse range of digital learning resources through appropriate technology that aligns with local conditions, ensuring equitable access to information and supporting sustainable literacy development.

To directly respond to the emergency 'red literacy' situation and bypass the limitations of internet infrastructure, a self-contained technological innovation is necessary. The proposed solution is the KutaBaca Offline Digital Library. This library utilizes a local server and an internal wireless network (appropriate technology) that allows students and teachers to comprehensively access e-books, modules, and other learning materials without dependency on an active external internet connection. Its content repository is primarily built on open educational resources (OER) and public domain materials sourced from various free, copyright-free websites, ensuring the project's sustainability, scalability, and strict adherence to intellectual property laws **(Lwoga, 2016)**. This model of an offline digital library has been proven effective in bridging the educational gap in remote regions, providing broad access to learning, and building a foundation for enhanced student literacy and digital skills **(Purbo, 2020, 2023)**.

The main objectives of this community engagement activity, documented in this paper, are to develop and successfully implement the KutaBaca Offline Digital Library in Kutamanah Village as an innovative solution to critical information access and literacy limitations, and to assess the functionality and usability of the system by teachers and students. Ultimately, this project aims to produce a replicable educational innovation model that can be adopted by other rural areas facing similar low-connectivity challenges, thereby supporting the achievement of SDGs Point 4 and Point 10.

2. METHODOLOGY

2.1 Research Methodology and Approach

This study employs a Research and Development (R&D) methodology, which is fundamental for creating and validating a specific technological product that addresses a community need. The development process specifically adheres to the System Development Life Cycle (SDLC) model. Utilizing the SDLC is crucial for software-based public service projects to ensure the final product is functional, meets user requirements, and is highly maintainable **(Pressman & Maxim, 2021; Sommerville, 2021)**. The R&D approach, combined with SDLC principles, was executed through the following stages: System Requirements Analysis, Design, Development, Implementation, and Evaluation.

2.2 Stages of Development and Implementation

The project execution followed a structured five-stage process derived from the SDLC model. The first stage, **System Requirements Analysis**, involved identifying the urgent need for a

Figure 1. The Process of System Requirements Analysis Through Observations and Interviews

zero-internet solution, confirming the specific content requirements, and validating the 'red literacy' status through field observations and interviews as shown in Figure 1.

The application utilizes a **Client-Server Architecture** as illustrated in Figure 2, where a local server hosts the application and database, and user devices (clients) access it via an internal Wi-Fi network, as appropriate for low-connectivity environments. The hardware configuration deployed utilizes a total of three dedicated computing units: one unit functions as the centralized server hosting the application, and the remaining two units are configured as dedicated client terminals (reader stations) for end-users. Crucially, a Uninterruptible Power Supply (UPS) unit is integrated into the system to ensure continuous operational stability and mitigate data loss risks associated with the frequent power fluctuations prevalent in the deployment area.

Following analysis, the **Design** stage focused on creating the robust system architecture. The system's use cases as shown in Figure 3 is defined, primarily centering on two main actors: the Teacher-Admin (responsible for content upload) and the Student/Teacher-Reader (responsible for accessing, searching, and reading digital content). This stage also finalized the Database Design as shown in Figure 4, which included essential tables such as users, books (storing metadata like title, author, category, and file path), and categories, ensuring data integrity and efficient retrieval. This stage included meticulously curating the content repository, where digital books, modules, and other educational materials were sourced exclusively from websites offering free access, public domain materials, and open-source licenses, guaranteeing compliance with copyright regulations. The primary sources for the KutaBaca content are detailed in Table 1.

