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Basic Training on Air Conditioner (AC) Maintenance and Repair for Musala Janitors in Padang City

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ABSTRACT

The high temperature in Padang City, between 22.90 and 34.80ºC, causes air conditioner (AC) to become a necessary equipment to provide cool and comfortable air in every room. The use of AC will have an impact on the need for experts in the field of AC maintenance and repair. This training aimed to provide knowledge and skills to participants regarding AC maintenance and repair, as well as optimizing the use of energy to save operational costs. The methods used in this training were the introduction of theory, demonstration, and practice by a trainer team experienced in the field of AC technology. The training materials provided were the introduction, basic understanding of AC technology, maintenance and repair methods, and energy saving. The training began with a delivery of the practice-supporting theory, in the form of material on AC basic components and working systems. This material was delivered through lecture, discussion, and question and answer session. This was followed by a practice using the AC trainer module. Participants were given an understanding on how to clean the AC (both indoor and outdoor systems), check the working system, observe the malfunction symptoms, and the causes of AC malfunction. This training was attended by two participants, namely the janitors of Musala Arafah in Puri Filano Asri Kubu Dalam, Padang City. The success level of this training was evaluated through oral test, interview, and practice test. The results showed that this training was able to increase the participants' knowledge about observing symptoms and causes of AC malfunction and equip participants with the necessary skills to perform basic AC maintenance and repair.

1. Introduction

A mosque/musala is a building established as a place of worship to Allah SWT, especially as a place to perform the five daily prayers and other sunnah prayers in congregation manner (Amrullah & Erianjoni, 2019). These Moslem places of worship can be encountered in almost every region in Indonesia (Amalia *et al*., 2020). In particular, mosques and musala are located in almost every neighborhood in Padang City. Because the air temperature in Padang City is relatively hot, namely between 22.90 and 34.80^{o}C (Central Bureau of Statistics, 2021), almost every musala there is equipped with air conditioner (AC). The use of AC in musala aims in cooling the room and providing comfort for the congregation worship (Syamsiyah & Izzati, 2021).

Musala Arafah is one of the places of worship in the Puri Filano Asri Parak Karakah housing complex, Padang. This musala was established independently in 2008 by the residents of the complex. Currently, Musala Arafah is managed by six administrators and two janitors. Musala Arafah has six ACs in good condition (four with 2PK capacity and two with 1PK capacity), four fans, and one 700 Watt sound system. The existence of AC in Musala Arafah is presented in Figure 1

Figure 1. The existence of AC in Musala Arafah

AC's working system often undergoes unexpected problems that can negatively affect the comfort of the congregation. The problems that occur in the Musala Arafah pertaining to AC include the following: 1) lack of checking the usage rate of AC operating hours, 2) users behavior that often opens the doors or windows when the AC is on, causing AC's working quality to become less optimal, 3) AC does not function properly so that the room temperature is not cool, causing an uncomfortable state for the congregation, and 4) AC maintenance is not performed regularly, which will reduce the service life of the AC. If the service life of the AC is short, the musala must incur extra expenses periodically in order to buy a new AC.

The amount of AC usage also affects its repair and maintenance so that several experts are needed to handle the problems that may occur. Repair and maintenance are necessary to extend the life of the equipment. If one component does not function properly in the system, the equipment as a whole becomes unable to work effectively and efficiently (Rahardjo, 2016).

One of the efforts to overcome this problem is by implementing a planned and scheduled activities for AC repair and maintenance. The maintenance system used in general is preventive maintenance, namely repair, replacement, and cleaning carried out periodically. Preventive maintenance has a number of advantages: 1) it can prevent malfunction of AC components, 2) minimize repair costs, 3) ensure better work safety, 3) does not require a lot of replacement component, 4) can extend the service life of the equipment, and 5) reduce malfunction that can occur at any time. The preventive maintenance system will provide an effective solution for AC handling so that the equipment continues

to work optimally and does not undergo malfunctions that can cause disruption in the work system of the equipment (Fatma *et al*., 2022).

The method commonly used in planning an integrated machine repair and maintenance is the RCM (reliability centered maintenance) method. Maintenance is an important thing that must be performed by every user. Maintenance can minimize disruption caused by malfunction of one component or more. Maintenance also plays a role in preventing a decline in machine's effectivity due to malfunction that negatively affects its working system (Suryanto, 2020).

Based on the aforementioned background and problems, the team conducted a community service activity in the form of basic training on AC repair and maintenance. This training aimed to equip the musala with specialized technicians in performing AC repair and maintenance properly and periodically.

