Journal of Information System and Technology Research

journal homepage: https://journal.aira.or.id/index.php/jistr/

Digitalization of Rural Water Management: Android-Based Billing for Community Systems using the ADDIE model

Nurfiah[1,*], Afdhal Dinilhak[2], Luthfil Khairi[3], Budy Satria[4] , Anggi Hadi Wijaya[5] Ajeng Dwi Asti[6], Arifan Rahman[7]

[1,2,3,4,5,6,7] Department of Informatics, Universitas Andalas, Indonesia

ARTICLE INFO

Article history:

Received May 8, 2025
Accepted May 29, 2025
Available online May 31, 2025

Keywords:

Android Application
Rural Digitalization
Smart Village
ADDIE Model
Community Empowerment

ABSTRACT

The integration of information technology in everyday life has changed the way people work, learn, socialize, make transactions, and make decisions. The use of Android-based smartphones is a real example of the use of technology. Android, which is open-source, has encouraged the development of applications widely according to need. Access to water is a fundamental human right. PAMSIMAS is a flagship program of the regional and central governments that seeks to meet water needs through the provision of clean water services in line with the Sustainable Development Goals (SDGs). In Durian Seribu Village, PAMSIMAS is a service to meet the water needs of the community and become a solution for rural communities to get clean water at low cost, but its management is still manual, such as recording water usage and billing, so it is inefficient, time-consuming, and prone to errors. From these problems, this study proposes the development and implementation of an Android application designed to simplify the recording and billing process for the PAMSIMAS program in Durian Seribu Village. This application aims to simplify management, increase data transparency, and simplify reporting. The results of tests that have been carried out using the black box method show that this application can facilitate officers in recording and billing payments for PAMSIMAS water usage. Officers only need to enter the total water usage, and the application will automatically calculate and print a receipt as proof of payment. Officers also do not need to calculate manually when reporting the total payment to the administrator. For administrators, this application makes it easier to monitor and evaluate the performance of recording officers. After the application was used for recording and billing, PAMSIMAS's revenue increased by around 30% from the revenue before using the application.

Corresponding Author:

Nurfiah,
Department of Informatics, Andalas University,
Padang City, West Sumatera Province.
Email: nurfiah@it.unand.ac.id

1. INTRODUCTION

The use of information technology has now become an important need in various aspects of daily life. Technology is used to make work easier, increase knowledge, social interaction, buying and selling transactions, and even earn additional income. The use of information technology can also help in making decisions and promoting transparency [1]. An example of the use of information technology is the use of gadgets. Gadgets are a term for small electronic devices that have many functions, for example, smartphones [2]. Smartphones are important devices in everyday life because they have many features that can help make daily activities easier[3]. The Android operating system dominates the smartphone market, with thousands, even millions of devices currently running on it [4]. Android is open source, so developers can create applications according to their needs [5]. Android will be the most widely used operating system in the world by 2024. Android is not only used as an operating system on smartphones but is also used on other electronic devices such as Smart TVs, Laptops, Netbooks, Smart Glasses, and even cameras [6].

Clean water is a basic need for human survival [7]. PAMSIMAS programs make it easier for communities to meet their water needs so that they can improve their quality of life and health [8]. PAMSIMAS is a water and sanitation provision

