ABDIMAS: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang
Vol.9(3) August 2024, 459-471
p-ISSN: 2721-138X e-ISSN: 2548-7159
http://jurnal.unmer.ac.id/index.php/jpkm

LPPM
UNMER
MALANG

Digital transformation in waste management: Enhancing financial transaction efficiency at a waste bank

Dinar Ajeng Kristiyanti, Angga Aditya Permana, Fahmy Rinanda Saputri, Monika Evelin Johan, Nabila Husna Shabrina, Kevin Aditya Hartono, Ray Anthony Pranoto

Department of Information Systems, Faculty of Engineering and Informatics
University of Multimedia Nusantara
Jl. Scientia Boulevard Gading, Curug Sangereng, Serpong,Tangerang, Banten, 15810, Indonesiam

ARTICLE INFO:

Received: 2023-12-28
Revised: 2024-01-06
Accepted: 2024-02-15
Published: 2024-02-29

Keywords:

Community-Based Participatory Research (CBPR), Community partnership program, Information system, Waste management

ABSTRACT

Waste management poses a serious global challenge. Indonesia, as one of the world's largest waste producers, faces significant impacts from this issue. At Bank Sampah Pamulang 25, manual transaction recording has been a major problem leading to various difficulties and data inaccuracies. To address this, the Community Partnership Program (PKM) was implemented focusing on developing the Waste Bank Financial Information System (SIKEBAS) to enhance efficiency and productivity. The research method used was Community-Based Participatory Research (CBPR), involving collaboration between local communities, students, and lecturers. Through a series of activities, the SIKEBAS website was successfully developed to automate waste and financial data recording and management. Evaluation of the implementation results showed a significant improvement in efficiency and productivity among Bank Sampah Pamulang 25 staff. Initially, 88.9 percent of participants did not understand the use of technology in transaction recording at the waste bank. However, after socialization, 75 percent of participants strongly agreed and 25 percent agreed that the SIKEBAS website facilitated the transaction process. Thus, the development of the web-based information system SIKEBAS has proven to be an effective solution to address the challenges of manual waste management.

How to cite: Kristiyanti, D. A., Permana, A. A., Saputri, F. R., Johan, M. E., Shabrina, N. H., Hartono, K. A., & Pranoto, R. A. (2024). Digital transformation in waste management: Enhancing financial transaction efficiency at a waste bank. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang, 9*(3), 459-471.
https://doi.org/10.26905/abdimas.v9i3.12937

1. INTRODUCTION

Waste is a serious challenge throughout the world, with production continuing to increase every year. Municipal solid waste production reaches around 2.01 billion tons every year, and around 33 percent of this waste is not managed safely (The World Bank, 2024). Based on Figure 1, the map illustrates the variation in municipal solid waste generated per capita across different regions, with higher waste production per day observed in North America and parts of Europe compared to lower rates in many African and Asian countries. On average, each person produces 0.74 kilograms of waste per day (The World Bank, 2024). Based on analysis of the 2022 global waste index, there are large differences in the amount of waste produced and how it is disposed of in 38 countries around the world

✉ Corresponding Author: **Dinar Ajeng Kristiyanti**: Tel. +62 21-5422-0808 | E-mail: dinar.kristiyanti@umn.ac.id

(Filipenco, 2024). UNEP (UN Environment Programme) predictions in 2025 show that cities in the world will produce more than 2.2 billion tons of waste every year, more than three times the amount in 2009 (UN Environment Programme, 2024). Based on the report, compiled by the philanthropic organization Minderoo Foundation, found that the world generated 139 million tons of single-use waste in 2021, is a major contributor to the composition of marine debris (Prihadi et al., 2023). An astonishing prediction states that by 2040, plastic waste polluting the earth could reach 1.3 billion tons (Meyrena & Amelia, 2020). The production of plastic waste is also associated with various negative impacts, including threats to health and the environment (Mardiah et al., 2022). The increase in online shopping activities, especially during the COVID-19 pandemic, has also contributed to the surge in plastic waste (Kurniawan & Rahma, 2022). This has become a global disaster that has triggered various health and environmental problems, prompting the need for collective action to overcome this serious problem globally, especially in Indonesia as one of the largest waste contributing countries in the world (Nikmah et al., 2023). Indonesia has recorded itself as one of the 5th largest waste producing countries in the world in 2020. Research conducted by UC Davis and Hasanudin University shows that up to 23 percent of fish samples collected and tested resulted in findings of plastic content in their stomachs (Hidayati et al., 2023). During 2022, there will be 69 million tons of waste produced by Indonesian people, of which 18.2 percent of the total, namely 12.5 million tons, is plastic waste. This percentage shows that plastic waste has continued to increase exponentially since 1995. To overcome this waste processing problem, one alternative that can be done is to develop the concept of a waste bank (Muryani et al., 2023).

