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Training on using electricity monitoring instruments for MSMEs in achieving sustainable energy efficiency in Legok Village

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Abstract
Culinary MSMEs (Micro, Small, and Medium Enterprises) in Legok Village face challenges in managing energy consumption efficiently, resulting in higher operational costs. These challenges are due to a lack of tools to monitor energy use and limited knowledge of advanced energy management practices. To address this, this program aims to enhance the understanding of culinary MSME managers in Legok Village about energy efficiency and its practical application by introducing commercially available IoT-based monitoring devices. These devices allow them to track and manage electricity consumption in their culinary businesses effectively. The methods used include theoretical presentations, tool demonstrations, practical exercises, and technology transfer. Evaluation results show that this training is highly effective and increases partner knowledge. Feedback from participants emphasizes the need for improved security, better practicality, and the addition of features such as peak watt monitoring.

Keywords: IoT; Energy consumption; Culinary MSMEs

Contributions to SDGs

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Pelatihan penggunaan instrumen monitoring listrik bagi UMKM dalam mewujudkan efisiensi energi yang berkelanjutan di Desa Legok

Abstrak
UMKM (Usaha Mikro, Kecil, dan Menengah) kuliner di Desa Legok menghadapi tantangan dalam mengelola konsumsi energi secara efisien, yang mengakibatkan biaya operasional yang lebih tinggi. Tantangan ini disebabkan oleh kurangnya alat untuk memantau penggunaan energi dan terbatasnya pengetahuan mengenai praktik manajemen energi tingkat lanjut. Untuk mengatasi hal ini, program ini bertujuan untuk meningkatkan pemahaman para pengelola UMKM kuliner di Desa Legok tentang efisiensi energi dan penerapan praktisnya dengan memperkenalkan perangkat pemantauan berbasis IoT yang tersedia secara komersial. Perangkat ini memungkinkan mereka untuk melacak dan mengelola konsumsi listrik dalam bisnis kuliner mereka secara efektif. Metode yang digunakan meliputi pemaparan teori, demonstrasi alat, praktik, dan transfer teknologi. Hasil evaluasi menunjukkan pelatihan ini sangat efektif dan meningkatkan pengetahuan mitra. Umpan balik dari peserta menekankan perlunya peningkatan keamanan, kepraktisan yang lebih baik, dan penambahan fitur seperti pemantauan watt puncak.

Kata Kunci: *IoT; Konsumsi energi; UMKM kuliner*

1. Introduction

Micro, small, and medium enterprises (MSMEs) are vital to Indonesia's economic growth, as highlighted in Undang-Undang Nomor 20 Tahun 2008, by creating jobs, enhancing income distribution, and promoting economic stability (Farida et al., 2024). In particular, culinary MSMEs in sectors that are energy-intensive play a crucial role in this landscape.

Despite their importance, these MSMEs face significant challenges, particularly regarding energy efficiency, which is essential for their sustainability and resilience. Indeed, energy efficiency is critical for the long-term viability of MSMEs (Herce et al., 2024), especially in the culinary sector, which often incurs high electricity consumption for daily operations.

To address these challenges, a prior program focused on training in electricity management for culinary MSMEs aimed to enhance participants' awareness and capabilities regarding energy consumption (Andarini & Saputri, 2024). While this program successfully improved participants' understanding, it became evident that further action was needed to introduce real-time electricity monitoring technologies for more effective and sustainable energy management. These technologies have been shown in previous studies to provide detailed insights into energy usage patterns, enabling more accurate identification of energy-saving opportunities and the potential to reduce electricity costs (Adebisi & Ndjuluwa, 2024; Purwania et al., 2020; Selvaraj et al., 2023). Implementing such systems also fosters a culture of energy awareness and supports long-term sustainable practices in business operations (Muniz et al., 2023).

As a continuation of this effort, this community service program was carried out in Legok Village, Tangerang, an area known for its thriving culinary MSMEs (Fianty et al., 2023; Saputri et al., 2023). The monitoring instruments comprised both commercially available devices and a self-designed Internet of Things (IoT)-based monitoring system. The IoT-based system allows MSME operators to monitor their electricity consumption in real-time via mobile phones or laptops, making energy management more convenient and efficient (Himer et al., 2023; Saputri et al., 2024).