service for the community managed by the Village Government and the Community[9]. PAMSIMAS is a flagship program of the regional and central governments to increase access to clean drinking water for rural communities [10], The goal of providing clean drinking water to everyone is in line with Sustainable Development Goal (SDG) 6 [11], every human being has the right to obtain healthy, clean water easily for daily needs [12]. Durian Seribu Village is a village located in Silaut District, Pesisir Selatan Regency, West Sumatra Province. The majority of the people in this village work in the plantation sector with oil palm as the main commodity, because the production of oil palm can significantly increase the economy, so people plant oil palm in their yards. Oil palm plants require more water when compared to other plants. The use of fertilizers on oil palms can reduce the quality of water in the soil and rivers, so that the water becomes cloudy, sap, smelly, and oily [13]. From these problems, the village government created the PAMSIMAS program by drilling several wells and distributing them to 389 households that have subscribed. PAMSIMAS in Durian Seribu Village is managed by the Village-Owned Enterprise (BumNag), which is an effort to achieve village independence, so its management must be carried out with good and transparent management. Customers are required to pay contributions based on the water usage each month. Recording of water usage and billing of contribution payments is carried out by officers every month, which is still done manually, so there is a high possibility of errors in calculations and data processing, it takes a long time, and is less effective and efficient, resulting in losses, namely decreased income and water use that is difficult to control. The calculation of total water usage is the total water usage for the current month minus the total water usage for the previous month. Because manual calculations are still used, officers will look for the total usage for the previous month from the meter reading book, which takes a long time and is prone to errors. The amount of the contribution is the total water usage multiplied by the rate per m3 plus the cost of the load. Based on these problems, the researcher will create and implement an Android Application for Recording and Billing Payments for PAMSIMAS in Durian Seribu Village. The researchers hope that this application can facilitate officers in recording and collecting monthly payments, create data transparency, and make reporting easier.

Previous research entitled Design of Android-based Community Drinking Water and Sanitation Information System (PAMSIMAS) aims to assist management in processing good PAMSIMAS data. Another study entitled Design of Application System for Recording and Payment of Water Bills in Grand Sulawesi Parepare [14] aims to help clean water customers check their water bills regularly and make it easier for providers to manage water. Another study entitled Drinking Water Management Information System at KP-SPAMS in Molotabu Village [15] aims to facilitate accurate data recording so as to reduce manipulation of water recording data and facilitate reporting of water consumption every month. Based on the research that has been done previously, there are still shortcomings, namely the information system or application that is designed is not connected to a thermal printer to directly print proof of recording and billing payments, in addition there is no feature to send reports directly via Whatsapp messages, so researchers will add these features to the Android Application for Recording and Billing Payments in PAMSIMAS in Durian Seribu Village

2. RESEARCH METHOD

The research begins with data collection by conducting interviews with administrators, analyzing problems, selecting the technology to be used, making designs, implementing, and testing. This study uses the research and development (R&D) method. Research and Development is a research method that can produce a product and test the effectiveness of the product [16]. Application development using the ADDIE model is suitable for product creation or development each stage is interrelated, and evaluation can be carried out at each stage [17]. In 1967, Reiser and Mollanda designed this model. Initially, this model was used to create teaching designs and teaching materials to be more effective and efficient [18]. ADDIE is a model with five integrated steps, namely Analysis, Design, Development, Implementation, and Evaluation [19], products produced have gone through needs analysis and have been tested for their effectiveness, so that the products can be used by the wider community [20]. The following figure illustrates the ADDIE model development.

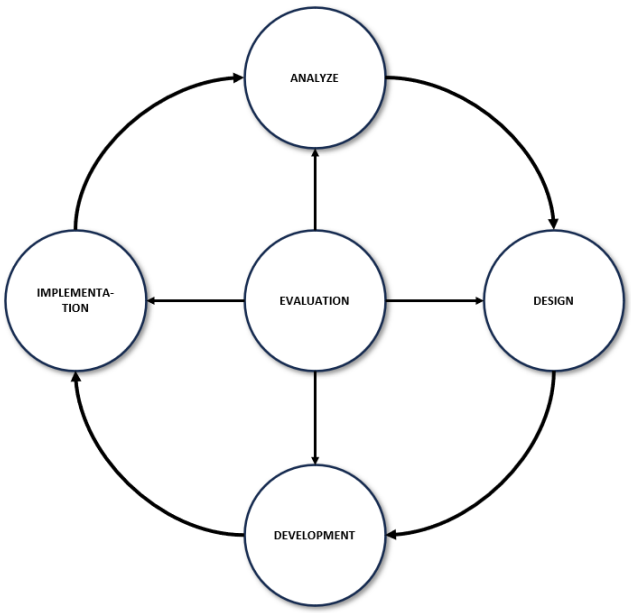

Figure 1. ADDIE Model Development

Based on Figure 1, the application development process is in accordance with the stages in the following sub-chapters.