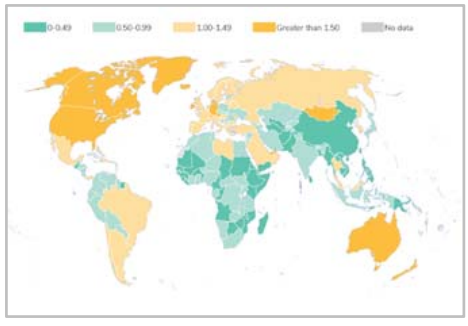

Figure 1. Annual municipal solid waste generated per capita (kilograms/capita/day)
(Source: The World Bank, 2024)

Waste banks are an important forum for increasing public awareness of clean and healthy lifestyles, while making a positive contribution to the economy, especially for housewives (Mulyadi et al., 2020). This concept collects sorted dry waste, manages it using banking principles, where what is saved is not money, but waste (Imdadurrohman, 2023). The collected waste is valued based on the market price at the time of the transaction, then recorded in the account book as people's personal savings. Waste banks not only provide financial benefits to the community, but also form a more efficient economic and waste management system (Utami et al., 2023). The growth of waste banks is quite rapid, reaching 5,244 units in 2017, spread across 34 provinces and 219 districts/cities (Srikandi, 2019). Waste bank guidelines and systems have been regulated in government regulation number 13 of 2012, emphasizing waste sorting, handing over, weighing and recording sales proceeds as part of the waste bank's working mechanism (Diyanah et al., 2019).

As is the case with the Pamulang 25 Waste Bank which is located in Puri Pamulang, South Tangerang. Pamulang 25 Waste Bank customers can make waste deposits by coming directly to the

office located at Pamulang Residents Hall RW 25, according to the monthly weighing schedule. The weighing process is carried out by officers based on the type of waste deposited, and the total weight of the waste is temporarily recorded on the weighing slip. Customers need to submit their savings book to the officer to record the results of deposit transactions by the administration officer at the office. After the recording process is complete, customers can take back their savings book at the Bank Sampah Puri Pamulang 25 office. Apart from that, customers can withdraw their savings balance by visiting the office, bringing a photocopy of their KTP, and filling in the withdrawal slip. The officer will record the withdrawal and provide the total amount of money according to the balance withdrawn by the customer.

However, several customers and officers of the Pamulang 25 Waste Bank faced problems in making transactions. Some customers complained that the savings book had to be taken with them when weighing the waste, and they needed to take it back at a later time. Customers also have difficulty finding out their current balance after weighing, because this information can only be known after the savings book is printed by an officer. Meanwhile, officers often have difficulty finding the location of customers carrying out weigh-ins and have difficulty introducing the Pamulang 25 Waste Bank to the public. Frequent human errors, coupled with file damage and lengthy searches when looking for data on waste deposits, savings or waste sales transactions, have become the main problem at Pamulang Waste Bank 25. The reports produced are often inconsistent, especially in terms of recaps. data on customer balances and sales recaps of sellers, as well as recaps required to be reported to the Environment and Forestry Service (DLHK) for the South Tangerang region. Incompatibility of data recorded in savings books is a major obstacle, creating communication errors between officers and customers. This situation was triggered by the use of a manual recording system, which was the main source of difficulties that needed to be overcome.

In dealing with the problem of waste management and recording transactions at the Pamulang 25 Waste Bank, it is necessary to implement the UMN Community Service Program (PKM) Internal Grant, with a focus on socializing and assisting the Waste Bank Financial Information System (SIKEBAS) website at the Pamulang 25 Waste Bank (Kristiyanti et al., 2021). This PKM activity aims to increase the efficiency of transactions and recording by storing all data in a database that can be accessed directly and is useful in involving assistance to citizens and officers in more efficient financial activities, providing education to stakeholders about the use of technology, and increasing human resources (Afuan et al., 2021). This application not only creates strategic planning for the future, but also optimizes digital technology for recording systems, big data and systematic data processing. With SIKEBAS, the convenience of customers and managers in accessing the financial transaction database at the waste bank can be increased. Both users, both customers and managers, can monitor every waste bank transaction and activity in more depth, periodically and in real-time (Ardiantoro & Rohmah, 2019). The importance of using technology has also been discussed by Utami et al. (2022), this research provides further understanding of the effectiveness and advantages of digital waste bank applications, especially in the case of the Solusi Hijau Waste Bank. By detailing the analysis and findings from the case study, deeper insight can be gained regarding potential improvements and improvements that can be adopted by the Pamulang 25 Waste Bank through the implementation of SIKEBAS.

2. METHODS

The method used to carry out community involvement around the Pamulang 25 Waste Bank is Community Based Participatory Research (CBPR). Community-Based Participatory Research (CBPR) is a research approach that places local residents as active partners in the entire research process, in contrast to traditional approaches which tend to be top-down (Rosyidah, 2021). In CBPR, village communities,

students and lecturers work together to design and carry out research that is relevant to local needs and aspirations (Richter et al., n.d.). Through collaborative dialogue and participatory meetings, they jointly formulate appropriate strategies to overcome the problems they face, thereby achieving common goals that are more meaningful and sustainable (Elia et al., 2020). The application of the CBPR methodology in research related to Waste Banks is reflected in Figure 2.

