

GO-BLOCK Innovation: Transforming plastic waste into paving blocks for inmate empowerment in Wirogunan prison

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Abstract

Plastic waste management in correctional facilities is increasingly complex due to limited space and management systems. The "GO-BLOCK" (Garbage to Block) community service program was implemented at the Class IIA Wirogunan Prison, Yogyakarta, to integrate waste management with the production of value-added goods. This program aims to educate inmates on waste sorting and provide technical skills in producing paving blocks from plastic waste. The methodology included Focus Group Discussions (FGD) with stakeholders, participatory socialization, and evaluation via pre-test and post-test instruments. Results showed significant improvements: understanding of waste sorting benefits rose from 40% to 95%, independent sorting practices increased from 35% to 80%, and technical training interest reached 85%. Beyond reducing waste volume within the prison, the program successfully initiated a circular economy empowerment model that equips inmates with productive skills for their post-release future. The synergy between ecological solutions and social empowerment holds potential for replication in other closed communities as an urban waste mitigation strategy.

Keywords: Plastic waste; Inmate empowerment; Paving block; Circular economy

Inovasi GO-BLOCK: Konversi sampah plastik menjadi paving block sebagai strategi pemberdayaan warga binaan lapas Wirogunan

Abstrak

Permasalahan sampah plastik di lembaga pemasyarakatan semakin kompleks akibat keterbatasan ruang dan sistem pengelolaan. Program PKM-PM "GO-BLOCK" (Garbage to Block) dilaksanakan di Lapas Kelas IIA Wirogunan Yogyakarta untuk mengintegrasikan manajemen limbah dengan produksi barang bernilai guna. Program ini bertujuan mengedukasi warga binaan mengenai pemilahan sampah sekaligus memberikan keterampilan teknis pembuatan paving block dari sampah plastik. Metode pelaksanaan meliputi Focus Group Discussion (FGD) dengan pemangku kebijakan, sosialisasi partisipatif, serta evaluasi melalui pre-test dan post-test. Hasil evaluasi menunjukkan peningkatan signifikan: pemahaman manfaat pemilahan sampah melonjak dari 40% menjadi 95%, praktik pemilahan mandiri naik dari 35% menjadi 80%, serta minat pelatihan teknis mencapai 85%. Selain mereduksi volume sampah di lingkungan Lapas, program ini berhasil menginisiasi model pemberdayaan ekonomi sirkular yang membekali warga binaan dengan keterampilan produktif untuk masa depan. Sinergi antara solusi ekologis dan pemberdayaan sosial ini potensial untuk direplikasi pada komunitas tertutup lainnya sebagai strategi mitigasi limbah perkotaan.

Kata Kunci: Sampah plastik; Pemberdayaan warga binaan; Paving block; Ekonomi sirkular

Contributions to
SDGs

8 DECENT WORK AND
ECONOMIC GROWTH



11 SUSTAINABLE CITIES
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1. Introduction

Global environmental issues are becoming increasingly complex, especially those related to the accumulation of plastic waste. Data from [Jambeck et al. \(2015\)](#) shows that Indonesia is the second largest contributor of plastic waste in the world after China. This situation not only affects marine ecosystems, but also causes serious problems on land, including in urban areas. At the local level, the city of Yogyakarta is facing a waste emergency due to the limited capacity of its final disposal sites and the low rate of waste sorting at source. This problem also extends to closed social spaces such as correctional institutions, which, despite being relatively isolated, still produce plastic waste that requires sustainable management.

Previous studies have shown that a participatory approach to waste management can increase public awareness and skills. For example, the eco-brick empowerment program in Bandung has successfully encouraged community involvement in recycling plastic into alternative building materials ([Wardani & Khotimah, 2021](#)), while the school-based waste bank initiative in Surabaya demonstrates the effectiveness of early environmental education ([Koneri & Maabuat, 2022](#)). However, most of these community service activities target open communities, so there have not been many studies examining the application of empowerment models and simple technological innovations in closed communities such as prisons. In fact, these communities have great potential as part of the process of social rehabilitation and community reintegration.

