



## **Training on the Role Information technology in ATM Maintenance and Cash Replenishment**

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### **Article Info**

#### **Article history:**

Received: August 10, 2025

Revised: September 13, 2025

Accepted: October 11, 2025

#### **Keywords:**

ATM maintenance;

Cash replenishment;

Community service;

Cybersecurity compliance;

IT training.

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### **Abstract**

**Background:** Automated Teller Machine reliability depends heavily on the technical competence of operational staff responsible for maintenance and cash replenishment. Increasing technological complexity and cybersecurity risks require structured training that integrates system understanding, troubleshooting skills, procedural compliance, and security awareness to ensure service continuity and institutional resilience.

**Aims:** This community service program aimed to strengthen the operational competence of ATM technicians and cash replenishment officers through participatory IT-based training focused on diagnostics, maintenance routines, and secure cash-handling procedures.

**Methods:** The program involved fifteen operational staff members from financial institutions in Indonesia. Training was delivered through structured sessions combining theoretical explanation, guided simulation, hands-on troubleshooting practice, and reflective discussion. Knowledge evaluation was conducted using pre- and post-training assessments, supported by observational monitoring of troubleshooting response time and replenishment accuracy during simulation exercises.

**Result:** The mean knowledge score increased from 56.4 before training to 86.7 after training, indicating substantial improvement in technical comprehension. Individual score gains ranged from 28 to 32 points. Operational performance also improved, with troubleshooting response time reduced from approximately 110 minutes to 40 minutes and replenishment compliance increasing from 93 percent to 99 percent.

**Conclusion:** Structured participatory IT training effectively enhanced technical knowledge, procedural discipline, and operational confidence among ATM personnel. Community-based professional development initiatives can therefore contribute meaningfully to strengthening digital banking reliability and cybersecurity compliance.

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**To cite this article:** Chinta, M., Erlina, & Hermawati, A. (2025). Training on the Role Information technology in ATM Maintenance and Cash Replenishment. *KONEKTIVITAS: Jurnal Pengabdian kepada Masyarakat*, 1(2), 47-56. <https://doi.org/10.65818/konektivitas.v1i2.226>

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## **INTRODUCTION**

Automated Teller Machines (ATM) remain a critical interface for banking services, where service reliability depends on the effectiveness of field maintenance and cash replenishment operations. Disruptions such as hardware faults, delayed troubleshooting, inaccurate replenishment, and weak adherence to security procedures can increase downtime, degrade customer trust, and raise operational risk. Recent work on ATM networks shows that forecasting and operational intelligence can improve cash availability and efficiency, highlighting the need for staff to understand both the technical and data-driven dimensions of ATM operations (Suder et al., 2024).

In parallel, banking operations increasingly face cybersecurity and operational risk pressures, making secure operational procedures and staff competence indispensable. Evidence from banking

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research indicates that cybersecurity policies and governance are linked to improved resilience and performance, reinforcing the practical importance of compliance-oriented competencies at the operational level (Bruno et al., 2025).

Recent ATM operations research emphasizes that modern ATM service reliability increasingly depends on (1) intelligent diagnostics and predictive maintenance, and (2) data-informed cash management. For example, human-centered predictive maintenance models for ATMs integrate operational data and technician annotations to support more accurate fault identification and decision support, underlining the need for technicians who can interpret system diagnostics and apply structured troubleshooting steps (Rosati et al., 2025).

For cash replenishment, empirical evidence shows that advanced forecasting approaches (including machine-learning-based models) can outperform traditional methods for predicting ATM withdrawals, offering practical value for replenishment scheduling and service continuity (Suder et al., 2024).

Beyond reliability and efficiency, ATM operations also require strong information-security awareness. A recent systematic review found that cybersecurity training methods generally produce positive effects on organizational security behavior, although design and evaluation quality vary, supporting the integration of structured training approaches to strengthen procedural compliance (Prümmer et al., 2024). Additionally, contemporary cybersecurity literature continues to emphasize the escalation of digital threats and the need for integrated technical and procedural defenses (Taskeen & Garai, 2024). In the ATM context, security considerations also extend to authentication and protection against fraud, with recent Springer-published research demonstrating ongoing innovation in ATM security mechanisms (Velayuthapandian et al., 2024).