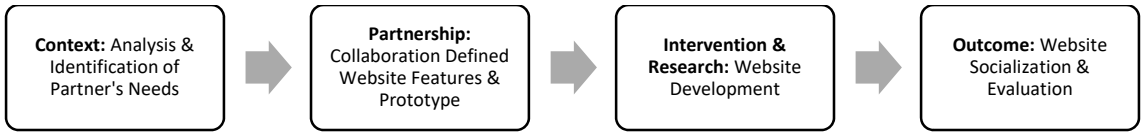

Figure 2. Research stages using the Community-Based Participatory Research method

Context Stage

The Context Stage begins with the analysis and identification of partner needs through surveys, aimed at gaining initial insights into the requirements for developing the SIKEBAS website, an extension of the Waste Bank Financial System. This stage, conducted from the first to the fourth week of March 2023, focuses on understanding the deep-seated needs and aspirations of stakeholders involved in the SIKEBAS project. It involves the execution team of the Community Partnership Program (PKM), waste bank operators, and waste collectors collaborating to assess and document these essential requirements.

Partnership Stage

The next stage is the Partnership Process, where the main features of the SIKEBAS website are determined through collaboration between villagers, students, and lecturers. This stage, conducted in the first week of May 2023, aims to establish a collective vision for the website's functionalities and design. It involves the execution team of the Community Partnership Program (PKM) and the operators of Pamulang 25 Waste Bank working together to brainstorm ideas and outline the essential features. Additionally, an initial prototype of the SIKEBAS website is developed during this stage to provide a preliminary concept of its appearance and operational capabilities.

Intervention & Research Stage

Next, the intervention & research stage was carried out to develop the SIKEBAS website involving the use of waterfall development methods and Rapid Application Development (RAD). This stage, conducted from the second week of May 2023 to the second week of September 2023, involved the execution team of the Community Partnership Program (PKM) ensuring the stability, security, and responsiveness of the SIKEBAS website. The choice of the waterfall approach to website development is driven by its structured and sequential nature, ensuring thorough planning and completion of each stage before proceeding (Breyter, 2022). The Waterfall model is a sequential (non-iterative) process, where progress flows downwards through several phases: requirement analysis, system design, implementation, integration and testing, deployment of the system, and maintenance (Senarath, 2021). To ensure the stability, security and responsiveness of the SIKEBAS website, the developer uses the PHP programming language, Laravel framework and Bootstrap. These three platforms were chosen because they are open source and are known to have a high level of security and strong support from the developer community (Kristiyanti et al., 2024). Thus, using PHP and Laravel can reduce the risk of

security vulnerabilities and provide solid protection against hacker attacks. In addition, Bootstrap is used to design a responsive website layout, ensuring that the SIKEBAS website can be accessed well and displays information optimally on various devices (Ramdiansyah & Anubhakti, 2020). In addition, the RAD method is also used to adapt projects to tight deadlines and facilitate adaptable changes based on partner feedback, enabling iterative improvements (Andreswari et al., 2020). RAD emphasizes an extremely short development cycle and is a "high-speed" adaptation of the Waterfall model. The phases of RAD include requirement planning, user design, construction, and cutover (Khan et al., 2020).

Outcome Stage

The final stage of this method involves the outcomes of the previous stages, which include socialization and evaluation of the website that has been developed. This stage conducted in the second week of November 2023, engages the execution team of the Community Partnership Program (PKM) and officers from Pamulang 25 Waste Bank. The socialization aims to introduce the website to Pamulang 25 Waste Bank stakeholders, provide an understanding of its benefits, and educate them about the use of the SIKEBAS website that has been created. Evaluation is carried out through pre-test and post-test to measure the increase in their understanding and skills regarding the SIKEBAS website. Evaluation was carried out through the use of a questionnaire that focused on knowledge about technology and use of the SIKEBAS website. The materials for socialization and the results of the post-test and pre-test evaluations can be viewed through the following link: https://tinyurl.com/materipelatihansikebas. This stage aims to measure the understanding and skills of stakeholders regarding the use of the SIKEBAS website that has been developed. Thus, the questionnaire was used as a tool to evaluate their level of knowledge about technology and ability to utilize the features provided by the SIKEBAS website. This evaluation also aims to provide a comprehensive picture of the impact of creating the SIKEBAS website on the Pamulang 25 Waste Bank community, and serve as a basis for further improvement and development in the future.

3. RESULTS AND DISCUSSION

The implementation of the Community Partnership Program (PKM) at the Pamulang 25 Waste Bank aims to overcome challenges in recording transactions that still use manual methods, with the aim of increasing efficiency and productivity at the Waste Bank. This PKM was carried out over a period of 8 months, starting from March to September 2023 and then continuing in November 2023. The initial stage of this activity involved a group discussion forum (FGD) with the Pamulang 25 Waste Bank Management, with the aim of identifying overall problems that would be solved. Next, an internal FGD was conducted with all PKM team members to formulate detailed activity plans.

Based on the results of a survey conducted in Pamulang 25 Village on May 27 2023, several problems related to waste management and transaction recording at the Pamulang 25 Waste Bank were revealed. Challenges faced include the need to bring a savings book when weighing waste, difficulty in accessing up-to-date balance information, and difficulty in finding the location of the customer doing the weighing. Apart from that, officers also experienced difficulties in introducing the waste bank to the public and faced problems with human error and file damage in recording transactions.