Several community-engagement studies at the national level have demonstrated the effectiveness of participatory approaches in plastic waste management, such as eco brick programs and creative waste processing initiatives reported in Community Empowerment ([Isnaeni et al., 2023](#); [Sujatna et al., 2022](#); [Syahputra et al., 2025](#)). These local outcomes indicate that educational interventions and simple production models can enhance citizen participation in waste management within open communities. To strengthen the scientific foundation of our proposed intervention, this article also adopts and adapts findings from international studies on community participation in solid waste management and the adoption of simple technologies, for example, in the study by [Jang et al. \(2020\)](#) and a review of sustainability practices ([Awino & Apitz, 2024](#)), thereby ensuring the GO-BLOCK program is built on a robust theoretical and empirical foundation.

The urgency of this issue is underscored by global projections indicating that without systemic intervention, plastic waste generation is set to increase drastically, with significant portions mismanaged ([Lebreton & Andrady, 2019](#)). While participatory solutions show promise, their translation into tangible, economically viable products is crucial for long-term sustainability. Recent advancements in construction materials research demonstrate the technical feasibility of incorporating plastic waste into building components like paving blocks, offering a dual benefit of waste reduction and value creation ([Awoyera & Adesina, 2020](#)). This scientific foundation informs the GO-BLOCK program's core innovation.

This community service program address these limitations by presenting a model for empowering inmates through the GO-BLOCK (Garbage to Block) program, an initiative to process plastic waste into paving blocks using the 3R (reduce, reuse, recycle) approach. This program is designed not only to produce useful products, but also to

instill technical skills, foster environmental awareness, and strengthen the confidence of inmates. Several recent studies have emphasized that community empowerment in environmental management must adopt participatory and context-based approaches to ensure behavioral transformation (Fajri & Kamarubiani, 2023; Leria et al., 2020; Syahputra et al., 2025; Wacnik et al., 2025). In the context of correctional institutions, participatory environmental programs have been proven to reduce ecological neglect and build personal responsibility among inmates (Adawiah et al., 2024; Bossen et al., 2016). Moreover, community service programs focusing on waste transformation into eco-products, such as paving blocks or eco bricks, have demonstrated measurable impacts on socio-environmental awareness and local innovation (Wacnik et al., 2025).

This community service program discusses the initial stages of a series of activities under the Student Creativity Program – Community Service (PKM-PM) GO-BLOCK (Garbage to Block) implemented at the Wirogunan Class IIA Correctional Facility in Yogyakarta. These initial activities were designed as the foundation for the overall program, including preparatory activities and coordination with the management of the Wirogunan Correctional Institution, a Focus Group Discussion (FGD) with strategic partners (the Correctional Institution, the Environmental Agency, and the Yogyakarta City Development Planning Agency), field observations of the actual conditions of waste management, socialization of waste sorting to inmates, evaluation through pre-tests and post-tests to measure the effectiveness of the activities, and the installation of posters encouraging waste sorting. The unique waste management challenges within correctional facilities, including security constraints and resource limitations, have been documented (Marinho et al., 2022), highlighting the need for tailored interventions like GO-BLOCK.

The results of this initial stage are expected to serve as a stepping stone in developing the core GO-BLOCK program, namely the processing of plastic waste into environmentally friendly paving blocks. Thus, this activity not only responds to environmental issues but also introduces a relevant contextual empowerment model for closed communities such as prisons. This activity also aims to bring together academics, local governments, and prisons to build mutual understanding, gather technical input, and strengthen cross-sectoral collaboration commitments.

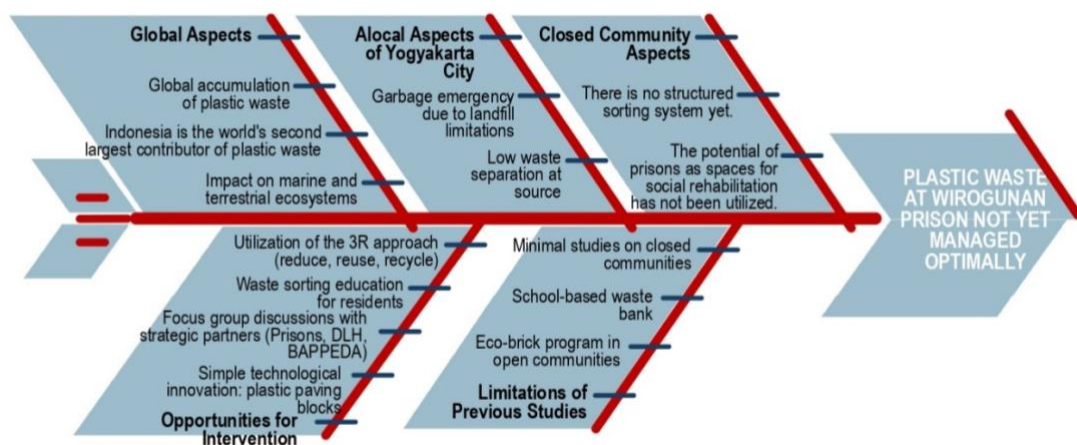


Figure 1. Diagram of root causes and intervention opportunities in plastic waste management at Wirogunan Prison