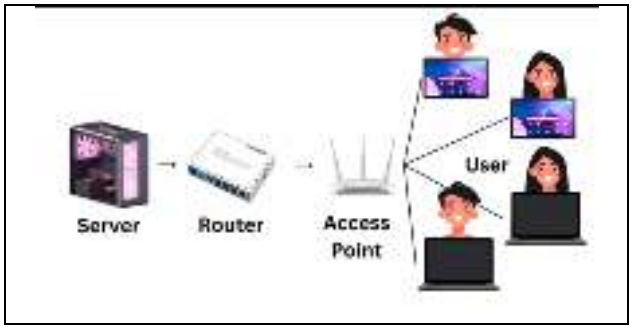

Figure 2. System Architecture of KutaBaca

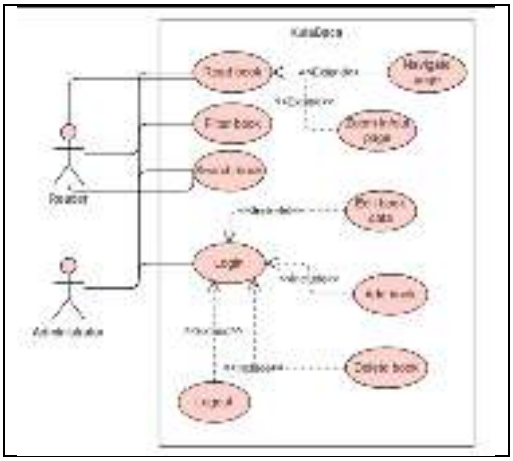

Figure 3. Use Case Diagram of KutaBaca

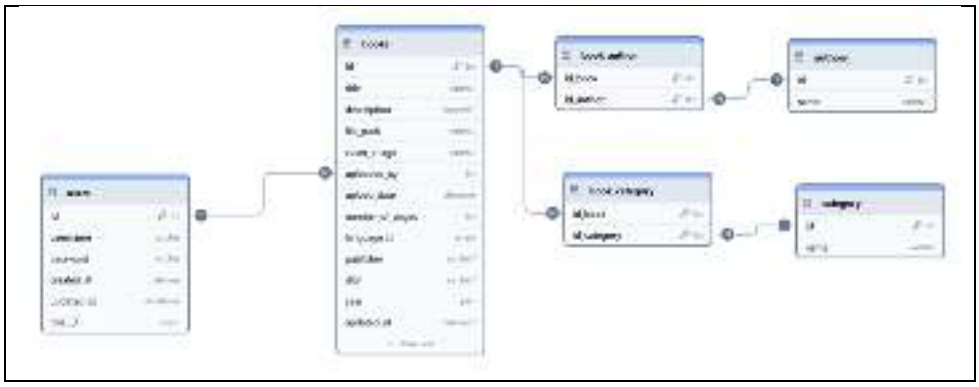

Figure 4. Database Design of KutaBaca

The **Development** stage encompassed the technical configuration of this hardware. Both the server and reader computers are provisioned with the Ubuntu Operating System, chosen for its stability and open-source nature. The backend application is built using the CodeIgniter framework (PHP) for its modularity and robust features, and MySQL is chosen as the Relational Database Management System (RDBMS). This stage also included setting up the dedicated internal Wi-Fi access point and uploading all digital content. Subsequently, the Implementation stage involved the physical deployment of the KutaBaca system within the school premises, accompanied by intensive socialization and training. Finally, the Evaluation stage assessed the system's quality and effectiveness through Functional Testing (UAT) and Usability Assessment (SUS).

Although the digital content utilized in KutaBaca originates from various online open-access repositories, these sources do not function as live online services within the system. Instead, all selected materials are downloaded, curated, and stored locally on the KutaBaca server during the development phase. Once deployed, the system operates entirely offline, allowing users to access all resources through an internal wireless network without external internet dependency. Table 1 therefore represents the initial content sources used for content acquisition and adaptation, rather than platforms accessed during system operation.

Table 1. Sources of Open Access and Copyright-Free Digital Content

No.	Book Source	Book Type
1	https://buku.kemendikdasmen.go.id/	Textbooks (Curricular) and Non-textbooks
2	https://budi.kemendikdasmen.go.id/	Textbooks and other types of reading books in Indonesian, English, and regional languages
3	https://bookdash.org/	English language non-fiction books for children
4	https://www.letsreadasia.org/	Fiction books in various languages for children

2.3 Evaluation Instruments

The evaluation of the KutaBaca system employed two complementary quantitative instruments to comprehensively assess both technical performance and user experience. The first instrument was Functional Testing, also referred to as User Acceptance Testing (UAT), which aimed to verify that all core system features operated correctly within a fully offline environment. This testing was particularly critical given the system’s reliance on local

infrastructure, where technical failure could directly disrupt learning activities in low-connectivity settings.

Functional Testing was conducted by all seven teachers involved in the implementation, consisting of two Teacher-Admins and five Teacher-Readers, and was also observed during student access to ensure system stability under real usage conditions. The testing covered essential functions, including offline content access, search and filtering features, administrative management, and overall system stability.

The second instrument was the System Usability Scale (SUS), a standardized 10-item questionnaire widely used to measure perceived usability **(Brooke, 1996)**. SUS was selected due to its simplicity, reliability, and suitability for diverse user groups, including elementary school students and teachers with varying levels of digital literacy. A total of 37 respondents participated in the usability evaluation, comprising 30 students from Grades 1 to 6 and 7 teachers (five Teacher-Readers and two Teacher-Admins). The combined use of UAT and SUS enabled a balanced evaluation of both system functionality and user-centered usability in the context of an offline digital library.

3. RESULTS AND DISCUSSION

3.1 System Development and Architecture

The KutaBaca Offline Digital Library is successfully developed utilizing a low-power single-board computer acting as the local server. The server, running on Ubuntu OS, hosted the application built with the CodeIgniter framework and connected to the MySQL database. This server is connected to a dedicated Wi-Fi router, creating a closed, internal Local Area Network (LAN) that guarantees fast, stable, and cost-free access to all digital resources, bypassing the external internet requirement **(Purbo, 2020)**. The architecture successfully implemented the defined use cases, allowing Teacher-Admins to manage the content efficiently and enabling students to search and read seamlessly. The inclusion of a UPS maintained system integrity despite local power instabilities.