To overcome this challenge, the Pamulang 25 Waste Bank Financial Information System (SIKEBAS) is presented as an effective and important solution. This web-based platform, accessible at https://sikebaspamulang25.com/login, provides various features, starting from waste data management, waste categories, customers, administrators, to sellers. In addition, SIKEBAS facilitates transactions such as

customer waste deposits, savings, and waste sales, while automatically generating financial reports that assist administrators in compiling routine reports for the Environment and Hygiene Service (DLHK) and peddler.

Figure 3. Field survey to Puri Pamulang Village 25

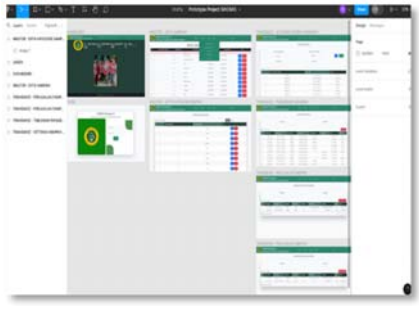

Figure 4. SIKEBAS Website Prototype

The method applied in developing the Sampang Bank Financial System (SIKEBAS) Pamulang 25 website is the waterfall method, which provides a structured and systematic framework for website development (Alexandra et al., 2023). In applying this method, website development is carried out sequentially, starting from the planning process to maintaining the SIKEBAS website. The programming language chosen is Hypertext Preprocessor (PHP), which is a server-side scripting programming language used together with HTML to create dynamic web pages (Wibowo et al., 2024). PHP was chosen because of its nature as server-side scripting, where all syntax and commands are executed on the server first before the results are sent to the browser in HTML format (Alam et al., 2022). Therefore, PHP is very suitable for creating websites. In addition, the Python programming language is also used as a data manager, because of its proven capabilities in data manipulation (Ziogas et al., 2021).

In developing the SIKEBAS website, the Laravel and Bootstrap frameworks were also used. Laravel was chosen because it has various libraries that speed up the application creation process. Using Laravel allows developers to more efficiently implement complex features on websites. Meanwhile Bootstrap is used to implement responsive web design, which ensures that the information displayed on the website can adapt to various devices used by users. Thus, the use of Laravel and Bootstrap in developing the SIKEBAS website provides advantages in terms of application creation efficiency and responsiveness to various devices (Putra, 2020).

This website development not only follows the waterfall method, but also applies the Rapid Application Development (RAD) method. The RAD approach allows the development of information systems in a relatively short time span, around 30-90 days, with a focus on three main stages: requirements analysis, design, and implementation. The main advantage of RAD is its ability to provide fast and flexible solutions to changing requirements, without disrupting the overall development process (Hasan et al., 2023). The implementation stage in RAD is aimed at preparing the system so that it is ready for use. The RAD method is an effective alternative in responding to changing needs in information system development (Andreswari et al., 2020).

Figure 5 is a dashboard that illustrates the various menu options available on the website. The dashboard display provides information regarding the total number of administrators, the total 25 Pamulang waste bank customers, the number of transactions carried out, and the total balance collected. The "Master" menu provides information regarding waste data, waste categories, customer data, management data and seller data. The "Transactions" menu provides information regarding financial transactions at the Waste Bank, including waste deposits by customers, savings withdrawals, as well as recording sales and purchases of waste. Finally, the "Reports" menu is used to produce various reports related to the financial and operational activities of the Waste Bank, such as cash flow reports, sales reports and financial reports for internal and external purposes. The aim of all these features is to facilitate the management of financial transactions and data management efficiently, as well as providing easy and fast access for customers and administrators of the Pamulang 25 Waste Bank to manage their activities more effectively and accurately.

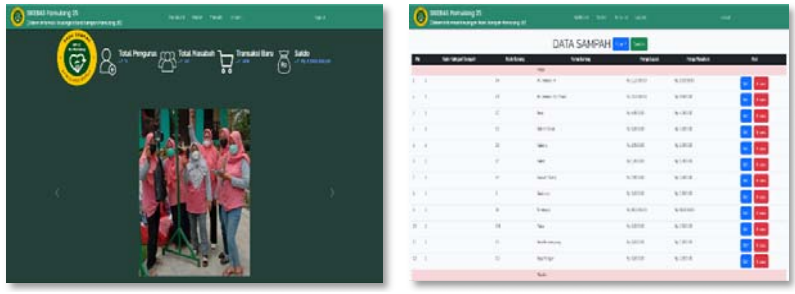

Figure 5. Dashboard page of the Pamulang 25 Waste Bank SIKEBAS website
Figure 6. Waste Master Data menu page for the SIKEBAS Pamulang 25 website

The "master" menu navbar functions as the main data management center in the Pamulang 25 Waste Bank system. In it, admins can manage information related to various entities related to the waste bank. The CRUD feature contained in the master menu allows admins to create, read, update and delete data easily. In Figure 6, there is a master menu "waste data" which contains information about various types of waste managed by the Pamulang 25 Waste Bank. Apart from that, the master menu also contains waste data, waste categories, customer data, management data, and seller data.