This initiative aims to empower culinary MSMEs in Legok Village by providing training activities, including practical tools for monitoring and managing energy consumption, ultimately enhancing participants' knowledge of energy efficiency and its practical applications through the introduction of commercially available and team-designed IoT monitoring devices, enabling them to effectively track and manage electricity consumption in their culinary businesses. Additionally, the program contributes to the achievement of the Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy), which emphasizes ensuring access to affordable, reliable, sustainable, and modern energy for all. By introducing technologies that enhance energy efficiency, the program also supports SDG 8 (Decent Work and Economic Growth), as improved energy management can lower production costs and bolster economic resilience for MSMEs.

The training activities encompassed both theoretical and practical aspects of energy monitoring. Participants were introduced to fundamental principles of energy efficiency and trained to use the various instruments. The commercially available devices offered basic monitoring functions, while the IoT-based system provided advanced features,

including real-time data access and analytics. By integrating these tools into their operations, MSMEs can better understand their energy usage patterns, identify inefficiencies, and implement cost-saving measures.

2. Methods

The activities were held at the residence of one of the MSME partners and included training on the use of electricity monitoring instruments. To support energy efficiency in Legok Village's culinary MSME sector, the training methods for the electricity monitoring system were designed to ensure participants understood the concepts and could apply the technology independently. The training included the use of commercial devices commonly sold in the market and Internet of Things (IoT)-based devices designed by the team. Both devices served as educational tools, providing solutions for partners to monitor and manage their electricity consumption during culinary production. The method used involved theoretical presentation, demonstration of the tools, practice by participants, and technology transfer to partners. These methods enabled participants to understand device operation, interpret generated data, and utilize the information to improve their business efficiency.

a. Theoretical presentation. The theoretical session introduced basic concepts (Wrenn & Wrenn, 2009), aiming for a clear and structured understanding while encouraging interactive discussions (Al-khresheh, 2024; Wardoyo, 2018).

b. Demonstration of tools. Following the presentation, the team conducted live demonstrations of both commercial devices and the IoT-based system. This demonstration aimed to provide participants with practical knowledge on how to effectively use the tools (Basheer et al., 2017; Loiser & Endne, 2022).

c. Practice by participants. Participants then practiced using both devices under the guidance of facilitators. The hands-on sessions helped build participants' confidence and their ability to apply skills in energy management (Abrahams & Millar, 2008; Jyrhämä, 2006; Millar, 2004).

d. Technology transfer to partners. At the end of the training, the IoT device was handed over to selected MSME partners along with usage guidelines and a user manual to support ongoing use (ProProfs Editorial, 2025).

e. Evaluation and feedback. Participants' understanding and satisfaction were evaluated through a post-training survey. This feedback was essential for evaluating the program's success and identifying areas for improvement (Darojat, 2022; Gusetyoningsih & Astutiningsih, 2014; Mashaan, 2020).

3. Results and Discussion

The training on electricity consumption monitoring systems for MSMEs in Legok Village yielded significant results, showcasing the effectiveness of the methods and tools employed. The training introduced two energy monitoring devices: a commercially available device and a team-designed IoT-based device. Both were supported by a detailed manual book, enabling participants to understand and utilize the devices efficiently.

3.1. Theoretical presentation

The training began with a theoretical session where participants were introduced to the basic concepts (Wrenn & Wrenn, 2009) of energy efficiency and the importance of monitoring energy consumption. The presentation-based training aimed to provide participants with a clear and structured understanding of the material, while facilitating interactive discussions to enhance information absorption and practical application (Alkhresheh, 2024; Wardoyo, 2018). This session explained the features and benefits of both the commercial and the team-developed IoT-based energy monitoring systems. Participants were also briefed on how these devices contribute to identifying inefficiencies and reducing operational costs.

3.2. Demonstration of tools

Following the theoretical session, the team conducted live demonstrations of both types of devices. The demonstration aimed to provide participants with a clear, practical understanding of effective tool and system utilization, bridging the gap between theory and real-world application (Basheer et al., 2017; Loiser & Endne, 2022). Regarding the commercial device, the team explained its operational steps, including setup, data visualization, and limitations. The IoT-based device demonstration showcased its advanced features, such as real-time monitoring via PCs, laptops, or smartphones, and data recording capabilities. This provided participants with a practical understanding of each tool's operation.