2.1. Analyze

Conducting a needs analysis on PAMSIMAS Durian Seribu Village by means of direct observation and conducting interviews with PAMSIMAS administrators and officers who record, the aim is to identify problems in data management, especially recording and billing water usage payments, the results obtained are that the process of recording and billing water usage payments is still done manually, namely recorded using a book, so that officers in the field need a long time and often make mistakes in the calculation process

2.2. Design

Making an application design in the form of a UI/UX design and features contained in the application. The PAMSIMAS application is made using the Java language for the Android version and the PHP programming language for data processing or Application Programming Interface (API), which connects the Android application with the database.

2.3. Development

The application development process consists of several stages, namely creating an Application Programming Interface (API), conducting API testing to ensure that requests and responses from the server are correct. The next stage is implementing UI/UX design and coding to connect UI/UX design and API.

2.4. Implementation

After the development process is complete, the next process is to conduct a trial of the application for PAMSIMAS administrators and officers. At this stage, the researcher explains the procedures and flow of using the application. The trial is carried out to obtain responses or feedback from administrators and officers on whether the application that has been developed is in accordance with the initial design and can be a solution to the problem of recording and billing water usage payments.

2.5. Evaluation

In the final stage, after the application has finished testing, the researcher makes improvements according to requests or suggestions from administrators and officers regarding the features or functionality of the application. Evaluation is carried out to perfect the features of the application being developed.

3. RESULTS AND DISCUSSION

The amount of the bill for payment for PAMSIMAS water usage is based on the amount of water used for 1 month in cubic meters (m3). The total water usage can be calculated using the following formula.

$$Total\ Usage = Last\ Month\ Usage\ - Current\ Month\ Usage \quad (1)$$

Then the total bill that must be paid can be calculated using the following formula.

$$Total\ Bill = (Total\ Usage\ x\ Cost\ ) + Basic\ Cost \quad (2)$$

Table 1 below presents information regarding the amount of fees and basic costs.

Table 1. Cost and Basic Cost

Cost Per M^3	Basic Cost
IDR. 2.000	IDR 4.000

Table 1 explained that the cost per cubic meter is 2,000 rupiah and the basic cost is 4,000 rupiah.

3.1. Systems Analysis

The application created has 2 levels of users, namely administrators and managers, the appearance and functionality are no different when logging in as an administrator or manager, the difference lies in the level of access to data, currently PAMSIMAS customer data is grouped by Household (RT), the number of registered RTs is 10, then each officer is given the responsibility to record according to the RT that has been determined by the administrator. For example, when an officer logs into the application, the officer can only see and manage customer data according to the RT that has become his responsibility, but if the administrator logs into the application, he can see and manage all customer data. system analysis is done using use case diagrams to make it easier to understand. From a user perspective, a use case diagram describes the workflow within a system[21], Use case diagrams are a type of Unified Modeling Language (UML) that provide an overview of the interaction of actors or users with system functionality [22], Apart from that, It is used to build a model that is able to understand the characteristics of the system [23]. Figure 2 below presents the analysis of the proposed system.