The "transaction" menu navigation bar functions to facilitate the transaction process that occurs at Bank Sampah Pamulang 25. In it, admins can record and manage transactions, view transaction history, filter data, see the amount of money for each customer and search for transactions based on certain criteria to make it easier. in managing and analyzing transaction data. The CRUD feature is also available in the transaction menu. In Figure 7 is the "customer waste deposit" transaction menu which functions to record every time a customer deposits waste to the Pamulang 25 Waste Bank. Apart from that, in the "transaction" menu there are also customer savings and waste sales transactions.

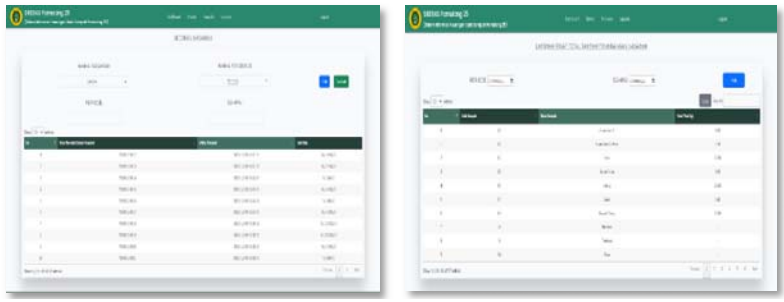

Figure 7. Customer Deposit Transaction menu page on the SIKEBAS Pamulang 25 website
Figure 8. Customer Weighing Total Waste Recap Report menu page on SIKEBAS Pamulang 25 website

Figure 9. Launching, socialization and support of the SIKEBAS Pamulang 25 website

The "report" menu navbar functions to present detailed information about various aspects of activities and transactions that occur at the Pamulang 25 Waste Bank. In it, admins can produce reports that include various data, making it easier for admins to access and analyze transaction data, produce financial reports, monitor the development of waste bank activities as a whole. Data filter features, search features, and print features are also available in the "report" menu to find the data needed more quickly, as well as print data for documentation and reporting purposes. In Figure 8 is the report menu "recap of

total customer weighing waste" which functions to provide a comprehensive overview of the amount of waste that has been weighed by customers at the Pamulang 25 Waste Bank based on the type of waste. Apart from that, in the "reports" menu there are also cash flow reports, sales reports and financial reports for internal purposes.

Socialization and assistance regarding the use of the SIKEBAS Pamulang 25 website was held at the Pamulang 25 Waste Bank Secretariat on November 11 2023. The aim of this activity was to provide guidance to the Pamulang 25 Waste Bank administrators in using the SIKEBAS website. In addition, evaluations were carried out to measure participants' level of knowledge before and after training, through pre-test and post-test. The evaluation results show that participants' knowledge of the SIKEBAS website has increased significantly, indicating the success of the Community Partnership Program's objectives in increasing transaction efficiency at the Pamulang 25 Waste Bank.

The following are the results of the pre-test and post-test evaluations carried out on nine administrators of the Pamulang 25 Waste Bank. Figure 10 shows the percentage of partners' understanding of using the SIKEBAS website before socialization and mentoring were carried out. Of the nine participants, eight did not understand how to use the SIKEBAS website, while one participant stated that they understood it. This indicates that partners tend to be less ready to adopt SIKEBAS website technology, and further efforts are needed to ensure that they have adequate resources and support to utilize this web-based information system.

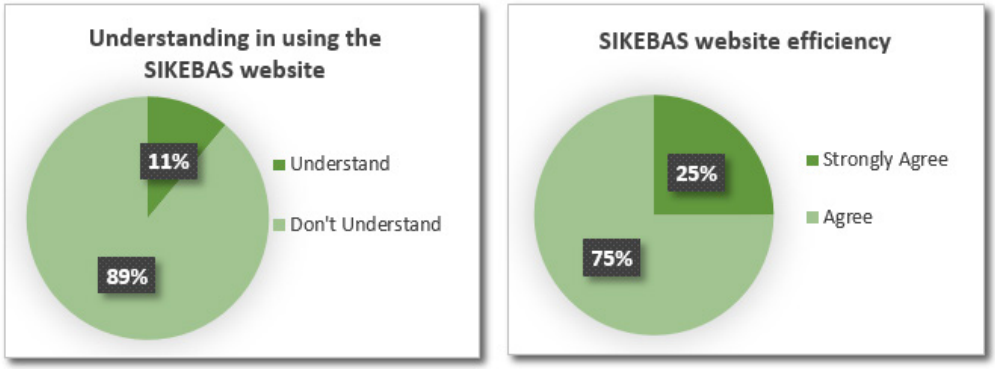

Figure 10. Percentage of partner understanding in using the SIKEBAS website
Figure 11. Percentage of SIKEBAS website efficiency in Managing Puri Pamulang Waste Bank 25

Figure 11 provides a visual illustration of how the SIKEBAS website can efficiently help partners in managing the Puri Pamulang 25 Waste Bank which shows 75 percent of respondents said they strongly agreed and 25 percent of respondents said they agreed. It can be concluded that partners feel that the SIKEBAS website provides concrete benefits in increasing the efficiency of waste bank management in Puri Pamulang RW 25. This can be seen from the results post-test evaluation in Table 1.