The system features allow students to search books based on multi-criteria, including title, author, category (e.g., textbook, story, science), and language (Indonesian and English). The interactive reader provides tools like zoom in/out and direct page navigation. The admin as the primary collection manager, responsible for content uploading and metadata editing. The user interface for KutaBaca features is illustrated in Figure 5.

3.2 Implementation and Socialization

The system hardware, including the server and two dedicated reader computers (all running Ubuntu OS), is physically installed at SDN 1 Kutamanah. The implementation phase included comprehensive training tailored to two user groups: Students (focusing on simple navigation) and Teachers (focusing on content access and system maintenance) as shown in Figure 6.

The training emphasized pedagogical integration, how teachers could use the diverse digital resources to specifically address the 'red literacy' deficiencies observed in the student body.

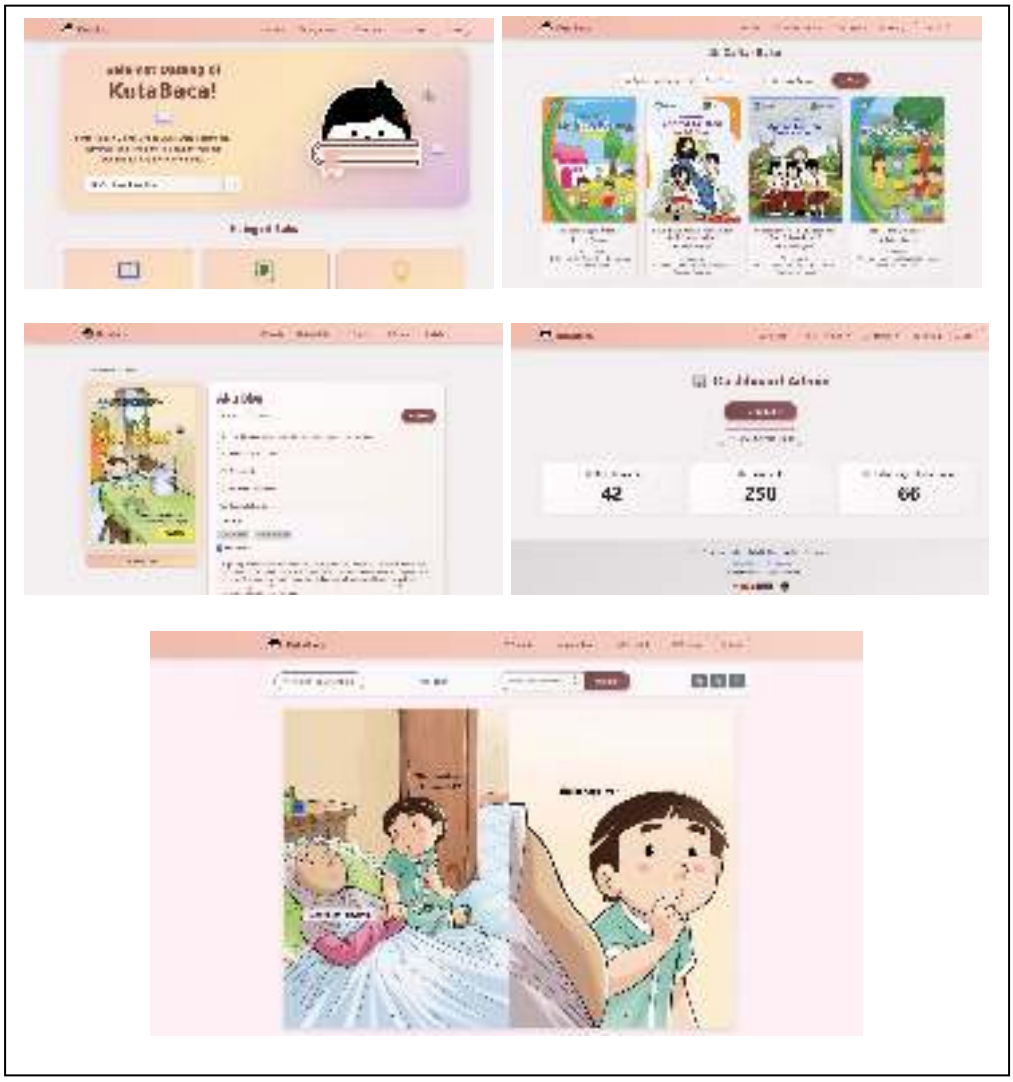

Figure 3. User Interface of KutaBaca Application

3.3 Evaluation Findings

The evaluation results confirmed the system's operational success and high user satisfaction based on the data collected from 37 respondents.

