



Training to Improve the Knowledge and Skills of Junior High School Students in the Field of Electrical Installation

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Abstract

The partner of this social service activity is the Muhammadiyah 11 Junior High School Special Program as part of the residents in the preaching area of the Muhammadiyah Branch Management (PCM) of Nogosari, Boyolali Regency. Regarding electrical installation, the problem faced by partners is that many students are still unfamiliar with electrical installation especially on technical specifications. The objective of this social service is to increase the knowledge and skills of students in electrical installation. The method of implementing the service is in the form of socialization and training in 3 meetings with material including the basics of electrical installation, KWH meter readings, knowledge of cables and connections, electrical installation equipment, and the use of equipment in electrical installations. The effectiveness of the activities was evaluated by conducting pre-tests, post-tests and direct observations on training participants. The evaluation results showed that the training activities were able to increase knowledge, namely students are able to answer between 1-3 questions correctly when the pre-test increases to 5-13 questions during the post-test, the skills and motivation of the participants in the field of electrical installation. However, further training activities are still needed with more in-depth materials and a longer duration.

1. Introduction

The partners of this community service activity are community members who live in the preaching area of the Muhammadiyah Branch Leadership (PCM) Nogosari, Boyolali Regency. PCM Nogosari oversees 13 Muhammadiyah Branch Committees (PRM) in villages in the Nogosari District area. The members of the association have various types of jobs and education levels. In every house there is an electrical installation for lighting and daily needs, for example for water pumps, irons, rice cookers, fans, refrigerators, to power carpentry tools and so on. Apart from residents who work in the electrical field such as the

Bureau of Electricity (BTL), electrical installers, ceiling workers, carpenters and masons, most residents are still unfamiliar with electrical problems.

In principle, the electricity network is divided into two parts, namely the network from the distribution network of the State Electricity Company (PLN) which then enters the house through the Miniature Circuit Breaker (MCB) which in the community is usually known as the electricity meter and the electrical installation circuit in the house after passing the electricity meter. After passing through the electricity meter, the power cable line will pass through the fuse house device and the new fuse then to the load such as lights or sockets. In the event of an electrical disturbance or emergency, if the disturbance occurs on the line after passing through the electricity meter, it is the responsibility of the customer, namely the homeowner. So, to prevent and anticipate if there is a disturbance in the network in the house, customers need to have basic knowledge of electrical installations including component standards and their installation (Ratnaya, et al, 2020).

Another thing that is no less important is about protection devices, namely the fuse section because many residents' homes still use fuses. Fuses have technical specifications, namely how much maximum current can flow in a home electrical installation. Various specifications of fuses that are widely used in household electricity include the size of 2 Amperes (A) for installed power 450 Volt Ampere (VA), 4A for installed power 900 VA, 6A for installed power 1300 VA, 10A for installed power 2200 VA and so on. This fuse must be selected according to the power installed in the house. The fuse is a protection device because the fuse will cut off the electricity when the current flowing in the load exceeds the current specifications on the fuse. One of the causes of too much electric current in the installation is a short in the electrical installation circuit. If the fuse selection is not correct according to the installed power specifications, if the current flowing is too large and a short occurs, the fuse will not turn off so that it will be able to trigger a fire.

A good electrical installation includes good power quality and also the quality of wiring in accordance with specifications as stipulated in the General Requirements for Electrical Installations (PUIL) 2011 (Badan Standar Nasional Indonesia (BSNI), 2011). The quality of electrical power that does not meet the equipment specifications, for example, the voltage is too high or too low, it will be able to cause damage to the equipment while the wiring that does not meet the standards, for example, the selection of an inappropriate cable size, which is too small, will be able to cause the cable to dissipate excessive heat when it gets a large load which can cause the cable to melt which in turn can trigger a short circuit that causes a fire in a residential house (Stokes, 2013). PUIL socialization activities are very important to be carried out to increase public understanding (Sultan, et al., 2021), (Sianturi, et al., 2021). Public understanding of electrical installation standards at home will be able to reduce the potential danger of accidents and fires caused by electrical installations (Yuniarti, et al., 2018).