Overall, the PKM program has had a positive impact on partners' knowledge and views. The material and activities presented in PKM are effective in increasing partners' understanding and motivation regarding web-based waste bank management. The evaluation results showed an encouraging response, with 75 percent of respondents stating that they strongly agreed and 25 percent agreed that the SIKEBAS website facilitated the transaction process at Puri Pamulang 25 Waste Bank. This indicates the effectiveness of the PKM activities initiated by the author in developing the SIKEBAS Pamulang 25 website. Increasing efficiency through digitizing transactions at waste banks is very important, especially

to reduce the amount of waste, especially plastic waste which is a serious issue in Indonesia. Therefore, through initiatives such as PKM, the Pamulang 25 Waste Bank can operate more efficiently and actively contribute to environmental preservation and reduce the negative impact of plastic waste in Puri Pamulang RW 25.

Table 1. Comparison table before and after training and socialization

Indicator	Before (Pre-test)	After (Post-test)
Understanding the Use of the SIKEBAS Website	The majority of participants had a low understanding of using the SIKEBAS website	The majority of participants had a better understanding of using the SIKEBAS website
Perception of the Benefits and Success of PKM	The majority of participants had low understanding and poor expectations	The majority of participants had a more positive perception of the benefits and success of PKM
Readiness for SIKEBAS Website Contributions	The majority of participants had low readiness	The majority of participants had a better understanding of the contribution of SIKEBAS website development to their welfare
Understanding of PKM Material and Benefits Received	The majority of participants have expectations that tend to be low	The majority of participants had a better understanding of the PKM material and the benefits they received
Understanding of the Direct Benefits of PKM	The majority of participants have expectations that tend to be low	The majority of participants had a better understanding of the delivery of the material and the direct benefits of PKM
Contribution of the SIKEBAS Website to Welfare	Uniform expectations	The majority of participants had a better understanding of the contribution of SIKEBAS website development to their welfare
Post-PKM Waste Management	The majority of participants had low levels of self-confidence	The majority of participants had a better understanding and confidence about waste management after PKM activities

4. CONCLUSION AND RECOMMENDATIONS

The implementation of the Waste Bank Financial Information System (SIKEBAS) has succeeded in significantly increasing efficiency and productivity in recording waste transactions. Through the CBPR method, the development of the SIKEBAS website is based on the active participation of local communities, students and lecturers, which produces solutions that are relevant to local needs and aspirations. The use of waterfall and RAD methods in website development produces a responsive and efficient platform, facilitating waste transactions and providing financial reports automatically. The evaluation shows an increase in partners' understanding and perception regarding the benefits of the SIKEBAS website, with the majority feeling that this system makes it easier to process transactions at Puri Pamulang 25 Waste Bank. Thus, this step not only increases efficiency in waste management, but also has the potential to reduce the negative impact of waste plastic in the environment, making a positive contribution to environmental sustainability, and strengthening the role of waste banks in maintaining cleanliness and environmental sustainability in Puri Pamulang RW 25.

Based on research findings, the following are several recommendations to increase the effectiveness of the implementation of the Waste Bank Financial Information System (SIKEBAS) in Banks Sampah

Pamulang 25 and ensure its sustainability and impact: (1) Provide a comprehensive and ongoing training program to ensure that all community members, including staff and participants, master the effective use of the SIKEBAS platform, with a focus on overcoming any technological barriers or challenges they may face; (2) Implement a structured feedback mechanism to regularly evaluate the performance and impact of SIKEBAS, solicit input from users and stakeholders to identify areas for improvement and ensure the continued viability and effectiveness of the platform in addressing the ever-changing needs of the Pamulang Waste Bank 25 and surrounding communities; (3) Establish partnerships with private parties or companies that care about the environment to support financing and development of advanced technology in waste management and improving SIKEBAS features; (4) Add a customer access feature, so customers can also access the SIKEBAS website.

ACKNOWLEDGMENTS

The author would like to thank Universitas Multimedia Nusantara and LPPM Universitas Multimedia Nusantara for the Internal PKM Grant with contract number 1279/PKMI/LPPM-UMN/III/2023 which really supports this PKM activity.