3.3. Prototype presentation and manual book

The IoT-based prototype in Figure 1 demonstrated its ability to provide real-time energy consumption data that could be accessed via PC, laptop, or smartphone. This feature differentiated it from the commercial device, which required manual data collection. The manual book (Figure 2) was well-received as an important tool for simplifying the learning process. It provided step-by-step instructions for device setup, data interpretation, and troubleshooting, ensuring participants' independent operation post-training.

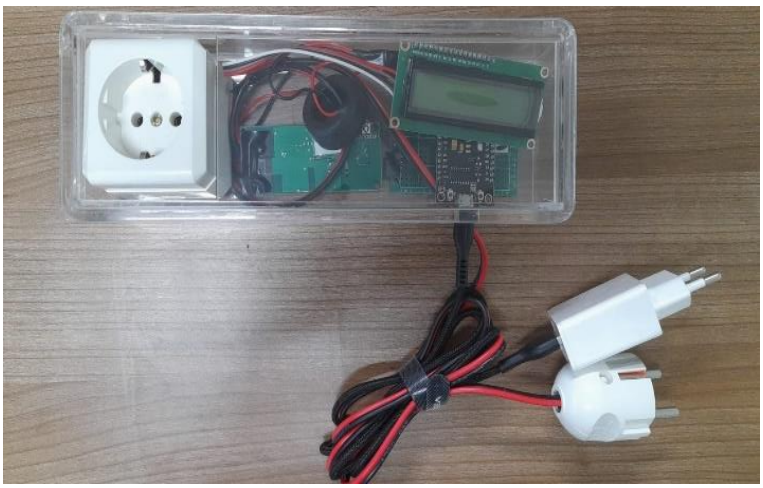

Figure 1. The IoT-based prototype of electricity monitoring system

3.4. Practice session

After the demonstration, participants practiced using both devices under the guidance of the training facilitators. They learned to set up the devices, interpret the data displayed, and identify areas for potential energy savings. These practical sessions were

crucial for building participants' confidence in using energy monitoring devices and translating theoretical knowledge into actionable skills.

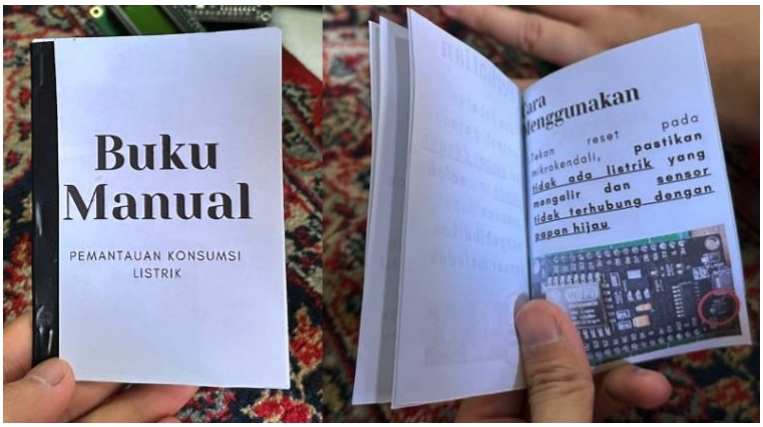

Figure 2. Manual book of IoT based monitoring system

Following the demonstration, participants actively practiced using both devices under the guidance of facilitators, displaying a high level of enthusiasm and engagement (as shown in Figure 3) and a growing interest in energy monitoring as a means to optimize their business operations. The interactive format of the training encouraged questions and discussions, allowing participants to better understand the tools' applications and limitations. These hands-on experiences helped participants optimize energy use in their operations while fostering a deeper understanding of the tools' applications and limitations (Abrahams & Millar, 2008; Jyrhämä, 2006; Millar, 2004).

Figure 3. Training condition

3.5. Evaluation results

Survey results from the post-training evaluation indicated a significant improvement in participants' knowledge and skills. 40% of participants rated the training as very effective and 60% considered it effective. Participants also reported an improved understanding of energy efficiency and monitoring systems, with 100% indicating increased knowledge. The feedback from participants emphasized the practicality and potential impact of the IoT-based device. Suggestions included improving the device's security, simplifying its design for ease of use, and adding features like peak wattage information. This constructive feedback will be used to refine the device and improve future training sessions.

