Jurnal Pengabdian Masyarakat
I-Com: Indonesian Community Journal
Vol. 6 No. 2, Juni 2026, hlmn. 396-405
E-ISSN : 2809-2031 (*online*) | P-ISSN : 2809-2651 (*print*)

Education on Hybrid Multi-Criteria Decision Making and Machine Learning through the Morning Class Program: Integration of Engineering and Technology

Nasir Usman[1], Muhammad Faisal[2*], Sri Wahyuni[3], Saharuddin[4], Lisa Fitriani Ishak[5], Darniati[6], Musdalifa Thamrin[7], Emil Agusalim Habi Talib[8], Alvina Felicia Watratan[9]

[1, 4, 7, 9] STMIK Profesional Makassar, Makassar, Indonesia
[2, 5, 6, 8] Universitas Muhammadiyah Makassar, Makassar, Indonesia
[3] Universitas Islam Negeri Alauddin Makassar, Makassar, Indonesia
*Corresponding author: muhfaisal@unismuh.ac.id

Received 24-03-2026	*Revised* 01-04-2026	*Published* 02-06-2026

ABSTRAK

Era Society 5.0 menuntut penguasaan sistem keputusan cerdas yang transparan, namun pemahaman praktis mengenai integrasi *Machine Learning* (ML) dan *Multi-Criteria Decision Making* (MCDM) melalui kerangka kerja *Hybrid Intelligence* masih terbatas di lingkungan akademik. Pengabdian masyarakat ini bertujuan meningkatkan kapasitas keilmuan akademisi melalui program internasional "Morning Class". Metode pelaksanaan menggunakan pendekatan *online joint lecture* yang melibatkan kolaborasi antara Universitas Muhammadiyah Makassar dan Multimedia University Malaysia. Kegiatan ini diikuti oleh 48 partisipan dan terbagi menjadi tiga fase: evaluasi awal, pemaparan modul integrasi teoretis-praktis, serta evaluasi akhir. Hasil evaluasi menunjukkan peningkatan pemahaman yang signifikan, dengan kenaikan skor rata-rata dari 65,8 pada *pre-test* menjadi 87,5 pada *post-test*. Peningkatan tertinggi (36%) tercatat pada indikator implementasi kerangka kerja hibrida. Temuan ini menegaskan bahwa sinergi antara nilai etika kepakaran manusia dan kecepatan pemrosesan data mesin merupakan solusi krusial bagi pengambilan keputusan modern. Program ini merekomendasikan lokakarya teknis lanjutan untuk mendukung implementasi riset yang lebih mendalam bagi institusi mitra.

Kata kunci: Edukasi; *Hybrid Intelligence*; *Machine Learning*; MCDM; Sistem Pendukung Keputusan.

ABSTRACT

The Society 5.0 era requires mastery of transparent and intelligent decision systems, yet practical understanding of integrating Machine Learning (ML) and Multi-Criteria Decision Making (MCDM) through Hybrid Intelligence frameworks remains limited in academic environments. This community service aims to enhance the scientific capacity of academics through the "Morning Class" international program. The methodology employed an online joint lecture approach involving collaboration between Universitas Muhammadiyah Makassar and Multimedia University Malaysia. The activity involved 48 participants and was divided into three phases: initial evaluation, delivery of theoretical-practical integration modules, and final evaluation. Results indicate a significant increase in understanding, with the average score rising from 65.8 in the pre-test to 87.5 in the post-test. The highest improvement (36%) was recorded in the hybrid framework implementation indicator. These findings confirm that the synergy between human expert ethical values and machine data processing speed is a crucial solution for modern decision-making. The program recommends further technical workshops to support deeper research implementation for partner institutions.

Keywords: *Education; Hybrid Intelligence; Machine Learning; MCDM; Decision Support Systems.*

INTRODUCTION

The transition to the Society 5.0 era currently demands decision-making systems that are not only intelligent and data-driven but also adaptive to changing dynamics. In practice, Machine Learning (ML) algorithms have proven their effectiveness in handling large-scale data complexity for classification and pattern prediction purposes, as described by Usman et al. (2023) regarding the advantages of algorithms such as Isolation Forest and One-Class SVM in detecting anomalies in seismic data. However, the implementation of ML is often hindered by interpretability challenges, where models tend to be considered "black boxes" whose decision processes are difficult to explain transparently to stakeholders. To mitigate these constraints, Hassija et al. (2024) emphasize the urgency of the Explainable AI (XAI) approach to restore user trust in critical sectors. This statement is reinforced by Romero-Obon et al. (2025), who propose the Human-in-the-Loop (HITL) paradigm to ensure that human expertise remains an integral part of the decision-making loop, thereby guaranteeing model accountability.