2. Methods

2.1 Participants and training location

This basic training on AC maintenance and repair was attended by two musala janitors with religious educational backgrounds and no previous knowledge or skills pertaining to AC. The training was held at Maintenance and Repair (MR) Laboratory at the Electrical Engineering Study Program, Padang State Polytechnic. Before training, the socialization activity was held in advance at Musala Afarah in Puri Filano Asri, RT 03, RW 04, Kubu Dalam Parak Karakah, East Padang Subdistrict, Padang City, West Sumatra. The training was implemented for four days, namely from August 29, 2023 to September 1, 2023, at 08.00–12.00 WIB.

2.2 The steps of community services activity

There were three steps in this community services activity:

2.2.1 Planning

There were three stages of planning. The first stage was the identification of training needs through interviews and observations with musala administrators, which resulted in the conclusion that a technician capable of performing AC maintenance and repair was needed. The second stage was the determination of the chosen participants, training materials, and training schedule. The participants of this training were two janitors of Musala Arafah. The subject of training materials provided was AC maintenance and repair. The training was planned to be conducted in August to September 2023. The third stage was the selection of training methods, in which the chosen methods were lectures, discussions, demonstrations, and practices on AC maintenance and repair.

2.2.2 Implementation

The first stage of implementation was an explanation of the training objectives, as well as the delivery of introductory material in the form of theoretical basics pertaining to AC, working principles, components, and common problems. The second stage was the demonstration, practice, and deepening of the material by delivering explanations about routine maintenance, preventive maintenance, and actions that need to be taken when problems occur in using AC. The participants were given the opportunity to practice using the AC module that had been prepared. At this stage, the trainer team presented examples of maintenance cases, repairs, and malfunction symptoms that occur in AC, as well as explained about work safety when working with AC, safe refrigerant handling, and other precautions. At the end of the training, a discussion and questions and answers (Q & A) session was held, in which the participants were allowed to ask questions and share their own experiences regarding this matter.

2.2.3 Evaluation

Evaluation in a training activity is a highly essential element to measure how well the training is performed (Tamsuri, 2022). The evaluation methods in this training were oral question and answer/discussion, interview, and practice using the trainer module prepared. Several common indicators measured include knowledge, skills, and work attitudes (Anissa, 2015). Knowledge tests were conducted before and after the training with aim to measure the increase in participants' knowledge. Then, observation or practice tests can help assess the extent to which participants can apply the knowledge and skills that had just been learned. Finally, interview was performed to assess changes in participants' attitudes or perceptions towards the training topics provided.

2.2.4 Monitoring

After the completion of the training, the team conducted regular monitoring activity every once in a month to evaluate the maintenance and usage of the AC in order to ascertain that the benefits of this community service activity remain sustainable and bring a long-term positive impact on the partners. This stage also provide insights for the trainer team in order to formulate more effective training programs with higher levels of knowledge and skills in the future.

3. Results and Dicussion

This training included several systematic stages as a part of community services activity. The activity on the first day was held at Musala Arafah in Puri Filano Asri Kubu Dalam, Padang, which was attended by two musala janitors, namely M. Tohir and Digo. Both of them possess a religious educational background, but have no previous knowledge and skills in the field of AC maintenance and repair. The team socialized the objectives, schedule, and planned materials to be delivered in the training. A discussion and Q & A session was then held between the team and the participants for 90 minutes. Figure 2 shows when the team gave a general explanation about the training.

Figure 2. Training socialization at the partner's location.

The activity continued on the second day. The chosen location was Maintenance and Repair (MR) Laboratory at the Electrical Engineering Study Program, Padang State Polytechnic based on a reason that this laboratory provides all the necessary equipment and AC training modules. The AC training module used has 10 types of malfunction in indoor system and 5 types of malfunction in outdoor system (Herizon, 2020). The team prepared training materials covering basic theory about AC, its components, routine maintenance, basic repairs, work safety, and work ethics. Mr. Khairul Dasman, S.T. as the laboratory technician in terms of the equipment provider ensured the availability of training facilities, namely classrooms, training tools, and AC equipment needed for simulation and demonstration practices, as shown in Figure 3.

Figure 3. Equipment preparation at MR Laboratory, Padang State Polytechnic.

The training on the third day was also attended by the two musala janitors. The trainer team used a projector to provide an introduction and remarks to the participants, also to explain the aims of the training (Figure 4). The team then explained the basic theory of AC, including its working principles, components, and common malfunction symptoms that may occur. The team then deepened the material by explaining routine maintenance, preventive maintenance, and actions that need to be taken when any problem occurs in using AC. The duration of the third day's training was 2 x 60 minutes.