To systematically address the interconnected challenges of plastic waste within the prison, a root cause analysis was conducted see [Figure 1](#). The diagram maps the primary drivers—such as limited inmate awareness, lack of sorting infrastructure, and absence of economic incentives—to the specific intervention points offered by the GO-BLOCK program. This visual framework guided the program’s design, ensuring that each activity directly targets an identified barrier, thereby creating a coherent theory of change from problem identification to sustainable solution.

The novelty of this activity lies in the application of a participatory approach in correctional institutions, which combines aspects of education, social rehabilitation, and environmental management. Furthermore, this activity offers a multi-actor collaboration framework that can be replicated in other closed communities such as Islamic boarding schools or social protection homes. Thus, the main objective of writing this scientific paper on community service is to describe the process and results of the implementation of the GO-BLOCK activity at the Class IIA Wirogunan Prison in Yogyakarta.

2. Method

The implementation method of this community service activity was presented descriptively, focusing on a participatory approach through Focus Group Discussions (FGDs), field observation, waste-sorting socialization, and evaluation stages. The program was conducted at the Wirogunan Class IIA Correctional Institution in Yogyakarta, targeting inmates as the primary beneficiaries, with assistance from prison officers and institutional collaboration with the Environmental Agency (DLH) and the Regional Development Planning Agency (BAPPEDA) of Yogyakarta City. The activity was implemented by the Student Community Service Creativity Program (PKM-PM) team from the Architecture Study Program, Universitas Teknologi Yogyakarta, who acted as facilitators in coordinating stakeholders, delivering educational materials, and guiding technical practices throughout the intervention process.

The implementation followed a structured participatory cycle, as illustrated in [Figure 2](#). The participatory approach used (FGD, site visit, interactive socialization, pre-post evaluation) follows best practice models in participatory research applied to solid waste management, which emphasize stakeholder co-creation, iterative feedback and mixed evaluation ([He et al., 2024](#)). This design allows both process evaluation (engagement, ownership) and outcome evaluation (knowledge change measured by pre- and post-tests).



Figure 2. Stages of program implementation at Wirogunan Prison

The activity began with problem and potential mapping through initial discussions with the Correctional Institution Management. This activity was carried out several times between July 25 and 28, 2025. Subsequently, a Focus Group Discussion (FGD) was held

on August 2, 2025, as an activity to disseminate the initial ideas for the proposed activities, present the GO-BLOCK (Garbage to Block) program design, and convey the technical expertise of the implementing team. The FGD also served as a forum for knowledge exchange, where participants provided technical, policy, and implementation strategy input. At this stage, the moderator facilitated the discussion to ensure the involvement of all parties and the formation of a collaborative commitment.

The next session involved a field visit to review the waste sorting facilities in the prison. This was done to evaluate the readiness of the infrastructure, identify additional needs, and develop technical strategies for implementing training on processing plastic waste into paving blocks for the next stage. This process emphasized that the intervention was not only a transfer of technology, but also a contextual adaptation appropriate to the conditions of the prison.

Data collection methods for evaluating activities were conducted through direct observation, visual documentation, and informal interviews with FGD participants. The analysis was conducted descriptively to assess stakeholder involvement, the level of acceptance among residents, and the program's sustainability opportunities. With this approach, the implementation method not only outlined technical steps but also emphasized the connection between the implementation of research results, academic expertise, and real implementation for the target community.

3. Findings and Discussion

This section presents the results and discussion of a series of community service activities that have been carried out at the Wirogunan Class IIA Prison through the PKM-PM GO-BLOCK program. The analysis focuses on four main aspects, namely: (1) Program Description and Partner Involvement, which explains the course of activities and the synergy between stakeholders; (2) Measurement of Activity Impact, which presents quantitative and qualitative measures of the program's contribution in terms of social, ecological, economic, and institutional aspects; and (3) Evaluation of the Contextual Empowerment Model, which emphasizes the evaluation of the implementation of adaptive strategies in the empowerment of inmates.