As a foundation for building public trust in the Society 5.0 era, Fonseca i Casas and Pi i Palomes (2026) suggest the use of Open Models and Digital Twins to open algorithmic visibility and openly validate every decision assumption. However, selecting the most appropriate XAI method is a significant challenge. Matejová dan Paralič (2025) provide a solution through a systematic Multi-Criteria Decision-Making (MCDM) approach to evaluate the most robust and transparent explanation techniques. Although conventional MCDM methods such as AHP, TOPSIS, or PROMETHEE are recognized as highly superior in accommodating rational human expert assessments, these techniques still have weaknesses in terms of adaptability to new data in real-time. Therefore, the technical challenge of synergizing traditional engineering principles with today's artificial intelligence technology becomes a crucial issue underlying the need for a more integrative framework.

Despite the potential integration between ML and MCDM offering a solution to algorithmic transparency problems, there is a significant gap between academic theory and practical implementation in university environments. At Universitas Muhammadiyah Makassar and other partner institutions, the curriculum tends to be dominated by teaching methods that are too theoretical, so that students and academics often experience constraints in formulating integrative frameworks that connect expert reliability with continuous data processing machines (continuous learning).

The urgency of this service is driven by the lack of access to practical tools capable of bridging data abstraction with field reality. Without appropriate intervention, there is a risk of creating technically efficient AI systems that ignore ethical values and human preferences. This is further emphasized by the findings of Islamia & Rahman Arif (2024) regarding the digital literacy level of Indonesian

students, which is still in the moderate category (73%), indicating the need for more concrete and applicable analytical capacity building.

Therefore, practical and collaborative educational interventions across institutions are needed, such as the "Morning Class" guest lecture program. This initiative is designed as a bridge that presents real case studies, ranging from smart diagnostics in the healthcare sector to price transparency in the plantation sector, to provide practical insights that are rarely found in conventional textbooks. Through the synergy of AI with experiential learning, this approach is validated by Murniarti & Siahaan (2025) as being capable of increasing student learning motivation and creativity, especially in virtual knowledge-sharing ecosystems that optimize team performance.

As a solution to various modern decision-making challenges, recent literature introduces the Hybrid Intelligence approach, namely the integration of Hybrid MCDM and Machine Learning to build Intelligent Decision Support Systems. Kocaman & Asan (2025) reinforce this concept by proposing a structured framework that categorizes such integration into five main modes to ensure decision effectiveness based on problem characteristics. The implementation of this system is expected to increase digital literacy and analytical capabilities of researchers in academic environments.

The need for this integrative framework is becoming increasingly urgent as the complexity of decision problems involving multiple criteria and alternatives increases. Bajwa et al. (2025) explain that this integration successfully balances objective criteria from data algorithms with subjective criteria from human expertise. In practice, this hybrid approach has been widely implemented, ranging from global supply chain automation at Amazon to Smart City service evaluation. In the context of smart city development in ASEAN, Hati and Kartikasari (2025) emphasize the importance of change management strategies to align technology with bureaucratic readiness and data privacy. Furthermore, Faisal et al. (2018) explain that information technology has reached the plantation sector to provide economic protection for farmers through price transparency.

In addition to urban governance and industry, the flexibility of this integration also shows transformative potential in the education and health sectors through service personalization. In the education sector, Mehta et al. (2024) highlight the role of AI in personalizing learning experiences and optimizing Outcome-Based Education (OBE) curriculum design. This synergy is also crucial in aligning higher education curricula to be adaptive to industry needs through multi-criteria assessments. Meanwhile, in the domain of biomedical informatics, Johara Chowdhury et al. (2025) prove that combining AHP-TOPSIS with machine learning algorithms can achieve thalassemia diagnostic accuracy of up to 99.28% while simultaneously increasing clinical transparency through XAI. This is reinforced by the view of Mian et al. (2020), which shows that modernizing university digital infrastructure is crucial to closing the gap in workforce skills in the Society 5.0 era.