REFERENCES

Afuan, L., Nofiyati, N., & Umayah, N. (2021). Rancang bangun sistem informasi bank sampah di Desa Paguyangan. *Edumatic: Jurnal Pendidikan Informatika*, *5*(1), 21-30. https://doi.org/10.29408/edumatic.v5i1.3171

Alam, P. F., Agustika, W., & Caesaron, D. (2022). Assistance for waste data management applications and Smart Drop Box as waste bank digitization tools. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang*, *7*(1), 1-10. https://doi.org/10.26905/abdimas.v7i1.7081

Alexandra, Y., Situmorang, R., & Kristiyanti, D. A. (2023). Fostering culinary diversification, food hygiene, and sanitation: A community outreach initiative for MSMEs. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang*, *8*(4), 769-781. https://doi.org/10.26905/abdimas.v8i4.10829

Andreswari, R., Ambarsari, N., Syahrina, A., Puspitasari, W., Novianti, A., & Darmawan, I. (2020). Design of e-Marketplace for village-owned small, micro and medium enterprise using rapid application development. *International Journal of Innovation in Enterprise System*, *4*(01), 35-43. https://doi.org/10.25124/ijies.v4i01.46

Ardiantoro, L., & Rohmah, M. F. (2019). Komputerisasi untuk peningkatan layanan nasabah pada bank sampah Gaposi Sejahtera Mojokerto. *Bantenese: Jurnal Pengabdian Masyarakat*, *1*(2), 69-78. https://doi.org/10.30656/ps2pm.v1i2.1720

Breyter, M. (2022). Waterfall, agile, and hybrid delivery frameworks. In *Agile Product and Project Management: A Step-by-Step Guide to Building the Right Products Right* (pp. 127-160). Berkeley, CA: Apress. https://doi.org/10.1007/978-1-4842-8200-7_6

Diyanah, K. C., Pawitra, A. S., Ati, L. P. A. P., Bastian, M., Septyaningsih, I., & Prasetyo, R. A. (2019). Pendampingan masyarakat bantaran sungai dalam pendirian bank sampah untuk meminimalisir sampah sungai di Kelurahan Pegirian Kota Surabaya. *Engagement: Jurnal Pengabdian Kepada Masyarakat*, *3*(2), 245-261. https://doi.org/10.52166/engagement.v3i2.32

Elia, G., Margherita, A., & Petti, C. (2020). Building responses to sustainable development challenges: A multistakeholder collaboration framework and application to climate change. *Business Strategy and the Environment*, *29*(6), 2465-2478. https://doi.org/10.1002/bse.2514

Filipenco, D. (2024, May 21). *World waste: Statistics by country and short facts*. Development Aid. Retrieved from: https://www.developmentaid.org/news-stream/post/158158/world-waste-statistics-by-country

Hasan, H., Arifin, R., Pato, M., Hidayat, F., & Nasir, K. R. (2023). Sistem monitoring aktivitas anak berbasis web menggunakan Model Rapid Application Development (RAD) pada TK Islam Terpadu Qurrata A'yun. *AJAD: Jurnal Pengabdian kepada Masyarakat*, *3*(3), 357-364. https://doi.org/10.59431/ajad.v3i3.220

Hidayati, D., F, F., A, A., Ashuri, N. M., Setiawan, E., Mulyadi, Y., Syahroni, N., Joesidawati, M. I., & S, S. (2023). Microplastic characteristic found in gastrointestinal tract of pelagic and demersal fishes in Tuban, East Java. *Journal of Marine-Earth Science and Technology*, *4*(1), 9-15. https://doi.org/10.12962/j27745449.v4i1.648

Imdadurrohman, A. (2023). *Analisis pembiayaan Mudharabah dari sampah dalam meningkatkan pendapatan santri Pondok Pesantren Al Ihya'ulumaddin Kesugihan Cilacap* (Doctoral dissertation, UIN Prof. KH Saifuddin Zuhri).

Khan, F. Q., Rasheed, S., Alsheshtawi, M., Ahmed, T. M., & Jan, S. (2020). A comparative analysis of RAD and agile technique for management of computing graduation projects. *Computers, Materials & Continua*, *64*(2), 777–796. https://doi.org/10.32604/cmc.2020.010959

Kristiyanti, D. A., Alexandra, Y., Situmorang, R., Athira, R. F., & William, J. A. (2024). Digitalization of village based on information technology through developing BUMDes MSMEs website and logo. *Jurnal Inovasi Hasil Pengabdian Masyarakat (JIPEMAS)*, *7*(1), 196-207. https://doi.org/10.33474/jipemas.v7i1.20803

Kristiyanti, D. A., Novera, D., Anjani, N., Tania, N., Andini, F., & Nasrulloh, N. (2021). Peningkatan kinerja kader posyandu Desa Cogreg Kabupaten Bogor melalui Sistem Informasi Pelayanan Posyandu (SIPANDU) berbasis web. *Jurnal Pengabdian Pada Masyarakat*, *6*(1), 6-13. https://doi.org/10.30653/002.202161.582

Kurniawan, M. A. R., & Rahma, A. S. (2022). Dampak PPKM terhadap sampah plastik di Jakarta. *Jurnal Pengabdian Masyarakat Biologi dan Sains*, *1*(1), 28-42. https://doi.org/10.30998/jpmbio.v1i1.952

Mardiah, N., Afifah, F. N., Syahidin, Y., & Sari, I. (2022). Design of an Insurance Patient visit information system using the V-Model Method. *Jurnal E-Komtek (Elektro-Komputer-Teknik)*, *6*(2), 265-278. https://doi.org/10.37339/e-komtek.v6i2.1018