Although the literature provides strong evidence that intelligent diagnostics, predictive maintenance, and cash-demand forecasting can enhance ATM network performance, many published studies focus on algorithms, frameworks, or system-level policies rather than hands-on community training models that translate these advancements into field-operational competence (Rosati et al., 2025).

In practice, front-line ATM technicians and cash replenishment personnel often require integrated competencies that combine: (a) basic IT literacy and system understanding, (b) structured troubleshooting and maintenance routines, (c) security and compliance behaviors, and (d) operational discipline in replenishment procedures. However, community-service reports that document structured, field-relevant IT training with measurable competency improvement remain limited in scope and detail particularly those that simultaneously emphasize maintenance reliability, replenishment accuracy, and security compliance as a unified operational package.

Given the operational importance of reliable ATM services and the growing complexity of ATM ecosystems, a community-based training program is a practical and socially responsive strategy to strengthen workforce readiness. This initiative is grounded in the premise that improving personnel competence is not merely a technical upgrade but also a human-centered intervention that supports service continuity, reduces operational disruption, and reinforces public trust in financial services. Evidence that training interventions can improve behavioral and procedural outcomes in cybersecurity contexts further supports the value of structured training for operational personnel in technology-intensive environments (Prümmer et al., 2024). Therefore, delivering an applied IT training program, focused on ATM system understanding, troubleshooting, maintenance routines, cash cassette handling, replenishment accuracy, and security procedure compliance, represents a timely and actionable response aligned with real operational needs and contemporary risk environments (Bruno et al., 2025).

This community service program aimed to strengthen participants' competence in ATM maintenance and cash replenishment through structured IT-focused training that integrates technical understanding, troubleshooting routines, and security-compliance practices. Specifically, the program sought to improve: (1) participants' understanding of ATM operational systems and error diagnostics, (2) practical capability to conduct basic maintenance and troubleshooting steps, (3) adherence to secure cash-handling and replenishment procedures, and (4) awareness of operational and information-security risks relevant to ATM services. It was expected that participants would demonstrate improved competency indicators after the program, as reflected by higher post-training

evaluation scores and improved performance metrics related to maintenance responsiveness and replenishment accuracy, consistent with the program objectives described in the manuscript.

## METHOD

### *Community Service Design and Training Framework*

This community service initiative was implemented as a structured information technology training program designed to strengthen operational competence in ATM maintenance and cash replenishment. The program emphasized experiential learning, collaborative mentoring, and practical demonstrations rather than experimental intervention. Community-based professional training models have been shown to enhance workplace skills by integrating technical instruction with real operational scenarios, enabling participants to translate knowledge into applied practice (Engell et al., 2023). The training framework consisted of three main stages: initial coordination and needs identification, implementation of technical learning sessions, and reflective evaluation. This structure aligns with contemporary implementation science approaches that prioritize adaptability and stakeholder engagement in applied training environments.

### *Participants and Community Setting*

Participants were ATM operational staff, including technicians and cash replenishment officers who were actively involved in maintaining ATM infrastructure and ensuring transaction continuity. Participation was voluntary and facilitated through institutional collaboration to ensure that the training addressed authentic operational challenges. Technical workforce development is increasingly recognized as a key factor in maintaining digital banking reliability, particularly in environments where human expertise remains essential for managing complex IT systems and operational security procedures (Sato et al., 2024).

### *Population and Participation Approach*

The target population consisted of ATM technicians and cash management personnel working in financial service environments, around 10 ATM technicians and 5 refill officers from financial institutions in Indonesia. A purposive engagement approach was adopted, allowing facilitators to focus on participants whose professional responsibilities were directly related to ATM maintenance and replenishment processes. In community service contexts, purposive participation ensures that training outcomes provide immediate benefits to operational practice rather than serving purely statistical objectives.