Figure 4. Explanation on AC basic theory, repair, and maintenance at MR Laboratory.

The team then introduced the components of the AC system, which consists of indoor and outdoor systems, and explained how to clean them. AC components consist of condenser, compressor, evaporator, capillary pipe, accumulator, outdoor fan, and indoor blower. Meanwhile, the electrical components of AC include thermistors, capacitors, overloads, electric motors (both in indoor and outdoor system), and control PCBs (Iqbal, 2015). The AC system functions to regulate temperature, humidity, and air circulation. Figure 5 displays these components in detail.

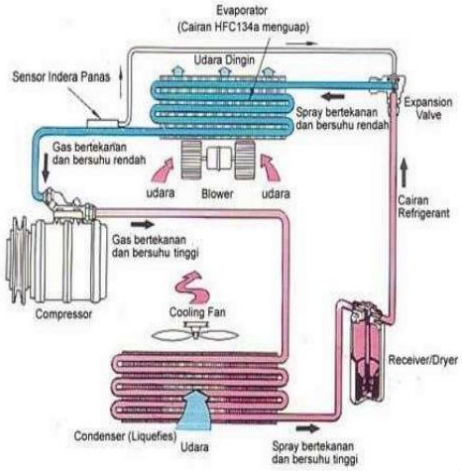

Figure 5. Components of AC system (Winarno, 2020)

On the fourth day of training, the trainer team provided guidance and explained the practice steps, while participants observed and actively participated in the material delivery. The duration of the fourth day's training was 4 x 60 minutes. Table 1 presents several cases of malfunction symptoms along with the components that were going to be analyzed as the suspected malfunction cause. The elaboration in the table was explained to the participants as manual for the next step.

Table 1. Malfunction symptoms and analysis of AC components.

Simulation switch	Malfunction symptoms that occur	Analyzed malfunction component
S1	Sleep indicator light on the display flashes, air from indoor blower is not cool, outdoor system is completely off	Coil thermistor
S2	Timer indicator light on the display flashes, air from indoor blower is not cool, outdoor system is completely off	Room thermistor
S3	Operational indicator light is off, system can be operated using remote controller, indoor and outdor systems operate normally	Display
S4	Swing does not move up and down	Stepper motor
5	Operational indicator light is off, system cannot be operated using remote controller (only manually), indoor and outdoor systems operate normally	Display
S6	AC system is completely off, manual buttons and remote controller cannot be operated.	Transformator
S7	AC system is completely off, operational indicator can be switched on using manual buttons and remote controller	Transformator
S8	There is no air gust from indoor blower, ice crystallization occurs in the evaporator, outdoor system operates normally	Motor fan capacitor
S9	There is no air gust from indoor blower, ice crystallization occurs in the evaporator, outdoor system operates normally	Motor/blower fan
S10	AC system is completely off	Voltage source entering the AC
S11	Air gust from indoor blower is not cool, outdoor system is completely off	Voltage source to the outdoor system
S12	Air gust from indoor blower is normal, condenser fan is off and condenser is hotter, compressor is on	Voltage source of motor fan/condenser fan
S13	Air gust from indoor blower is normal, condenser fan is off and condenser is hotter, compressor is on	Motor fan capacitor
S14	Air gust from indoor blower is not cool, compressor is not on	Voltage source to the compressor

S15	Air gust from indoor blower is not cool, compressor is not on	Compressor capacitor

Next, the team gave the opportunity for the participants to practice the malfunction simulation using the AC training module that had been prepared, as shown in Figure 6.

Figure 6. Participants practiced the malfunction simulation using the training module.

During the practices, the participants were constantly reminded of the importance of safety when working with AC, safe refrigerant handling, and other precautions. At the end of the fourth day's training, the team performed an evaluation regarding the material that had been delivered to the participants. This evaluation was intended to determine how well the participants understand the training materials and measure the extent of their knowledge improvement pertaining to this matter. The evaluation was conducted using two methods: an oral test and interview for 60 minutes and a practice test for 60 minutes. The materials tested in the oral examination and interview were maintenance concepts, basic electricity, equipment knowledge, understanding/definition of AC, knowledge of types of AC, functions of AC, and knowledge of AC components. The materials tested in the practice examination were observation of malfunction symptoms, AC repair, and work safety. The results of the material evaluation are presented in Figure 7.