Responding to these needs, Universitas Muhammadiyah Makassar (Indonesia), in collaboration with Multimedia University (Malaysia), organized an interactive guest lecture program entitled Morning Class: Integration of Engineering and Technology as a concrete form of knowledge transfer. This international collaboration allows for the exchange of perspectives on how subjective criteria (MCDM) are influenced by different cultural and policy contexts in each country. This virtual collaboration initiative is in line with the Collaborative Online International Learning (COIL) paradigm described by Hackett et al. (2024) as an inclusive and environmentally friendly learning method that connects educators across countries to internationalize the curriculum through integrated online assignments. Through this community service activity, the service team seeks to educate and increase the scientific capacity of participants regarding the implementation of Hybrid MCDM and Machine Learning. This is expected to provide comprehensive insights into how the integration of engineering and technology disciplines can produce accurate, transparent, and adaptive decision-making solutions in the Society 5.0 era.

IMPLEMENTATION METHOD

This community service activity was carried out on August 18, 2025, through the Zoom Meeting virtual platform. The implementation location is online to facilitate international collaboration between Universitas Muhammadiyah Makassar (Indonesia) and Multimedia University (Malaysia). The target audience in this activity is the academic community, which includes lecturers, researchers, and students from various universities. A total of 48 participants were involved, across a wide range of regions including Makassar, Malaysia, to Eastern Indonesia regions such as Kolaka Utara and Manokwari. The implementation method for this activity uses an online joint lecture approach, which is packaged in the program "Morning Class: Collaboration & Sharing Session". The workflow of this one-day event is mapped in Figure 1. The implementation is systematically divided into three main phases designed to ensure effective and structured knowledge transfer:

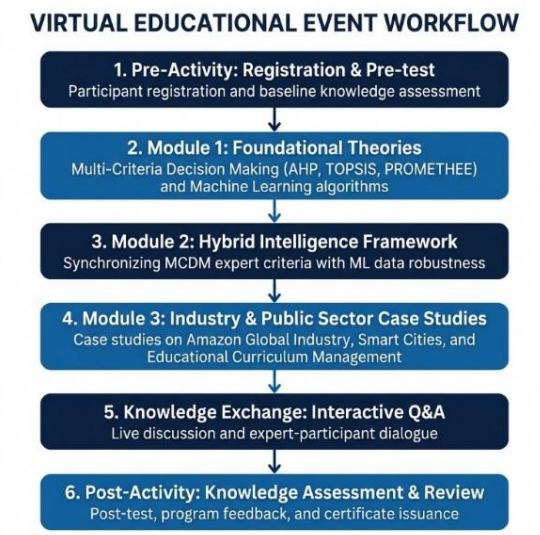

Figure 1 Operational Workflow of the One-Day Collaboration & Sharing Session

1. Pre-activity Assessment and Preparation Phase

The session begins with Participant Registration via online forms to collect institutional profiles and expertise backgrounds. Prior to the delivery of the core material, participants are required to complete a Pre-test consisting of 10 multiple-choice questions regarding basic MCDM concepts and Machine Learning applications. This aims to establish a baseline for participants' initial understanding and identify knowledge areas that most require emphasis during the session.

2. Implementation and Knowledge Transfer Phase

This stage is the core of the program, divided into three progressive educational modules:

Module 1: Theoretical Foundation. Injection of basic theories regarding Hybrid MCDM methods (such as AHP for criteria weighting, and TOPSIS and PROMETHEE for alternative ranking) and an introduction to the spectrum of Machine Learning algorithms (Supervised vs. Unsupervised Learning).

Module 2: Hybrid Intelligence Synergy. Presentation of the framework explaining the technical integration between human expertise inputs (MCDM) and machine data prediction capacity (ML) to produce more accountable decisions.

Module 3: Industry Contextualization. Exploration of real-world case studies, including logistics optimization at Amazon and XAI applications in health diagnostics, to provide a practical overview of how the theory is professionally applied.

3. Evaluation and Closing Phase

The activity concludes with a Knowledge Exchange session through interactive panel discussions, where participants are encouraged to dissect technology integration challenges in their respective institutions. As the final stage, participants complete a Program Feedback questionnaire regarding the quality of the material and speakers, as well as a Post-test to quantitatively measure the effectiveness of the education. The program ends with official Certificate Issuance as a form of appreciation and recognition of the active participation of the academic community.