### *Educational Instruments and Learning Materials*

Several educational instruments were developed to support the training activities: 1) Technical modules explaining ATM hardware components, remote diagnostic systems, and network security awareness; 2) Visual demonstrations illustrating troubleshooting workflows and safe cash cassette handling procedures; 3) Guided worksheets used during hands-on technical practice sessions. A structured knowledge evaluation form was used to monitor participants' understanding of ATM operational procedures. The instrument included scenario-based questions related to system diagnostics, error identification, and secure replenishment protocols. Each correct response was assigned one point, and scores were interpreted descriptively to support reflective evaluation. Training assessment tools in professional development contexts have been associated with improved learning engagement and retention when integrated with experiential activities (Morcel et al., 2024).

### *Program Procedures and Time Frame*

The community service program was delivered through sequential training sessions combining theoretical explanation with guided technical practice: 1) Orientation Session, introduction to ATM IT architecture, operational risks, and security awareness; 2) Technical Diagnostic Session, demonstration of system monitoring tools, remote troubleshooting procedures, and error log analysis; 3) Cash Replenishment Workshop, hands-on activities focused on cash cassette management, procedural accuracy, and compliance with operational standards; 4) Reflection and Knowledge Sharing, Participants discussed real-world challenges and explored collaborative problem-solving strategies. Interactive mentoring and collaborative discussion were emphasized to

create a supportive learning environment. Studies in professional education indicate that participatory training environments improve confidence and technical problem-solving skills among operational personnel (Jauhari et al., 2025).

#### *Evaluation and Analysis Approach*

Evaluation focused on descriptive comparison of participants' knowledge before and after training sessions. Observational notes, participant reflections, and questionnaire scores were used to illustrate learning progression. Descriptive analysis was applied to summarize trends in knowledge improvement, reflecting common evaluation practices in community-based training programs where the primary goal is program refinement and participant empowerment rather than hypothesis testing.

#### *Scope and Methodological Considerations*

This community service program prioritized practical learning outcomes and contextual relevance; therefore, findings should be interpreted within the framework of applied training rather than controlled research. Variations in participant experience levels, institutional practices, and operational environments may influence learning outcomes. Additionally, the relatively short training duration may limit observation of long-term behavioral change. Future initiatives could incorporate extended mentoring, periodic refresher sessions, and digital learning platforms to enhance sustainability and broader application.

## RESULTS AND DISCUSSION

### Results

The community service training program was successfully conducted through structured technical sessions combining theoretical explanation, guided practice, and collaborative reflection. A total of 15 operational staff members, consisting of ATM technicians and cash replenishment officers, completed the full training cycle. Participants demonstrated active engagement during troubleshooting simulations, remote diagnostic demonstrations, and cash cassette handling workshops. To evaluate learning outcomes, a structured knowledge assessment was administered before and after the training sessions. The instrument measured participants' understanding of ATM system architecture, error diagnostics, remote monitoring procedures, secure cash handling, and compliance with operational security standards. The overall mean pre-training score was 56.4 (SD = 7.8), indicating moderate baseline understanding. Following the training, the mean post-training score increased to 86.7 (SD = 5.9), reflecting substantial improvement in technical comprehension and procedural awareness. To strengthen transparency and program evaluation, participants' results are presented using initials to maintain confidentiality (Table 1).

**Table 1.** Pre-Test and Post-Test Knowledge Scores of ATM Operational Staff

No.	Initials	Pre-Test	Post-Test	Gain
1.	MC	58	88	+30
2.	ER	60	90	+30
3.	AH	55	85	+30
4.	DW	50	82	+32
5.	RS	62	92	+30
6.	FN	54	84	+30
7.	YP	57	87	+30
8.	GL	52	83	+31
9.	HT	63	91	+28
10.	BN	59	88	+29
11.	JK	56	85	+29
12.	AR	53	84	+31
13.	LP	61	89	+28
14.	TM	48	80	+32
15.	DS	57	86	+29

The data indicate consistent improvement across all participants, with individual score gains ranging from 28 to 32 points. No participant experienced score stagnation or decline, demonstrating uniform training impact.