3.1. Program description and partner involvement

The Forum Group Discussion (FGD) held on August 2, 2025, at the Wirogunan Class IIA Prison successfully brought together various stakeholders, including prison officials, students, academics, and representatives from the Environmental Agency (DLH) and the Yogyakarta City Development Planning Agency (BAPPEDA) (Figure 3). The FGD served as a forum for presenting the GO-BLOCK program design and as a means for partners to actively participate in providing technical and policy input.



Figure 3. Conducting FGD with partners and gathering commitments

The next step was a field visit to inspect the waste sorting facilities within the prison (Figure 4). This was done to evaluate the readiness of the infrastructure, identify additional needs, and develop a technical strategy for implementing training on processing plastic waste into paving blocks. This process confirmed that the intervention was not only a transfer of technology, but also a contextual adaptation appropriate to the conditions of the prison.



Figure 4. Field Visit to inspect the condition of waste sorting land available at Wirogunan Prison

This activity was followed by a Waste Sorting Socialization event held on Friday, August 8, 2025, from 8:30 to 10:00 a.m. at the Wirogunan Class IIA Prison (Figure 5). The socialization was attended by 20 inmates who are partners in the program, with assistance from prison officers. The purpose of the socialization was to educate inmates about the importance of proper waste management, introduce them to the different types of waste, and explain the benefits of processing plastic waste into useful products such as paving blocks.



Figure 5. Socialization of waste sorting PKM-PM GO-BLOCK

The material was delivered interactively, accompanied by images and practical explanations to make it easy to understand (Figure 6). The activity ran smoothly with high enthusiasm from the participants. These results reinforce the program's commitment and lay the foundation for the implementation of the core GO-BLOCK in the next phase. The material is delivered interactively, accompanied by images and practical explanations to make it easy to understand.

The remarkable knowledge gain (mean score 2.6 to 4.4) aligns with documented outcomes of community-based education in SWM (He et al., 2024). However, the novel contribution of this study lies in achieving this within a closed community. This success can be theorized through the lens of participatory design (Bossen et al., 2016; Wacnik et al., 2025), where initial FGDs served as 'co-creation' phases, fostering inmate ownership.

This contrasts with purely instructive models common in open communities, suggesting that in restricted settings, preliminary stakeholder integration is even more critical for educational efficacy.



Figure 6. Installation of posters encouraging waste sorting

3.2. Impact assessment of activities

The implementation of waste sorting socialization in the PKM-PM GO-BLOCK program at the Wirogunan Class IIA Prison showed a significant increase in the understanding, awareness, and motivation of the inmates. The pre-test results showed that most respondents (65%) stated that they had never sorted waste before, and only 40% knew the benefits of waste sorting. In addition, 55% of respondents had never participated in training related to waste management. This condition shows that inmates still have limited access to information and environmental education before this program.

The post-test results after the outreach activities showed quite a strong positive change. The percentage of respondents who knew the benefits of waste sorting increased to 95%, with 90% stating that they were ready to be actively involved in waste management in prisons. Interest in training in processing plastic waste into paving blocks also increased significantly, with 85% of respondents stating that they were very interested in participating in further training. The increase in the average score for understanding waste management from 2.6 (fairly low) in the pre-test to 4.4 (high) in the post-test further confirms that this activity has succeeded in raising ecological awareness and motivating inmates to become actively involved.

The improvement in knowledge scores we observed (mean 2.6 increase to 4.4) is consistent with findings from participatory solid waste management (SWM) studies, which report significant post-intervention increases following community-based educational programs (Awino & Apitz, 2024; He et al., 2024). The key distinction lies in the context: international studies typically focus on open communities, whereas GO-BLOCK demonstrates that similar educational effects can be achieved within closed communities such as prisons, despite unique challenges related to access and security protocols.

Thus, the socialization stage serves as a bridge between program formulation (FGD) and technical implementation (production training), ensuring that program success is measured not only by physical output, but also by the internalization of educational values and active participation of residents.