RESULTS AND DISCUSSION

Implementation of Educational Activities

This community service activity was carried out in the form of an interactive virtual guest lecture (*online joint lecture*) through the Zoom Meeting platform entitled "Morning Class: Collaboration & Sharing Session". The activity, with the main theme "Integration of Engineering and Technology," was the result of international collaboration between Universitas Muhammadiyah Makassar (Indonesia) and Multimedia University (Malaysia) held on August 18, 2025. Documentation of this virtual guest lecture is shown in Figure 2.

The target audience for this activity consists of the academic community, which includes lecturers, researchers, and students. Based on attendance data and virtual room monitoring, the activity was enthusiastically attended by approximately 48 participants. Interestingly, the reach of the participants was very wide, not only from the Makassar and Malaysia areas, but also from various regions in Indonesia, such as Kolaka Utara and Manokwari, West Papua. Figure 3 shows the enthusiasm and wide reach of participants from various institutions. This indicates the high interest of academics in utilizing artificial intelligence technology within the engineering discipline.

Figure 2 Documentation of the Morning Class Program Implementation via Virtual Platform

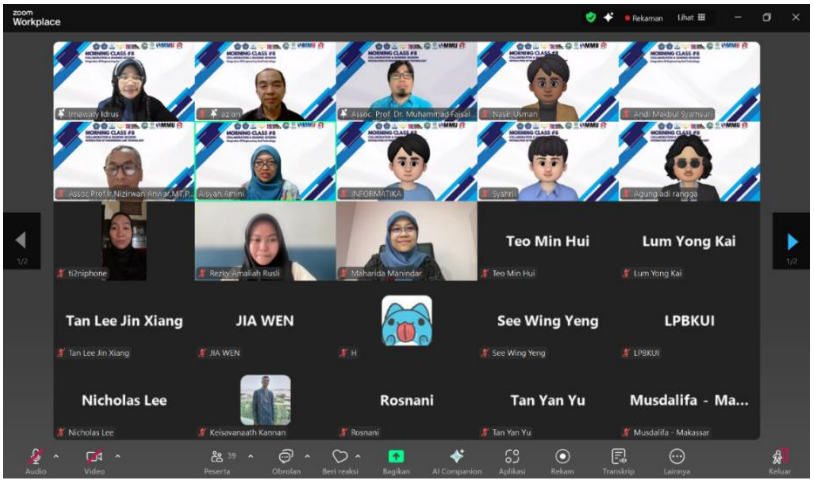

Figure 3 Enthusiasm and Broad Outreach of Participants from Various Higher Education Institutions in Indonesia and Malaysia

Presentation of Materials and Knowledge Transfer

The main focus of this activity was the scientific presentation concerning the integration of Hybrid Multi-Criteria Decision Making (MCDM) and Machine Learning (ML) to build Intelligent Decision Support Systems. The education session began with a foundational explanation regarding the basics of MCDM (such as the AHP, TOPSIS, and PROMETHEE methods), which are superior in rational transparency, and basic ML

techniques (Classification, Clustering, Regression, and Feature Selection), which are robust in handling large-scale data patterns.

Next, participants were given comprehensive insights regarding the Hybrid Intelligence framework. This module highlights how the weakness of ML, which is often considered a "black box," can be overcome by incorporating human expert criteria and considerations through MCDM. To facilitate understanding among participants from various engineering backgrounds, this session also presented real case studies from the industrial and public sectors, including:

1. Global supply chain automation at Amazon driven by AI.
2. Smart City service evaluation and personalization using sentiment analysis and MCDM to measure accessibility, affordability, and public privacy.
3. Higher education curriculum alignment systems to be adaptive to industrial needs through multi-criteria assessment.

EVALUATION AND IMPACT OF ACTIVITIES

The achievements of this activity were evaluated through two main approaches: quantitative and qualitative.

Quantitative Evaluation

The quantitative evaluation was conducted to measure the improvement in participants' understanding of the integration of Hybrid MCDM and Machine Learning. The instruments used were *pre-test* and *post-test* which each consisted of indicators for mastery of basic concepts and implementation of the framework. The comparison of the average scores of participants is presented in Table 1 and visualized in Figure 4.