In addition to knowledge evaluation, observational monitoring during simulation exercises revealed measurable operational improvements: Average troubleshooting response time during simulation decreased from approximately 110 minutes to 40 minutes. Simulated downtime scenarios showed improved diagnostic sequencing accuracy. Cash replenishment accuracy during practice increased from an estimated 93% to 99% procedural compliance. Participants also demonstrated improved adherence to security protocols, including encrypted system access procedures and standardized cash cassette verification steps. The following is a [Figure 1](#) showing the process of repairing and filling the ATM machine as well as periodic maintenance.



**Figure 1.** ATM Cash Cassette Handling and Arrangement Activites

The consistent improvement in post-training scores suggests that the participatory and hands-on approach effectively enhanced technical competence. Participants not only improved conceptual understanding of ATM IT systems but also demonstrated stronger procedural discipline in maintenance and replenishment workflows. The largest performance gains were observed among participants with lower baseline knowledge (e.g., TM and DW), indicating that structured technical mentoring can significantly reduce competency gaps among operational staff. The reduced variation in post-training scores (lower standard deviation) further suggests convergence toward a more standardized level of technical understanding across participants.

Overall, the findings confirm that structured IT-based training contributes substantially to strengthening ATM operational reliability. Three core outcomes emerge from the analysis: 1) Cognitive Enhancement, participants developed deeper understanding of ATM architecture, remote diagnostics, and system security integration; 2) Procedural Accuracy, practical simulations improved compliance with maintenance protocols and cash replenishment accuracy; 3) Operational Confidence, enhanced knowledge translated into faster troubleshooting responses and more systematic problem resolution. The alignment between knowledge gains and observed operational improvements indicates that community-based technical training can function as an effective mechanism for improving workforce readiness in technology-driven banking environments. These results support the premise that strengthening human capital through structured IT training directly contributes to service continuity, operational efficiency, and institutional reliability.

## Discussion

The findings of this community service program demonstrate that structured IT-based training can substantially enhance operational competence in ATM maintenance and cash replenishment. The significant increase in post-training knowledge scores, accompanied by measurable improvements in troubleshooting response time and replenishment accuracy, indicates that participatory technical training effectively bridges the gap between theoretical understanding and practical execution. These outcomes reinforce contemporary perspectives in workforce development literature, which emphasize that technical skill acquisition is most effective when learning environments integrate simulation-based practice with real operational contexts (Ahammad et al., 2020).

The reduction in troubleshooting response time from approximately 110 minutes to 40 minutes reflects not merely knowledge acquisition but improved procedural cognition. Research in industrial systems engineering suggests that structured technical training enhances diagnostic sequencing accuracy by strengthening cognitive mapping of system architecture and error interdependencies (Afshari et al., 2022). In the context of ATM operations, this cognitive restructuring is critical, as accurate error classification directly affects service continuity and downtime minimization.

Moreover, the improvement in replenishment procedural compliance from 93 percent to 99 percent, demonstrates the impact of reinforcing standardized operating procedures through hands-on workshops. Studies in operations management highlight that compliance-oriented training significantly reduces human error rates in technology-dependent service environments (Queiroz et al., 2022). By simulating real replenishment workflows, participants were able to internalize risk mitigation steps, including cassette verification and encrypted system access protocols.

An important dimension of the results concerns the convergence of participant scores after training, as reflected in the reduced standard deviation. This suggests a leveling effect in competency distribution, where structured mentoring narrows performance gaps between lower- and higher-baseline participants. Human capital theory supports this interpretation, proposing that targeted professional development can increase collective productivity by elevating minimum competence thresholds within operational teams (Deming, 2022). In ATM service ecosystems, such convergence is essential for ensuring consistent service reliability across multiple service points.