The evaluation results show a significant increase in residents' knowledge, motivation, and commitment to waste sorting. Based on the post-test results, knowledge about the benefits of sorting increased from 40% to 95%, while involvement in socialization and interest in participating in further training rose to 85–100%. This data confirms that

socialization activities have succeeded in building ecological awareness and fostering a sense of shared responsibility in maintaining the cleanliness of the prison environment.

Table 1. Comparison of pre- and post- workshop

No	Evaluation Questions	Pre-Test	Post-Test	Change (%)	Measured elements
1	Garbage is a problem in Yogyakarta	70%	100%	+30	Initial awareness of environmental issues (perception of waste problems at the local level)
2	Have you ever sorted trash before?	35%	80%	+45	The behavior of inmates in waste sorting
3	Understanding the benefits of waste sorting	40%	95%	+55	Conceptual knowledge about the benefits of sorting (environment, health, economy)
4	Have you ever participated in outreach activities or training on waste management?	45%	100%	+55	Level of previous exposure to education (experience participating in formal/informal activities)
5	Interested in taking a paving block making course	50%	85%	+35	Motivation and interest in participating in follow-up activities (GO-BLOCK core program)
6	Willing to participate in waste management activities at the prison	55%	90%	+35	Commitment to active participation of residents in waste management programs
Average score		2,6	4,4	+1,8	

The increase in ecological awareness and motivation among inmates corresponds with findings by [Leria et al. \(2020\)](#) and [Andinar et al. \(2023\)](#), who found that structured community engagement in waste recycling activities effectively promotes sustainable behavioral change. Similar evidence is also reflected in participatory design studies ([Bossen et al., 2016](#); [Cooper et al., 2022](#)), confirming that co-creation methods involving marginalized groups accelerate environmental learning and collective responsibility. In this regard, the GO-BLOCK model not only transfers knowledge but establishes a systemic participatory framework that aligns with contemporary empowerment paradigms.

3.3. Evaluation of contextual empowerment models

The GO-BLOCK program is designed as a contextual empowerment model that adapts to the social and environmental conditions of prisons. FGDs serve as the initial stage of strategy development, while waste sorting socialization serves as a stage for strengthening the capacity of inmates through simple and practical education.

Socialization does not only focus on information transfer but also builds collective awareness that waste management is a shared responsibility, not merely the task of prison officers. Materials on types of waste (garbage, diapers, and scrap) and simulations of the paving block manufacturing process prove that visual and practical approaches can improve understanding. Thus, this program shows that contextual empowerment needs to be carried out in stages: from aligning perceptions (FGD), basic education (socialization), to technical application (paving block manufacturing training). The FGD resulted in a shared understanding that the program is not only technical in nature, but

also educational and rehabilitative. Inmates are not only trained to produce paving blocks but are also encouraged to understand the waste cycle and its economic value.

The impact of the socialization activities can be analyzed in two main dimensions. First, the cognitive impact in the form of increased knowledge and awareness of the inmates regarding the importance of waste sorting, as evidenced by the pre-test and post-test results which showed an average jump in comprehension scores from 2.6 to 4.4 (scale of 1–5). Second, the participatory impact, namely the increased readiness of the inmates to be involved in follow-up activities of processing plastic waste into paving blocks.

Beyond knowledge gain, a critical outcome is the observed shift towards ecological behavior and responsibility. Theoretical frameworks suggest that environmental knowledge, when coupled with a sense of connectedness to the issue, is a strong predictor of pro-environmental action ([Otto & Pensini, 2017](#)). The interactive socialization and hands-on future promise of creating a useful product (paving blocks) likely fostered this connection among inmates, moving the intervention beyond mere instruction towards cultivating ecological citizenship. This aligns with the core tenets of Participatory Action Research (PAR), which posits that sustainable change arises from cycles of reflection and action within the community itself ([Cornish et al., 2023](#)).

The main social impact that emerged was an increase in the awareness and motivation of inmates in managing plastic waste. Through discussions and technical presentations, inmates understood the economic potential of waste and its relevance to post-release life skills. This change is in line with the findings of [Wardani & Khotimah \(2021\)](#), which emphasize that practice-based education can increase community participation in waste management. However, unlike that study, which targeted open communities, this research shows that similar interventions are also relevant and effective when applied in closed communities such as prisons. The skills-building component of GO-BLOCK aligns with meta-analytic evidence showing that vocational training in prisons significantly improves post-release outcomes ([Wilson et al., 2000](#)). Transforming plastic waste into paving blocks represents an applied form of material innovation, contributing to the broader scientific pursuit of viable plastic recycling pathways ([Thiounn & Smith, 2020](#)).