At the conclusion of the training, the IoT-based devices developed by the team were officially handed over to the selected MSME partners. This phase provided comprehensive guidance on independently operating the devices, including troubleshooting advice. A simplified user manual was also provided to facilitate ongoing usage. This technology transfer enables MSMEs to monitor and manage their energy consumption effectively on a continuous basis.

3.6. Program impact

The results highlight the training's success in bridging the gap between theoretical understanding and practical application. The IoT-based system's advanced features make it a valuable tool for MSMEs seeking to effectively monitor energy use and reduce costs (Luechaphonthara & Vijayalakshmi, 2019; Wirasasmita et al., 2022). Combined with the manual, participants now possess the knowledge and resources to adopt sustainable energy practices. Moreover, their active involvement in evaluating the tools and providing feedback underscores the training's participatory approach, which aligns well with SDG Goals 7 (Affordable and Clean Energy) and 8 (Decent Work and Economic Growth).

4. Conclusions

The electricity consumption monitoring system training for MSMEs in Legok Village successfully met its objectives of enhancing energy efficiency knowledge and practical application among participants. The program introduced both commercial devices and IoT-based monitoring devices designed by the team, equipping participants with the necessary tools to track and manage electricity consumption in their culinary businesses. Through theoretical presentations, demonstrations, hands-on practice, and technology transfer, the training effectively enhanced participants' understanding and ability to use these devices.

The quantitative evaluation data indicated a positive outcome. A total of 60% of participants rated the training as effective, while 40% rated it as highly effective. All participants reported an increase in their knowledge of energy management, with many expressing a readiness to apply what they learned to improve energy efficiency in their businesses. Additionally, feedback revealed key suggestions for future improvements, including enhanced security features, ease of use, and the addition of a peak wattage feature in the monitoring devices.

This program not only addressed the immediate needs of the MSMEs in Legok Village but also supported the broader goal of promoting sustainable energy practices. By empowering MSMEs with the skills and tools to monitor and manage their electricity consumption, the training aligns with sustainable development goals, particularly in providing affordable and clean energy solutions. Moving forward, the program should incorporate participant feedback to continuously improve the tools and training methods, ensuring greater impact and sustainability.

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Author Contributions

Activity organizer: FRS, MIF, MT; Article preparation: FRS; Analysis of service impact: FRS, MIF; Presentation of service results: FRS; Article revision: FRS, MT

Conflict of Interest

The authors declare no competing financial or non-financial interests in relation to this manuscript.

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Reference

Abrahams, I., & Millar, R. (2008). Does Practical Work Really Work? A study of the effectiveness of practical work as a teaching and learning method in school science. *International Journal of Science Education*, *30*(14), 1945–1969. https://doi.org/10.1080/09500690701749305

Adebisi, J. A., & Ndjuluwa, L. N. P. (2024). A Survey of Power-Consumption Monitoring Systems. *E-Prime - Advances in Electrical Engineering, Electronics and Energy*, *7*, 100386. https://doi.org/10.1016/j.prime.2023.100386

Al-khresheh, M. H. (2024). The role of presentation-based activities in enhancing speaking proficiency among Saudi EFL students: A quasi-experimental study. *Acta Psychologica*, *243*(February), 104159. https://doi.org/10.1016/j.actpsy.2024.104159

Andarini, R., & Saputri, F. R. (2024). Training for Improving Energy Efficiency Awareness in The Home Industry Sector Rahmi. *Jurnal Pengabdian UNDIKMA: Jurnal Hasil Pengabdian & Pemberdayaan Kepada Masyarakat*, *5*(4), 580–587. https://doi.org/10.33394/jpu.v5i4.11630

Basheer, A., Hugerat, M., Kortam, N., & Hofstein, A. (2017). The effectiveness of teachers' use of demonstrations for enhancing students' understanding of and attitudes to learning the oxidation-reduction concept. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(3), 555–570. https://doi.org/10.12973/eurasia.2017.00632a

Darojat, O. (2022). Pedoman Evaluasi Pelatihan. In *Universitas Terbuka*.