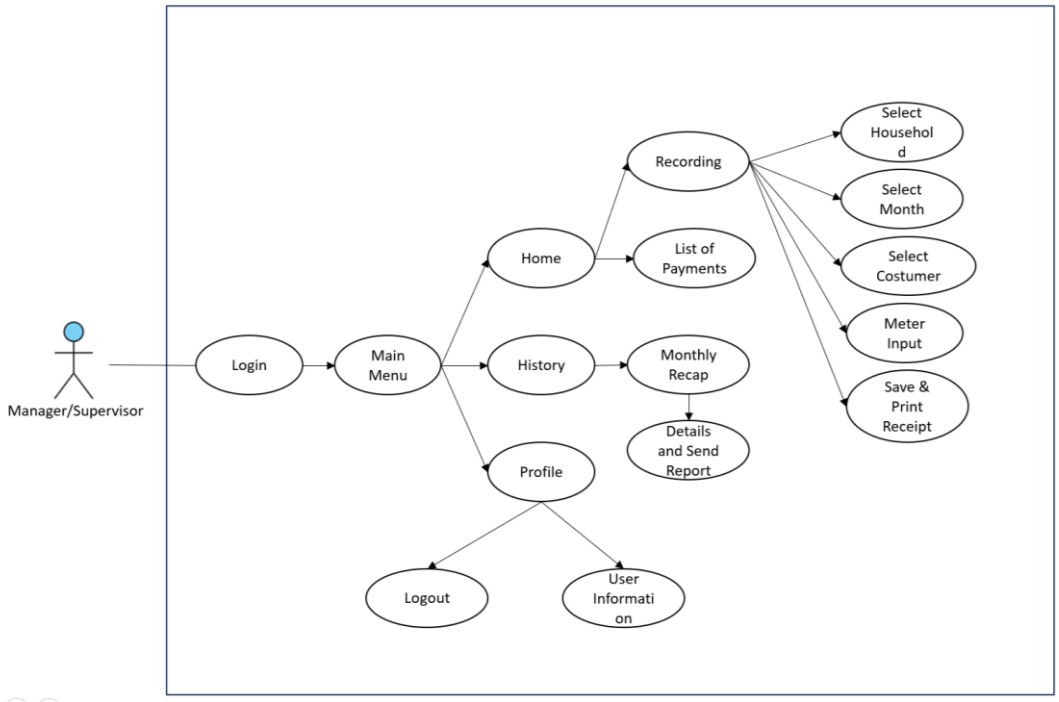

Figure 2. Proposed Use Case Diagram

Based on Figure 2, administrators or managers must first log in to access the menus in the application. This login process is carried out as an effort to maintain the security and confidentiality of information, and data can only be accessed by people who have the authority to log in and access the features in the application.

3.2. Design UI

User Interface (UI) Design is the graphical layout, such as images, text, icons, transitions, and animations of an application [24] User Interface design is an important element because it functions as a link between the user and the application [25] A good user interface can provide ease and comfort for users when using the application [26]. The following is a general user interface design to make it easier to understand the proposed application.

1) Log-in Page Design

Figure 3. Log-in Page Design

2) Home Page Design

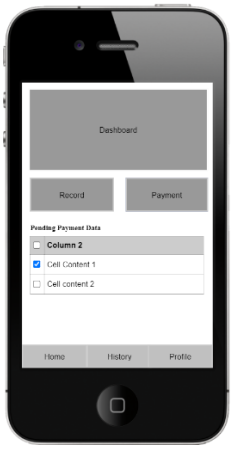

Figure 4. Home Page Design

3) Recording and Billing Page Design

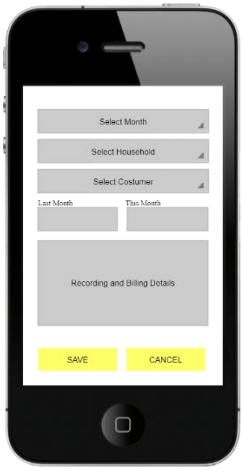

Figure 5. Recording and Billing Page Design

4) Recording History Page Design

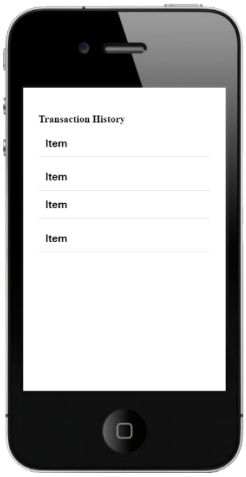

Figure 6. Recording History Page Design

3.3. Implementation System

1) Log-in Page

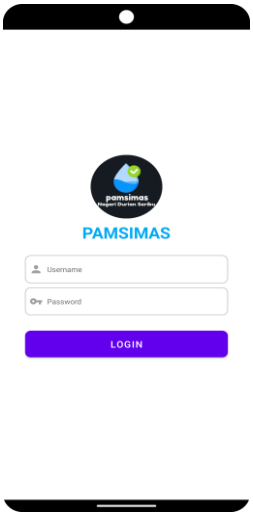

Figure 7. Login Page

Figure 7 is the application log-in page. Enter your username and password to log into the application.