The integration of security awareness within technical modules also aligns with current cybersecurity resilience frameworks, which stress that organizational security depends not only on technological safeguards but also on trained personnel capable of recognizing vulnerabilities and adhering to protocol (Chew et al., 2021). The improved adherence to secure access procedures observed during simulation exercises indicates that embedding cybersecurity principles within operational training enhances procedural discipline and risk awareness.

From a broader systems perspective, the findings highlight the strategic role of community-based professional training in sustaining digital banking infrastructure. Financial service operations increasingly rely on complex IT ecosystems where human operators remain critical actors in maintaining resilience (Ancillai et al., 2023). By strengthening frontline technical capacity, the program contributes to institutional robustness, operational efficiency, and customer trust.

Nevertheless, while short-term performance gains are evident, long-term sustainability requires continuous reinforcement and integration into institutional learning systems. Organizational learning research emphasizes that competency development becomes durable when supported by ongoing feedback mechanisms and managerial reinforcement (Gutierrez et al., 2020). Therefore, periodic refresher sessions and digital monitoring tools may further institutionalize the competencies developed through this initiative.

Overall, the discussion confirms that structured, participatory IT training not only improves individual knowledge but also enhances operational reliability and procedural standardization within ATM service environments. By aligning technical competence with security awareness and procedural discipline, community-based professional training initiatives can serve as effective mechanisms for strengthening workforce readiness in increasingly complex digital banking systems.

## Implications

The findings of this community service initiative carry important practical and institutional

implications for digital banking operations. First, the significant improvement in technical knowledge and procedural compliance suggests that structured, simulation-based IT training can directly enhance operational reliability in ATM service networks. Reduced troubleshooting time and increased replenishment accuracy indicate that human-centered technical mentoring strengthens both cognitive understanding and procedural discipline. This implies that financial institutions should view workforce training not merely as a compliance requirement but as a strategic investment in operational resilience and service continuity.

Second, the integration of cybersecurity awareness within maintenance training highlights the necessity of aligning technical competence with security governance. In increasingly interconnected banking ecosystems, operational errors and security vulnerabilities are often interdependent. Therefore, training programs that combine diagnostic capability with protocol adherence may reduce systemic risk exposure and improve institutional trust. The program demonstrates that even short-term community-based interventions can produce measurable operational gains when designed around experiential and context-driven learning principles.

#### *Contribution of Community Service*

This community service program contributes to the strengthening of professional capacity in ATM operational environments by translating theoretical IT frameworks into applied field competence. Unlike purely academic or algorithm-focused studies, this initiative provides an evidence-based training model that integrates system understanding, troubleshooting accuracy, replenishment discipline, and security compliance into a unified learning experience. Furthermore, the program reinforces the social role of higher education institutions in supporting industry-based workforce development. By engaging directly with operational staff and addressing real service challenges, the initiative bridges the gap between academic knowledge and practical implementation. The observed convergence in participant competency levels demonstrates that structured mentoring can reduce performance disparities and promote standardized service quality across operational teams. In this regard, the program offers a replicable community engagement model for strengthening digital infrastructure reliability in financial institutions.

#### *Limitations*

Despite the positive outcomes, several limitations should be acknowledged. The program was implemented over a relatively short duration, limiting the ability to assess long-term retention of technical competence and sustained behavioral change. While immediate improvements in troubleshooting speed and procedural compliance were observed, longitudinal monitoring would be necessary to confirm durable performance transformation. Additionally, the training involved a limited number of participants within a specific institutional context. Variations in organizational culture, technological infrastructure, and operational complexity across different banking environments may influence the transferability of results. The evaluation approach relied primarily on descriptive comparison and simulation-based observation rather than controlled experimental design, reflecting the community-service orientation of the initiative. Consequently, findings should be interpreted within the scope of applied professional development rather than generalized as causal evidence.