The calculation of the electricity load used by each household is also an important thing for the community to know. The use of electricity in households is expressed in Kilo Watt Hour (KWH) which is recorded by the electricity meter. Currently there are two types of electricity meters used in the community, namely post-paid electricity meters where the electricity consumption displayed on the meter is paid every mid to end of the month and prepaid electricity meters where customers buy electric power capacity or KWH first and then this capacity quota will continue to decrease along with daily use. The electrical load

used by each of these loads can simply be seen from the size of the load or usually known as how many Watts the load is. Furthermore, the conversion of the load used into the cost that must be paid by customers for both prepaid and postpaid electricity is also important for the community to know. By understanding how to calculate the electricity usage load, the community can optimize the selection and usage patterns of existing household devices so that the amount of electricity usage can be controlled (Astuti, et al., 2018).

The missionary area of PCM Nogosari fosters several schools including Muhammadiyah Junior High School (SMP) 11 Special Program Nogosari. Students who attend school here mostly come from the Nogosari sub-district community and some from other surrounding sub-districts. Students of junior high school age have a very strategic role, namely as the next generation in society. These students need to gain knowledge about electrical installations so that they can avoid potential accidents due to electrical installations or take action in emergencies due to electrical installations. In addition to dealing with emergencies, the provision of knowledge in the field of electrical installation that is owned later can be deepened and honed to be used as capital skills for work (Yusran, et al., 2020). In the partner school, there are no subjects either directly in the curriculum or in additional lessons that teach about electrical installation material. In the world of education, in addition to formal learning methods, informal forms of education can be used to improve knowledge and or skills in various fields such as training to improve web programming skills for junior high school teachers (Supriyono, et al., 2020), training to improve understanding of the preparation of math problems for junior high school teachers (Khotimah, et al., 2021), training to improve the recitation of adzan memorization for muadzin (Shohabiya, et al., 2022), training to improve understanding of the importance of drinking traditional herbal medicine and how to grow herbal raw material plants (Priyono, et al., 2022), and training in making natural pesticides for farmers (Muslim, 2022).

Based on the search for publications on the results of the implementation of community service in the past, it can be seen that the socialization and training of electrical installation is important for various community groups, for example for village youth (Kusnadi, et al., 2020), traditional market traders (Prasetyo, et al., 2019), and youth who drop out of school (Tjandra, et al., 2019.). Based on the description above, a community service activity is carried out regarding socialization and training on the basics of electrical installation which aims to increase knowledge and skills in the field of electrical installation for students at partner schools.

2. Methods of Implementation

The solution offered by the proposing team to solve partner problems is to conduct socialization and training on basic electrical installations. Community service activities that have been carried out by previous servants in the form of socialization or information dissemination can be carried out through various forms of activities such as for example the distribution of leaflets to the community (Asmin, and Toressy, 2022), direct classical exposure (Istiqomah, and Mahendra, 2022), direct practice based on a theme/material formulated in a question (Setiawan, et al., 2022) and a combination of explanation in classical meetings coupled with practice (Alvianshah and Sahri, 2022). In this article, the form of activity with a combination of socialization and training was chosen because it is effective in increasing knowledge and skills as also done by other service teams such as

Supriyono et al (2015). Socialization and training activities are carried out in the form of classes to improve theoretical knowledge coupled with practice to improve participants' skills.

The implementation of this community service activity was carried out in several stages. The first stage is preparation which includes discussions with partners, namely the Principal of SMP Muhammadiyah 11 Special Program Nogosari, which is included in the PCM Nogosari preaching area to discuss the details of the activity implementation plan including the schedule, place, and facilities needed. The second stage is the preparation of infrastructure and facilities for activities which include the preparation of socialization and training modules, and preparation of materials such as cables, devices and installation equipment, props, and rooms along with LCD viewers. The third stage is the implementation of socialization and training carried out for 3 meetings at the partner school campus between August 6 and 22, 2022. The training materials included electrical concepts, types and specifications of cables and electrical devices (fittings, sockets, fuses, types of lamps), and cable connection practices. The fourth stage is the evaluation of the activity implementation. One example of documentation of the implementation of activities can be seen in Figure 1.