2) Home Page

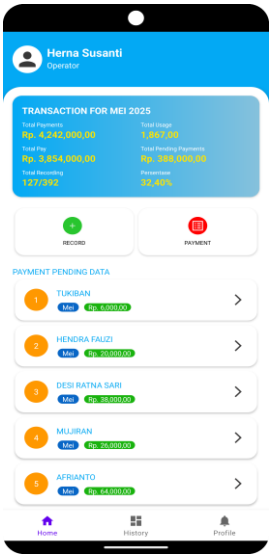

Figure 8. Home Page

Figure 8 is the main application page. On this page, a summary of payment records and bills, arrears information, information on the number of customers, and the percentage of water usage records is displayed. On this page, there are also 2 menus, namely the record and bill menus, besides that, it also displays a list of customers who are in arrears in payments.

3) Recording and Billing Page

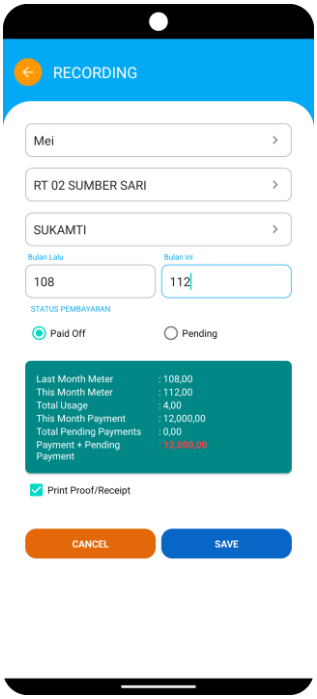

Figure 9. Recording and Billing Page

Figure 9 is a display for recording water usage and payment bills. First, the officer selects the month, household, and customer, then an input form will appear for the total water usage this month. After that, the bill details will appear automatically. When the officer selects the print receipt checkbox and presses the save button, the proof of payment receipt will appear automatically as shown in Figure 10 below.

Figure 10. Receipt for recording and payment of bills

4) History Page

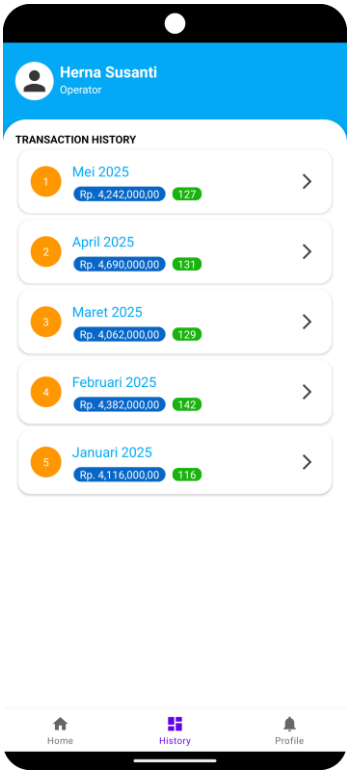

Figure 11. History Page

Figure 11 is a display of the History page, which contains a summary of the recording and payment history. If you click on one of the Histories, the History details page will appear as shown in Figure 12 below.