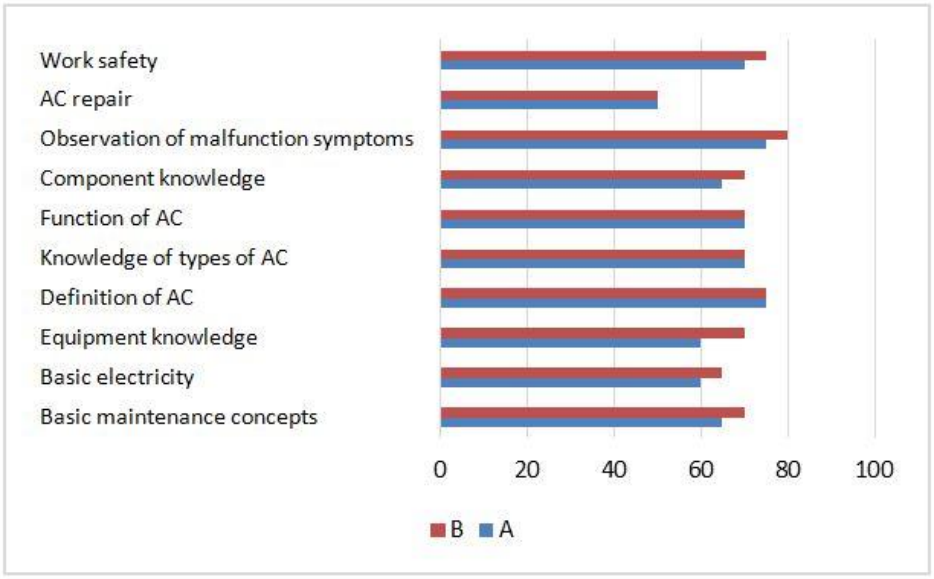

Figure 7. The comprehension test results of the material evaluation.

From Figure 7, it can be seen that both participants understood the material provided. The average score of this comprehension test result is 67.75%. The highest score, namely 77.5%, was resulted by the material on observation of AC malfunction symptoms. Meanwhile, the lowest score, namely 50%, was resulted by the material on AC repair. The distribution of average scores is presented in Figure 8.

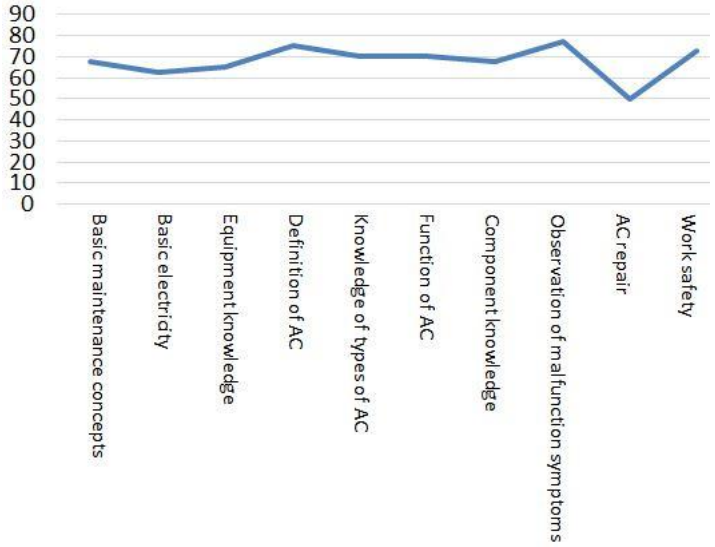

Figure 8. The resulted average score of the material evaluation.

In summary, this training was declared successful in improving participants' knowledge on AC maintenance and repair. Participants were quite good in terms of observing the malfunction symptoms and causes, as well as work safety and maintenance, especially cleaning the indoor and outdoor systems. However, this training did not equip the participants to become an expert and skilled AC technicians. This is because becoming an expert technician in the field of AC maintenance and repair requires more comprehensive knowledge and qualified skills, which can be achieved by attending more advanced level training.

4. Conclusions

Based on the results of the evaluation and implementation of this community service activity, it can be concluded that this basic training on AC maintenance and repair has succeeded in increasing the knowledge and skills of the participants, namely two musala janitors, with an average score of 67.75%. The participants, who had been given the training, were able to perform general maintenance in the form of cleaning the indoor and outdoor systems, analyzing the symptoms and causes of AC malfunction, and have realized the importance of energy efficiency. Nonetheless, in the future, comprehensive skilled and advanced level training is required in order to to become an expert technician in the field of AC maintenance.

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