Figure 1. Documentation of the implementation of service activities: photos of the service implementation team and students participating in electrical installation training at partner schools on August 6-22, 2022.

In the implementation of training, it is necessary to conduct an evaluation to determine the effectiveness of the activity. Some examples of evaluation forms for training activities carried out by previous service teams include interviews and discussions with participants (Busaeri, et al., 2018), direct observation of participants' practical performance (Handayani, et al., 2021), and by using questionnaires (Mukharom and Sihotang, 2020). Based on these publications, in this article, the implementation team conducted an evaluation using a combination of various forms of evaluation to measure the effectiveness of activities in three aspects, namely cognitive, psychomotor and affective aspects. To determine the effectiveness of the training on increasing knowledge about the basics of electrical installation (cognitive aspect), before the implementation of the activity, a pre-test was conducted and after the activity, a post-test was conducted. The results of the pre-

test and post-test were then compared. To determine the effectiveness of training on improving skills (psychomotor aspects) and affective aspects, observations were made on each student.

3. Results and Discussion

The total number of training participants was 27 students involving 14 students (consisting of 3 boys and 11 girls) of class VII and 13 students (consisting of 6 boys and 7 girls) of class VIII. Evaluation of the effectiveness of the implementation of activities seen from three aspects, namely cognitive aspects, psychomotor aspects, and affective aspects is described as follows.

3.1. Increased knowledge (cognitive aspect)

To determine the increase in participants' knowledge, a preliminary test (pre-test) was held before the implementation of the activity and the final test (post-test) after the implementation of the activity. The questions for the pre-test and post-test were the same, namely there were 20 questions with materials including: (1) units of electric voltage, (2) units of electric current, (3) the amount of PLN electricity voltage at home, (4) the function of the fuse in the house, (5) the function of the electricity meter in the house, (6) the name of the unit of electric power in household devices, (7) the name of the tool for measuring electric voltage, (8) Voltage and electric current from PLN are AC or DC types, (9) units of electrical energy consumption of household appliances such as a lamp, (10) Unit of electrical energy recorded on the electricity meter, (11) type of cable, (12) type of fuse, (13) A house that subscribes to 900 VA electricity uses a fuse with what capacity/size, (14) type of fuse, (15) what MCB stands for, (16) fuse replacement tools/components, (17) name of cable that contains electric current, (18) why use rubber shoes/sandals when working with electrical installations, (19) calculation of KWH to cost in Rp, (20) calculation of cost in Rp to KWH.

The results of the pre-test answers showed that the average participant can only answer correctly between 1-3 questions, especially questions number 1, 2, and 3. After the training, the results of the post-test answers showed that the average participant can answer correctly between 5-13 questions. The questions that were mostly not answered correctly were questions number 12-20. The results of the pre-test and post-test answers show that in general the implementation of the activity was able to improve the cognitive abilities of the training participants. However, the relatively short training time caused the absorption of more advanced material including the calculation of power and electricity payment costs was not maximum, which can be seen from the answers of the trainees.

3.2. Skill improvement (psychomotor aspect)

In addition to receiving theoretical material about electrical installation, the trainees also received practical material to improve their skills as follows. First, participants were introduced to the types of cables. In this material, participants were shown cables that are widely used in household installations and the cable size written on the insulator of the cable body, for example NYM, 3 x1.5 mm, which means that the type of cable is NYM which contains 3 cores (phase, neutral, and ground), each core has 1.5 mm in size. After that, each participant was asked to practice reading and explaining cables with other sizes.

Second, participants were introduced to the test-pen device (Figure 2) which can be used to detect the presence of electric current in a place. In this material, students are given an example to detect the presence of electric current in a cable connection that has four sockets, namely at the phase point (there is current flowing) and neutral (no current flowing) where when the tip of the test-pen is touched at the phase point, the lamp on the test-pen will light up while if it is touched at a neutral point, the test-pen lamp will not light up. After being given an example, each student practiced using the test-pen. The results of observations in this practical activity showed that all participating students were able to use the test-pen to detect the presence of electric current in a place to avoid electric shock incidents.