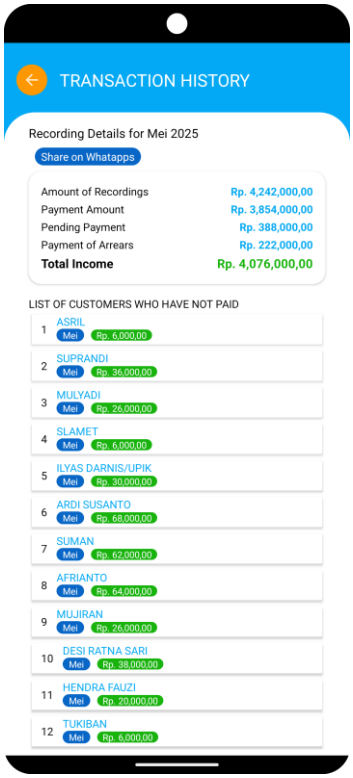

Figure 12. Detailed History Page

Figure 12 displays the recording and payment history in detail. If you want to share the history via WhatsApp message, you can select the share button.

3.4. Testing

Application testing aims to find errors in each application feature so that evaluation and improvements can be made [27] The application testing process adopts black box techniques, which focus on testing the functionality of an application, whether the application has worked according to the design that has been made [28]In addition, the goal is to ensure that the output produced is in line with the input received.. This test uses a user experience approach when interacting with the interface design and features contained in the application [29]. Black box testing consists of several types, namely functional testing, non-functional testing, and regulation testing [30]. In this study, researchers chose to test based on application functionality. Table 2 below shows the test results using the black box.

Table 2. Outcome Black Box Testing

No	Menu / Process	Expected results	Outcome
1	The login button is pressed	Displays the main application page	True
2	Note menu is pressed	Display the meter reading page	True
3	Input select month pressed	The month selection appears	True
4	The household selection input is pressed	Show household options	True
5	Customer selection input pressed	Display a list of customer choices according to the household	True
6	Enter total usage this month	Display total water usage and total bill	True
7	Check the checkbox to print the receipt and press the save button.	Recording data is saved and prints receipts	True
8	The History menu is pressed	Display a summary of PAMSIMAS water usage recording and payment history	True
9	The profile menu is pressed	Displays information about the currently logged-in user.	True
10	The logout button is pressed	Exit the application	True

4. CONCLUSION

The application created is only used to record and collect water usage. Based on the test results using the black box application, Officers can be more efficient in recording and billing PAMSIMAS water usage fees., officers only need to input the total water usage, then the application will automatically calculate and print a receipt as proof of payment, officers also do not need to calculate manually when reporting the total payment to the administrator. For administrators, the application makes it easier to monitor and evaluate the performance of recording officers. After the application was used for recording and billing, PAMSIMAS's income increased by approximately 30% from the income before using the application. Suggestions for further application development can be added with a meter scan feature for inputting usage and integrated with an analytics dashboard.

REFERENCES

[1] Nurfiah and K. Zaman, "Data Mining Performance Assessment of Regional Development Planning Agency Employees Using Bayesian Classifier Algorithm," *Jurnal Sistim Informasi dan Teknologi*, Sep. 2022, doi: 10.37034/jsisfotek.v5i2.175.

[2] H. Rusnedy, L. Syifa Tanjung, and A. Mudi Priyatno, "Penyuluhan Tentang Dampak Positif Penggunaan Gadget Bagi Anak Usia Dini," 2024, [Online]. Available: https://digit.web.id/index.php/dcs

[3] T. Sutter, T. Kehrer, M. Renhard, B. Tellenbach, and J. Klein, "Dynamic Security Analysis on Android: A Systematic Literature Review," *IEEE Access*, vol. 12, pp. 57261–57287, 2024.

[4] J. Keteku, G. O. Dameh, S. A. Mante, T. K. Mensah, S. L. Amartey, and J.-B. Diekuu, "Detection and Prevention of Malware in Android Mobile Devices: A Literature Review," *Int J Intell Sci*, vol. 14, no. 04, pp. 71–93, Oct. 2024, doi: 10.4236/ijis.2024.144005.