The social impact of the activity is clearly evident through the increase in the knowledge and awareness of the inmates. Pre-post testing is widely used to capture short-term knowledge gains in community interventions and has been validated in SWM interventions ([He et al., 2024](#)). Our observed gains therefore reflect a credible immediate outcome of the socialization session. The post-test results show a significant increase in understanding, including:

- a. Inmates understand the importance of disposing of waste in its proper place and sorting it before mixing it.
- b. Knowledge has increased regarding the categories of rotten waste, diapers, and scrap.
- c. Awareness has increased that unsorted waste will cause unpleasant odors and pollution.
- d. A good understanding of the paving block manufacturing process indicates that the material is well accepted.
- e. Awareness grows that waste management is a shared responsibility.

- f. Inmates feel they have gained additional knowledge and skills that will be useful in their lives after release.

In addition, the placement of waste sorting posters at seven strategic points within the prison reinforces the socialization message, making it more sustainable. This shows that a simple visual approach can broaden the educational impact, in line with the findings of [Koneri & Maabuat \(2022\)](#) on school-based waste bank programs. The success in changing inmate behavior underscores the importance of social factors and structured education in waste separation, a finding consistent with broader literature ([Brandstätter et al., 2020](#)). However, in the context of prisons, this intervention targets a limited population that was previously underserved by environmental programs.

The short-term benefits that are already apparent are changes in the attitudes of inmates towards environmental issues: they understand that waste management is a shared responsibility, not just the task of prison officers. In the long term, this program has the potential to equip inmates with new skills that are relevant to life after release, as well as making a real contribution to reducing the volume of plastic waste in the prison environment.

Therefore, the GO-BLOCK model transcends being a waste management project; it represents a holistic, community-embedded intervention for rehabilitation. By integrating principles of Participatory Action Research ([Cornish et al., 2023](#)) with applied technical innovation ([Awoyera & Adesina, 2020](#)), it creates a virtuous cycle: addressing an immediate environmental need (plastic waste) while building skills, responsibility, and self-efficacy among a marginalized population. This approach not only addresses the local waste crisis but also contributes to the broader UN Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 8 (Decent Work and Economic Growth).

4. Conclusion

The GO-BLOCK program has successfully built collective awareness of the importance of plastic waste management in closed environments such as prisons. FGD as a participatory approach has proven effective in building synergy between academic, bureaucratic, and social actors. Empowering inmates not only leads to skills development but also affirms that environmental solutions can originate from marginalized communities with cross-sector support.

The PKM-PM GO-BLOCK activity at the Wirogunan Class IIA Prison has succeeded in increasing inmates' awareness and knowledge of the importance of waste sorting, while also motivating them to actively participate in environmental management. Evaluation through pre-tests and post-tests showed a significant increase in understanding of the benefits of sorting, involvement in socialization, and interest in participating in follow-up programs. This initial intervention had a social impact in the form of a growing sense of collective responsibility for the prison environment and a readiness to accept innovations in waste processing into useful products.

This initiative affirms that participatory environmental education in correctional settings contributes significantly to behavioral transformation and ecological citizenship, consistent with previous empowerment studies. The implication of this activity is that

waste sorting socialization can serve as a contextual empowerment model for closed communities by integrating aspects of environmental education, social rehabilitation, and multi-actor collaboration. Furthermore, the GO-BLOCK program demonstrates the potential for replication in similar institutions such as Islamic boarding schools or social protection houses, thereby strengthening community ownership and contributing more broadly to sustainable, community-based environmental conservation efforts and long-term ecological impact.

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Authors Contribution

Activity implementation: ET, HHS, ASDI, BDSFR, MNSN, MNR; Article preparation: ET, BDSFR, MNSN; Analysis of service impact: HHS, ASDI, BDSFR, MNR; Presentation of service results: HHS, ASDI, MNR; Article revision: ET, MNSN.

Conflict of Interest

The authors declare no conflict of interest regarding the research, implementation of the program, or the preparation of this article. All activities of the PKM-PM GO-BLOCK community service program were conducted transparently with full support from partners, funding provided by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia (Kemdikbudristek), and academic supervision from Universitas Teknologi Yogyakarta.

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