Third, participants were introduced to a basic measuring instrument, a digital multimeter (Figure 2) that can be used to measure electrical installation variables, namely voltage and current. In this section, participants were first shown the parts of a digital multimeter and how to use it to measure the voltage at the socket and read the results. After that, every participant was asked to practice using a multimeter to measure the voltage on a cable connection that already had several sockets in turn. Observations of the practice session showed that all participants were able to use a digital multimeter to measure voltage.



Figure 2. Digital multimeter and test-pen trained to partner school students.

Fourth, participants were introduced to electricity meter reading (KWH meter). In this material, participants were invited to the electricity meter in the school and then explained the parts of the KWH meter and then taught how to read it. Then the participants were given questions about the readings on the KWH meter. Fifth, finally, participants were introduced to cable connection. In this material, participants were first shown the practice of how to peel the insulator (cable wrap) with cable peeler pliers and then connected two cables with the simplest connection type but strong and safe. After that, each participant was asked to practice stripping cables and making connections.

The results of observations on the implementation of activities showed that it is able to improve the skills of participants in reading cables specification, using a test-pen tool, using

a digital multimeter to measure voltage, reading a KWH meter, using cable stripping tools and connecting cables.

3.3. Improvement in affective aspects

One of the aspects that can be observed to measure the success of community service implementation is the affective aspect which is shown from observing the enthusiasm of participants as conducted by Lanawati et al (2022), (Muhtadi, et al., 2019). In addition, affective aspects can also be observed through filling out questionnaires about the benefits of community service activities obtained by participants (Pratiwi, et al., 2022). The results of observations made during the implementation of training activities showed that all training participants were very active and enthusiastic in participating in all activities both during the theory and practice. Participants were also able to explain about the practical material they did. Although the field of electrical installation has been impressive for men, in training, female students showed the same enthusiasm as male students.

3.4. Obstacles that are still faced

In general, the implementation of the activities went smoothly and the evaluation results showed that the implementation of the activities could improve the knowledge (cognitive aspects), skills (psychomotoric aspects) and affective aspects of the participants. However, the knowledge and skills faced by participants from this training are generally has not optimal yet in solving the problems faced by partners. Of the 27 students who participated in the training, there was already one male student who had good knowledge and technical skills in accordance with the material provided. The activity implementation team noted that there were still obstacles faced during the implementation of the activity, especially the short duration of the training. The training was only carried out in 3 sessions x 40 minutes (total 120 minutes) for each class to adjust to the availability of time in partner schools on the sidelines of teaching and learning activities, making the delivery of material both theory and practice less optimally absorbed by participants. For the implementation of further services, if possible, the number of sessions can be increased so that the training material can be more numerous and in-depth so that it can solve partner problems optimally.

3.5. Condition comparison before and after the implementation of activities

A comparison of conditions in partners between before and after the implementation of the service can be seen in Table 1.

Table 1 Comparison of partner conditions between before and after the implementation of the activity.

Before Implementation	After Implementation
Participants: (1) do not have knowledge about electrical installation, (2) do not have the skills to use equipment for electrical installation.	Participants: (1) knowledge about electrical installation has increased, (2) already have skills in the electrical field including reading specifications on cables, using a test-pen to detect electric current, using a digital multimeter, reading KWH meters at home, using cable strippers and connecting cables.

4. Conclusion

Based on the results of the implementation of the activity, it can be concluded that this training activity is able to increase partner knowledge in the field of electrical installation which can be seen from the results of the pre-test and post-test answers. After attending the training, participants were able to answer more questions correctly than before attending the training, namely students were able to answer 1-3 questions correctly during the pre-test then increased to being able to answer between 5-13 questions during the post-test. The training activities have also been able to improve participants' skills, namely the skills of reading specifications on cables, using a test-pen to detect the presence of electric current, using a digital multimeter, reading KWH meters at home, using cable stripping tools and connecting cables. From the affective side, it can be seen that both male and female students have the same high enthusiasm for participating in this training activity. However, the problems faced by the partners have not been fully resolved because the knowledge and skills obtained by the participants have not been in-depth so further training is needed.

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