[5] Y. Darnita, M. Husni Hidayat, R. Toyib, and A. Wijaya, "Aplikasi Kamus Pembelajaran Bahasa Jepang Pada Sistem Operasi Android Menggunakan Algoritma String Matching Knuth-Morris-Pratt," *Jurnal Media Infotama*, vol. 20, no. 1, p. 230, Apr. 2024.
[6] G. Al Ghazali, R. Adriansyah, S. R. Hutabarat, W. Handika, K. S. Kusnanda, and I. Gunawan, "Analisis Sistem Operasi Android Pada Komputer Pengguna Diseluruh Dunia Pada Era Modern," *Jurnal Inovasi Artificial Intelligence & Komputasional Nusantara (JIKOMNUS)*, vol. 2, no. 1, pp. 32–35, 2025.
[7] G. Mujtaba, M. U. H. Shah, A. Hai, M. Daud, and M. Hayat, "A holistic approach to embracing the United Nation's Sustainable Development Goal (SDG-6) towards water security in Pakistan," Jan. 01, 2024, *Elsevier Ltd*. doi: 10.1016/j.jwpe.2023.104691.
[8] Moch. M. Rahman *et al.*, "RANCANG BANGUN DAN IMPLEMENTASI APLIKASI PEMBAYARAN PAM DESA PANDANREJO BERBASIS WEB DENGAN METODOLOGI SCRUM," Feb. 2025.
[9] A. R. Ismail and Z. Sidik, "PERANCANGAN SISTEM INFORMASI PENYEDIAAN AIR MINUM DAN SANITASI MASYARAKAT (PAMSIMAS) BERBASIS ANDROID," *Journal Of Software Engineering And Communication*, vol. 2, no. 2, pp. 49–55, Oct. 2024, doi: 10.56190/jsec.v2i2.62.
[10] D. S. Puspita, I. S. S. Kawuryan, and W. Handayani, "Evaluasi program penyediaan air minum dan sanitasi berbasis masyarakat (PAMSIMAS): studi di Kabupaten Temanggung," *Jurnal Pengelolaan Lingkungan Berkelanjutan (Journal of Environmental Sustainability Management)*, pp. 71–81, Apr. 2023, doi: 10.36813/jplb.7.1.71-81.
[11] A. Monroy-Licht, L. Carranza-Lopez, A. C. De la Parra-Guerra, and R. Acevedo-Barrios, "Unlocking the potential of Eichhornia crassipes for wastewater treatment: phytoremediation of aquatic pollutants, a strategy for advancing Sustainable Development Goal-06 clean water," Jul. 01, 2024, *Springer*. doi: 10.1007/s11356-024-33698-9.
[12] M. Adhie Matandung Bulo, A. Dewi Ekayani, and M. Christine Dolontelide, "Implementasi PAMSIMAS dalam Mendukung Pencapaian SDGs ke-6 di Indonesia," *Journal Of Social Science Research*, vol. 4, pp. 10269–10282, 2024.
[13] R. Riska, S. Syarifah, and A. Hafriliza, "Dampak Perkebunan Kelapa Sawit Terhadap Kualitas Air Di Desa Alur Dua, Kota Langsa," *Pros. SemNas. PeningkatanMutu Pendidikan*, vol. 2, no. 1, Jan. 2021.
[14] M. H. Munsir and Muh. Basri, "PERANCANGAN SISTEM APLIKASI PENCATATAN DAN PEMBAYARAN TAGIHAN AIR DI GRAND SULAWESI PAREPARE," Jan. 2024.
[15] M. N. Isra, M. Latief, and R. H. Dai, "SISTEM INFORMASI PENGELOLAAN AIR MINUM PADA KP-SPAMS DI DESA MOLOTABU," Jan. 2024.
[16] K. Alfani Bramantio, P. Mei Nata, P. Dian Pratiwi, and Sutadi, "Pengembangan Media Pembelajaran Pendidikan Agama Buddha Berbasis Android Dengan Model Addie," 2024.