Farida, F., Samiaji, A. B. M., Ramadhanti, N., Pebrianto, D., Sari, D. A., & Susanti, A. A. (2024). Optimization of the business management in the MSMEs of pothil in

Mertoyudan, Regency Magelang. *Community Empowerment*, *9*(7), 1017–1021. https://doi.org/10.31603/ce.9931

Fianty, M., Saputri, F. R., & Dewi, C. S. (2023). PKM UMKM Culinary Based on Information Technology: E-Commerce Website Design in Legok Village, Tangerang, Banten. *I-Com: Indonesian Community Journal*, *3*(4), 1508–1516. https://doi.org/10.33379/icom.v3i4.3208

Gusetyoningsih, R., & Astutiningsih, S. E. (2014). Evaluasi Pelatihan. In *Pelatihan*.

Herce, C., Martini, C., Toro, C., Biele, E., & Salvio, M. (2024). Energy Efficiency Policies for Small and Medium-Sized Enterprises: A Review. *Sustainability*, *16*(3). https://doi.org/10.3390/su16031023

Himer, S. El, Ouaissa, M., Ouaissa, M., Krichen, M., Alswailim, M., & Almutiq, M. (2023). Energy Consumption Monitoring System Based on IoT for Residential Rooftops. *Computation*, *11*(4). https://doi.org/10.3390/computation11040078

Jyrhämä, R. (2006). The function of practical studies in teacher education. *Research-Based Teacher Education in Finland-Reflection by Finnish Teacher Educators*, 51–69.

Loiser, P. T., & Endne, W. (2022). Effect of demonstration method on learning success. *International Journal of Curriculum Development, Teaching and Learning Innovation*, *1*(1), 1–6. https://doi.org/10.35335/curriculum.v1i1.51

Luechaphonthara, K., & Vijayalakshmi, A. (2019). IOT based application for monitoring electricity power consumption in home appliances. *International Journal of Electrical and Computer Engineering*, *9*(6), 4988–4992. https://doi.org/10.11591/ijece.v9i6.pp4988-4992

Mashaan, N. (2020). The Role of Feedback in Teaching and Learning: an overview. *International Multidisiplinary Conference on Education, Management and Technology*.

Millar, R. (2004). *The role of practical work in the teaching and learning of science* (Issue October).

Muniz, R. N., Júnior, C. T. D. C., Buratto, W. G., Nied, A., & González, G. V. (2023). The Sustainability Concept: A Review Focusing on Energy. *Sustainability*, *15*(19). https://doi.org/10.3390/su151914049

ProProfs Editorial. (2025). *Explained: The Difference Between User Guide & User Manual*.

Purwania, I. B. G., Kumara, I. N. S., & Sudarma, M. (2020). Application of IoT Based system for Monitoring Energy Consumption. *International Journal of Engineering and Emerging Technology*, *5*(2), 81–93.

Saputri, F. R., Fianty, M. I., & Dewi, C. S. (2023). Visual Branding Strategies For Culinary Msmes In Legok Village: A Community-Centered Approach Through Design Training. *International Journal Of Community Service*, *3*(4), 269–274. https://doi.org/10.51601/ijcs.v3i4.224

Saputri, F. R., Tampubolon, M., Fianty, M. I., & Andarini, R. (2024). A Comprehensive IoT Solution for Electrical Energy Consumption Monitoring: System Development Using NodeMCU ESP32, SCT-013, ZMPT101B, and Blynk Platform. *Journal of Logistics, Informatics and Service Science*, *11*(6), 379–391. https://doi.org/10.33168/jliss.2024.0622

Selvaraj, R., Kuthadi, V. M., & Baskar, S. (2023). Smart building energy management and monitoring system based on artificial intelligence in smart city. *Sustainable Energy Technologies and Assessments*, *56*, 103090. https://doi.org/10.1016/j.seta.2023.103090

Wardoyo, C. H. (2018). Using Classroom Presentation Technique in Teaching Speaking Explanation Text in Senior High School. *Retain: Journal of Research in English Language Teaching*, *06*(1), 34–42.

Wirasasmita, R. H., Prihatmoko, D., & Supriyadi, M. (2022). Sistem Monitoring Pemakaian Daya Listik Pada KWH Meter Menggunakan SMS gateway. *Disprotek: Jurnal Teknik Elektro, Teknik Sipil, Teknik Industri, Teknik Informatika, Sistem Informasi Dan Akuakultur*, *13*(1), 65–73. https://doi.org/10.34001/jdpt.v13i1.3111

Wrenn, J., & Wrenn, B. (2009). Enhancing Learning by Integrating Theory and Practice. *International Journal of Teaching and Learning in Higher Education*, *21*(2), 258–265.