Table 2. Functional Testing and User Acceptance (UAT)

Function/Feature	Role Tested	Result	Discussion
Offline Content Access	Student and Teacher-Reader	100% Passed	Confirmed the core objective: instant, zero-internet access via the local Wi-Fi.
Content Search and Filtering	Student and Teacher-Reader	100% Passed	Users successfully navigated and located materials using defined criteria.
Admin Login and Management	Teacher-Admin (2 Persons)	100% Passed	Confirmed successful content uploading and system maintenance capability.
System Stability	All Roles (37 simultaneous users)	Passed	The local server maintains stability during peak usage.

The 100% functional success rate observed in the UAT (Table 2) demonstrates the technical reliability of KutaBaca as a robust and infrastructure-independent educational tool suitable for low-connectivity environments. In addition to functional performance, system usability was evaluated using the System Usability Scale (SUS), yielding an overall average score of 83.1, which is categorized as *Excellent*, as presented in Table 3.

The SUS results indicate that KutaBaca is perceived as highly usable by both students and teachers. The higher average score among students (84.5) suggests that the interface design and navigation are intuitive and accessible for young users, supporting early literacy engagement. Meanwhile, the teachers' SUS score (81.7) reflects positive perceptions regarding system reliability and ease of content access, which are essential for effective classroom integration and independent learning facilitation. Overall, these findings suggest that the system successfully accommodates the needs of different user groups within a low-connectivity educational context and provides a solid foundation for its broader educational application. Figure 6 shows documentation of the programme.

Table 3. Usability Assessment using System Usability Scale (SUS)

User Group	Total Respondents	Average SUS Score	SUS Grade & Description
Students (Grades 1-6)	30	84.5	Grade B+ (Excellent)
Teachers (Reader and Admin)	7	81.7	Grade B (Good)
Overall Average	**37**	**83.1**	**Grade B+ (Excellent)**

Figure 4. Implementation and Evaluation of KutaBaca System

3.4 Discussion

Beyond technical performance, the successful deployment of KutaBaca—supported by a 100% functional success rate and an Excellent SUS score (83.1)—demonstrates the effectiveness of the R&D methodology in addressing real-world technological barriers in low-connectivity educational settings. The local server architecture, built on Ubuntu, CodeIgniter, and MySQL, effectively eliminates dependency on external internet connectivity, directly addressing one of the key factors contributing to the low regional Quality Education Index. Moreover, the

system's reliance on free and copyright-compliant educational resources ensures legal compliance while supporting long-term sustainability. This intervention illustrates a practical strategy for mitigating the digital divide and fulfilling the core objective of the PkM program to strengthen literacy and promote inclusive education in Kutamanah Village.

From the participants' perspective, these technical advantages translated into tangible educational benefits. Students demonstrated increased engagement during reading activities, as access to diverse digital books provided meaningful alternatives beyond limited printed textbooks. Teachers reported that the system supported greater instructional flexibility, enabling them to recommend reading materials aligned with students' literacy levels without concerns related to internet availability. In addition, the offline nature of the system minimized technical disruptions during learning sessions, contributing to a more focused and consistent learning environment.

Furthermore, the local-server architecture empowered teachers to assume an active role as content managers, fostering a sense of ownership and enhancing system sustainability. This finding aligns with previous studies indicating that community-based and infrastructure-adaptive technologies are more likely to be adopted and maintained in rural educational contexts. Accordingly, KutaBaca not only addresses immediate literacy challenges but also contributes to long-term digital inclusion, educational resilience, and the achievement of SDGs related to quality education and reduced inequalities.

4. CONCLUSIONS

The KutaBaca project successfully completed the development, implementation, and evaluation of an Offline Digital Library system in Kutamanah Village, Purwakarta. The system offers an effective solution to improve literacy and directly addresses the village's "red literacy" status. In the Development phase, the team built a functional closed-network digital library based on CodeIgniter and MySQL running on Ubuntu, using free and copyright-compliant educational materials so learning can occur without external internet access. During Implementation, the system was integrated smoothly into the school through proper hardware deployment, one server and two reader stations supported by a UPS and training that equipped teachers to operate the system effectively. The Evaluation phase further validated the system's success, achieving an 83.1 SUS usability score and a perfect 100% UAT result, proving that KutaBaca is reliable, easy to use, and beneficial for the school community. The project also serves as a replicable model supporting SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities) by expanding access to educational resources in remote regions through appropriate technology. For long-term sustainability, the project recommends preparing a structured maintenance guideline, strengthening teacher administrator capacity, establishing collaboration with the local Education Office, and ensuring regular content updates along with interactive learning modules to maintain student engagement and literacy growth.

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