[17] M. Waruwu, "Metode Penelitian dan Pengembangan (R&D): Konsep, Jenis, Tahapan dan Kelebihan," *Jurnal Ilmiah Profesi Pendidikan*, vol. 9, no. 2, pp. 1220–1230, May 2024, doi: 10.29303/jipp.v9i2.2141.
[18] Moses Adeleke Adeoye, Kadek Adrian Surya Indra Wirawan, Made Shania Satya Pradnyani, and Nyoman Intan Septiarini, "Revolutionizing Education: Unleashing the Power of the ADDIE Model for Effective Teaching and Learning," *JPI (Jurnal Pendidikan Indonesia)*, vol. 13, no. 1, pp. 202–209, Apr. 2024, doi: 10.23887/jpiundiksha.v13i1.68624.
[19] H. Abuhassna, S. Alnawajha, F. Awae, M. A. Bin Mohamed Adnan, and B. I. Edwards, "Synthesizing technology integration within the Addie model for instructional design: A comprehensive systematic literature review," *Journal of Autonomous Intelligence*, vol. 7, no. 5, p. 1546, May 2024, doi: 10.32629/jai.v7i5.1546.
[20] Okpatrioka, "Research And Development (R&D) Penelitian Yang Inovatif Dalam Pendidikan," Mar. 2023.
[21] L. Setiyani, "Implementasi Cybersecurity pada Operasional Organisasi," 2021.
[22] R. P. Nair, M. G. Thushara, and K. Somasundaram, "Graph-Based Generation and Validation of Use Case Diagrams," *Procedia Comput Sci*, vol. 259, pp. 1356–1365, 2025, doi: 10.1016/j.procs.2025.04.090.
[23] P. P. Pamungkas, M. Danny, and A. Muhidin, "Sistem Informasi Kepegawaian Berbasis Web Studi Kasus PT. Hara Sentosa Mandiri," *Jurnal Teknologi Dan Sistem Informasi Bisnis*, vol. 6, no. 1, pp. 177–186, Jan. 2024, doi: 10.47233/jteksis.v6i1.1129.
[24] D. L. Santoso, I. Mufidah, and M. Iqbal, "Perancangan User Interface Website Laboratorium Analisis Perancangan Kerja dan Ergonomi Universitas Telkom dengan Metode Double Diamond," 2024, [Online]. Available: https://j-innovative.org/index.php/Innovative
[25] Septiani Kurnia and Nur Nawaningtyas, "Analisis Interaksi Pengguna dalam Desain User Interface dan User Experience yang Lebih Baik Menggunakan Metode Heuristik," *Jurnal Teknik Mesin, Industri, Elektro dan Informatika*, vol. 3, no. 4, pp. 113–119, Oct. 2024, doi: 10.55606/jtmei.v3i4.4433.
[26] D. Ari Anggara, W. Harianto, and A. Aziz, "PROTOTIPE DESAIN USER INTERFACE APLIKASI IBU SIAGA MENGGUNAKAN LEAN UX," Mar. 2021.
[27] M. Jibril, Zulrahmadi, and M. Amin, "PENGUJIAN SISTEM INFORMASI E-MODUL PADA SMPN 1 TEMPULING MENGGUNAKAN BLACK BOX TESTING," 2024.
[28] P. Long and J. Zhao, "Equivalence, Identity, and Unitarity Checking in Black-Box Testing of Quantum Programs," *Journal of Systems and Software*, vol. 211, 2024, doi: https://doi.org/10.1016/j.jss.2024.112000.
[29] N. R. D. Zahra *et al.*, "PENGUJIAN PADA WEBSITE SMARTPETSCARE UNTUK LAYANAN GROOMING HEWAN MENGGUNAKAN METODE BLACK BOX TESTING," 2025.

[30] Uminingsih, M. N. Ichsanudin, M. Yusuf, and Suraya, “PENGUJIAN FUNGSIONAL PERANGKAT LUNAK SISTEM INFORMASI PERPUSTAKAAN DENGAN METODE BLACK BOX TESTING BAGI PEMULA,” vol. 1, no. 2, pp. 1–8, May 2022, doi: 10.55123.