Meyrena, S. D., & Amelia, R. (2020). Analisis pendayagunaan limbah plastik menjadi ecopaving sebagai upaya pengurangan sampah. *Indonesian Journal of Conservation*, *9*(2), 96-100. https://doi.org/10.15294/ijc.v9i2.27549

Mulyadi, M., Wahyudi, R., & Putri, I. S. (2020). Peran bank sampah dalam meningkatkan pendapatan ekonomi ibu-ibu rumah tangga. *Wasana Nyata*, *4*(2), 145-153. https://doi.org/10.36587/wasananyata.v4i2.750

Muryani, R., Santoso, S., & Firdiyani, F. (2023). Pengelolaan bank sampah berbasis aplikasi mobile dalam mewujudkan smart environment (Studi kasus Bank Sampah Meranti di Kelurahan Buaran Indah Kota Tangerang). *Jurnal Multilingual*, *3*(4), 1412–1482.

Nikmah, A., Kurniawan, D., Putri, A., & Sahdi, J. (2023). Pengolahan sampah rumah tangga menjadi eco enzim yang dapat dimanfaatkan masyarakat Desa Arul Putih. *Jurnal Pengabdian pada Masyarakat Indonesia*, *2*(5), 38-42. https://doi.org/10.55542/jppmi.v2i5.857

Prihadi, S., Yogatama, M. A., Rachmansyah, A., Shefiani, N., Eka Karistalia, N., Sari, N. V., Viola Khalifah, P., Widyastuti, R., Cardinalia, R. S., Azzahra, S. A., & Azilia, W. (2023). Pelatihan pengolahan sampah plastik untuk meningkatkan kesadaran masyarakat kelurahan kerten akan bahaya sampah plastik dengan langkah berkelanjutan. *Society/ : Jurnal Pengabdian Masyarakat*, *2*(5), 237–244. https://doi.org/10.55824/jpm.v2i5.331

Putra, M. Y. (2020). Responsive web design menggunakan bootstrap dalam merancang layout website. *Information System for Educators and Professionals: Journal of Information System*, *5*(1), 61-70.

Ramdiansyah, F. D., & Anubhakti, D. (2020). Perancangan e-commerce pada bintang fashion menggunakan PHP & Laravel Framework. *IDEALIS/ : InDonEsiA JournaL Information System*, *3*(1), 457–461. https://doi.org/10.36080/idealis.v3i1.2092

Richter, L. E., Carlos, A., & Beber, D. M. (n.d.). *Metodologi pengabdian masyarakat*.

Rosyidah, N. (2021). Pendampingan pembuatan laporan keuangan KSPPSAI-Amanah Sawocangkring Sidoarjo menggunakan Metode CBR. *DINAMIS: Jurnal Pengabdian Kepada Masyarakat*, *1*(2), 108-116. https://doi.org/10.33752/dinamis.v1i2.5720

Senarath, U. S. (2021). Waterfall methodology, prototyping and agile development. *Tech. Rep.*, *June*, 1–16. https://doi.org/10.13140/RG.2.2.17918.72001

Srikandi, A. A. A. W. (2019). Konstruksi Model Akad Wadi'ah Yad Adh-Dhamanah dalam mengembangkan islamic sociopreneurship di Bank Sampah Manfa'at, Desa Bolorejo, Kabupaten Tulungagung. *Universitas Islam Negeri Sunan Ampel Fakultas Ekonomi dan Bisnis Islam Program Studi Ekonomi Syariah Surabaya*.

The World Bank. (2024). *Trends in solid waste management*. The World Bank. Retrieved from: https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html

UN Environment Programme. (2024). *Chemicals and pollution action*. UN Environment Programme. Retrieved from: https://www.unep.org/topics/chemicals-and-pollution-action?gad_source=1&gclid=CjwKCAiAopuvBhBCEiwAm8jaMXoPXs2AvRW5pXcZHIFFi0o1Os1TGqXbL18s5OaVtI155CSdBeCaBxoCeioQAvD_BwE

Utami, K., Rialmi, Z., & Nugraheni, R. (2022). Analisis perencanaan aplikasi bank sampah digital studi kasus pada bank sampah solusi hijau. *Jurnal Penelitian Manajemen Terapan (PENATARAN)*, *7*(1), 34-49.

Utami, K., Prasvita, D. S., & Widiastiwi, Y. (2023). Pengembangan sistem manajemen bank sampah berbasis web untuk mewujudkan keberhasilan ekonomi sirkular di masyarakat. *Indonesian Journal of Computer Science*, *12*(1), 239-251. https://doi.org/10.33022/ijcs.v12i1.3140

Wibowo, D. W., Khairy, M. S., Rizza, M. A., Fitriana, A., & Sari, P. A. (2024). Waste management improvement with software application at Wringinsongo Village, Tumpang Regency, Malang. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang*, *9*(2), 307–315. https://doi.org/10.26905/abdimas.v9i2.12182

Ziogas, A. N., Schneider, T., Ben-Nun, T., Calotoiu, A., De Matteis, T., de Fine Licht, J., Lavarini, L., & Hoefler, T. (2021). Productivity, portability, performance. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis*, 1–13. https://doi.org/10.1145/3458817.3476176