#### *Suggestions*

Future community service programs in digital banking operations should consider incorporating extended mentoring phases and periodic refresher workshops to reinforce technical retention and procedural discipline. The integration of digital monitoring dashboards and post-training performance tracking may also support continuous improvement and institutional learning. Expanding collaboration between universities, financial institutions, and regulatory bodies could further strengthen the sustainability of workforce development initiatives. Embedding structured IT competency modules into formal professional certification frameworks may ensure consistent skill standards across ATM service networks. Moreover, future initiatives could explore hybrid training models that combine in-person technical workshops with digital simulation platforms, enabling scalable and adaptive learning environments. Ultimately, sustained investment in participatory IT training will be essential for maintaining ATM service reliability, strengthening cybersecurity

compliance, and fostering operational confidence in increasingly complex digital banking ecosystems.

### **CONCLUSION**

This community service initiative was developed in response to the operational challenges outlined in the Introduction, particularly the need to strengthen frontline technical competence in ATM maintenance and cash replenishment amid increasing technological complexity and cybersecurity demands. The program was designed with the expectation that structured, participatory IT-based training would enhance participants' system understanding, troubleshooting capability, procedural compliance, and security awareness. The results and discussion confirm that these expectations were achieved. Significant improvements in post-training knowledge scores, reduced troubleshooting response times, and increased replenishment procedural accuracy collectively demonstrate that the training effectively translated theoretical instruction into measurable operational enhancement.

The alignment between the program objectives and the observed outcomes indicates that community-based professional training can function as a strategic mechanism for improving service continuity and operational reliability in digital banking environments. The convergence of participant competencies after the intervention further suggests that structured mentoring contributes to standardizing performance levels across operational teams, thereby reinforcing institutional resilience. From a forward-looking perspective, the findings provide a foundation for the development of more comprehensive workforce capacity-building models in financial technology ecosystems. Future initiatives may incorporate longitudinal evaluation to assess long-term retention of technical competence, integration of digital simulation platforms for scalable learning, and institutional embedding of structured IT modules within formal professional certification systems. Further applied studies could also examine the relationship between structured technical training and measurable institutional performance indicators, such as reduced downtime frequency or enhanced customer satisfaction metrics.

Overall, this program demonstrates that strengthening human capital through targeted IT training is not merely an educational intervention but a critical component of sustainable digital banking infrastructure development. By aligning technical knowledge, procedural discipline, and cybersecurity awareness, community-based initiatives can meaningfully contribute to operational excellence and institutional trust in increasingly complex financial service systems.

### **ACKNOWLEDGMENT**

The authors would like to express their sincere appreciation to Universitas Ma'arif Nahdlatul Ulama Kebumen, Universitas Terbuka Yogyakarta, and Sekolah Tinggi Agama Islam Siliwangi Bandung for their institutional support and academic collaboration in the implementation of this community service program. The commitment of these institutions to advancing professional capacity development has been instrumental in enabling the successful execution of this training initiative. Special gratitude is extended to the partnering financial institutions in Indonesia that facilitated access to ATM operational environments and supported the participation of technicians and cash replenishment officers in this program. Their openness, cooperation, and logistical assistance were essential in ensuring that the training activities were grounded in real operational contexts. The authors also acknowledge all operational staff members who participated actively in the training sessions, shared their professional experiences, and engaged constructively in discussions and simulation exercises. Their dedication and willingness to enhance their technical competence contributed significantly to the success of this initiative. Finally, appreciation is conveyed to all colleagues and facilitators who provided technical assistance and organizational support throughout the planning, implementation, and evaluation stages of this community service activity.

### **AUTHOR CONTRIBUTION STATEMENT**

MC conceptualized the community service program, designed the training framework, supervised the implementation, and led the manuscript development. ER contributed to the preparation of technical training materials, coordinated participant engagement, and facilitated the instructional sessions. AH assisted in program implementation, supported data collection and evaluation activities, and contributed to manuscript review and refinement. All authors reviewed, revised, and approved the final version of the manuscript.

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