Tabel 1. Comparison of Participants' Understanding Scores Before and After Education

Evaluation Indicator	Average *Pre-test* Score	Average *Post-test* Score	Improvement (%)
Basic Concepts of MCDM & ML	68.5	89.2	30.2%
Implementation of *Hybrid Intelligence*	63.1	85.8	36.0%
Total Accumulation	65.8	87.5	33.0%

Based on the data in Table 1, there is a significant increase in all indicators. The highest increase was recorded in the implementation of the *Hybrid Intelligence* indicator, which shows that participants began to understand how to technically integrate human expertise into machine models. The jump in the average score from 65.8 to 87.5 (Figure 4) validates the effectiveness of the *Morning Class* program in transferring complex knowledge within a limited duration of time.

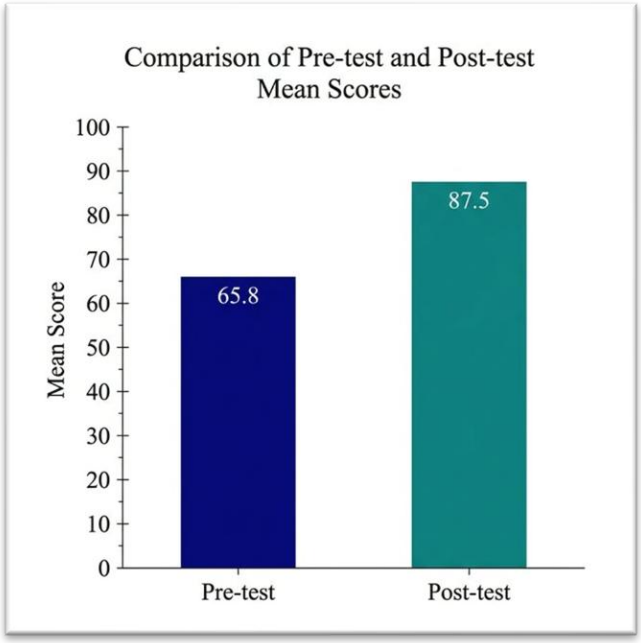

Figure 4 Comparison of Pre-test and Post-test Mean Scores

Qualitative Evaluation

Qualitative evaluation was measured through the level of engagement and enthusiasm of participants during the discussion and Q&A sessions. Knowledge transfer was assessed as successful in sparking critical thinking among participants regarding three essential points: the practical meaning of engineering and technology integration in industry, technical challenges in combining engineering principles with new technologies, and future technological trends. This discussion enriched participants' insights into how crucial it is to build systems that do not only rely on historical data (ML) but also consider values of practical expertise and ethics (MCDM).

Constraints and Future Community Service Plans

The main constraint faced was time limitation. The topic of *Hybrid Intelligence* has high technical complexity, so the short duration of the sharing session meant that the presentation focused more on the high-level conceptual framework. Participants did not yet have the opportunity for hands-on practice (*hands-on coding*).

As a sustainable solution, the service team has designed a **Future Community Service** agenda which includes:

1. **Technical Workshop Series:** Mentoring direct *Hybrid MCDM-ML* calculation simulations using software (such as Python or Expert Choice) with public datasets.

2. **Collaborative Research Mentorship:** Facilitating research collaboration between Universitas Muhammadiyah Makassar and Multimedia University for participants who want to implement this framework into their final projects or scientific publications.

3. **Development of Practical Modules:** The development of pocketbooks or technical guide modules in Indonesian that can be openly accessed by the academic community of partner institutions.

CONCLUSION

The community service activity through the Morning Class: Integration of Engineering and Technology education program has successfully achieved its targets with the active participation of the academic community from various regions in Indonesia and Malaysia. Based on qualitative and quantitative evaluation results, there has been a significant increase in understanding regarding the urgency of the Hybrid Intelligence framework. This is evidenced by an increase in the average score from 65.8 in the pre-test to 87.5 in the post-test. The integration of conventional engineering principles with artificial intelligence technology has proven to be a crucial solution for generating decisions that are not only intelligent but also transparent and accountable in the Society 5.0 era.

REFERENCES

Bajwa, A. U. R., Siriwardana, C., Shahzad, W., & Naeem, M. A. (2025). Material selection in the construction industry: a systematic literature review on multi-criteria decision making. *Environment Systems and Decisions*, *45*(1), 8. https://doi.org/10.1007/s10669-025-10001-w

Faisal, M., Rahman, Shabir, F., & Ida. (2018). Design and Implementation of Plantation Commodities Price Information Broadcaster via Autoreply Short Message Service on Smartphone. *2018 2nd East Indonesia Conference on Computer and Information Technology (EIConCIT)*, 212–217. https://doi.org/10.1109/EIConCIT.2018.8878575

Fonseca i Casas, P., & Pi i Palomes, X. (2026). Building Society 5.0: a foundation for decision-making based on open models and digital twins. *Advanced Engineering Informatics*, *69*. https://doi.org/10.1016/j.aei.2025.103970

Hackett, S., Dawson, M., Janssen, J., & van Tartwijk, J. (2024). Defining Collaborative Online International Learning (COIL) and Distinguishing it from Virtual Exchange. *TechTrends*, *68*(6), 1078–1094. https://doi.org/10.1007/s11528-024-01000-w

Hassija, V., Chamola, V., Mahapatra, A., Singal, A., Goel, D., Huang, K., Scardapane, S., Spinelli, I., Mahmud, M., & Hussain, A. (2024). Interpreting Black-Box Models: A Review on Explainable Artificial Intelligence. *Cognitive Computation*, *16*(1), 45–74. https://doi.org/10.1007/s12559-023-10179-8

Hati, S. W., & Kartikasari, D. (2025). SMART CITY IN ASEAN: A SYSTEMATIC REVIEW TOWARD THEORY, TRENDS, AND CHALLENGES. *Revista de Gestão Social e Ambiental*, *19*(2), e011190. https://doi.org/10.24857/rgsa.v19n2-028

Islamia, I., & Rahman Arif, A. (2024). Assessing Digital Literacy Skills among Indonesian University Students in the Age of Society 5.0. *Jurnal Educative: Journal of Educational Studies*, *9*(2), 182–194. https://doi.org/10.30983/educative.v9i2.8678

Johara Chowdhury, S., Mahmud, T., Tasnim, F., Sharmin, S., Nawal, S., Papri, U. H., Dolon, S. A., Alam, Md. E., Hossain, M. S., & Andersson, K. (2025). A Hybrid MCDM and Machine Learning Framework for Thalassemia Risk Assessment in Pregnant Women. *Diagnostics*, *15*(22), 2833. https://doi.org/10.3390/diagnostics15222833

Kocaman, H., & Asan, U. (2025). Integration Modes Between MCDM Methods and Machine Learning Algorithms: A Structured Approach for Framework Development. *Mathematics*, *14*(1), 33. https://doi.org/10.3390/math14010033

Matejová, M., & Paralič, J. (2025). A Multi-Criteria Decision-Making Approach for the Selection of Explainable AI Methods. *Machine Learning and Knowledge Extraction*, *7*(4), 158. https://doi.org/10.3390/make7040158

Mehta, M., Mehta, R., Mehta, A., & Mehta, P. (2024). Impact of Artificial Intelligence on Outcome-Based Education. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, 85–108. https://doi.org/10.32628/CSEIT228619

Mian, S. H., Salah, B., Ameen, W., Moiduddin, K., & Alkhalefah, H. (2020). Adapting Universities for Sustainability Education in Industry 4.0: Channel of Challenges and Opportunities. *Sustainability*, *12*(15), 6100. https://doi.org/10.3390/su12156100

Murniarti, E., & Siahaan, G. (2025). The synergy between artificial intelligence and experiential learning in enhancing students' creativity through motivation. *Frontiers in Education*, *10*. https://doi.org/10.3389/feduc.2025.1606044

Romero-Obon, M., Rouaz-El-Hajoui, K., Sancho-Ochoa, V., Vargas, R., Pérez-Lozano, P., Suñé-Pou, M., & García-Montoya, E. (2025). Human-in-the-Loop AI Use in Ongoing Process Verification in the Pharmaceutical Industry. *Information*, *16*(12), 1082. https://doi.org/10.3390/info16121082

Usman, N., Utami, E., & Hartanto, A. D. (2023). Comparative Analysis of Elliptic Envelope, Isolation Forest, One-Class SVM, and Local Outlier Factor in Detecting Earthquakes with Status Anomaly using Outlier. *2023 International Conference on Computer Science, Information Technology and Engineering (ICCoSITE)*, 673–678. https://doi.org/10.1109/ICCoSITE57641.2023.10127748