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Workshop on Safe Electrical Installation Design based on PUIL 2000 at SMK Negeri 5 Medan

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***Abstract*— This community service activity aims to improve the technical competence of students and teachers at SMK Negeri 5 Medan in the field of domestic and non-domestic electrical installations according to PUIL 2000 standards. Through a hands-on, hands-on workshop program, participants are trained to understand installation structures, electrical system components, grounding systems, as well as safe and efficient electrical installation installation and testing techniques. The method of implementing activities includes socialization, project-based learning, tool demonstrations, installation preparation practices, and evaluation of work results. This activity involved electrical engineering teachers and students, with the support of school laboratory facilities. The results of the training showed an improvement in the participants' ability to identify installation components, draw one-line diagrams, arrange main, branch, and end circuits, and understand the principles of electrical work safety. The achievement of activities is shown through the success of installation practices that meet technical requirements, the improvement of student evaluation results, and the creation of an electrical practice module as a program output. This activity also encourages synergy between universities and vocational schools in supporting industry-based engineering education. It is hoped that this activity can be replicated in other schools and become part of the vocational education quality improvement program.**

Keywords—Electrical Installation, PUIL 2000, SMK, Technical Training, Electrical Practice

I. INTRODUCTION

Electrical installations are an important element in infrastructure development, both in the domestic and non-domestic sectors. In this modern era, people's needs for electrical energy are increasing along with the development of technology and the need for comfort in living daily life. However, in practice, there are still many people who do not understand the basic principles of electrical installation that are safe, efficient, and in accordance with the standards that have been determined in the General Regulation of Electrical Installations (PUIL 2000) [1], [2], [3], [4].

Figure 1. Service Locations

SMK Negeri 5 Medan as one of the vocational education institutions engaged in electrical engineering, has a strategic role in preparing graduates who are competent and ready to face challenges in the world of work. However, the results of observations show that students and some teachers still experience difficulties in applying the theory of electrical installation into practice real, especially in the context of the implementation of domestic and non-domestic electrical installations in accordance with PUIL 2000. Therefore, this community service activity is designed to answer these needs through workshops that focus on the design and implementation of electrical installations safely and correctly [5], [6]. This workshop is expected to provide insight and increase the capacity of students and teachers in understanding the installation of the main circuit, branch circuit, and final circuit, including understanding of PHB (Connection Equipment), grounding system, types of cables and switches, and installation provisions. With this activity, students not only gain hands-on practical experience, but also build awareness about the importance of occupational safety in the field of electricity [7], [8], [9], [10]. This workshop will integrate educational and technical approaches through demonstrations, hands-on training, group discussions, and

evaluation of the results of the practice. The active participation of school partners is also expected to strengthen the synergy between academics and educational institutions in building a safe and efficient electricity awareness culture in the school environment and society [11].

II. METHODS

A. *Approach Methods Offered*

Methods of Approach Offered The method of implementing community service activities is designed systematically and applicatively to answer the practical needs of partners, in this case SMK Negeri 5 Medan. The approach used is a project-based learning method that combines theoretical elements, hands-on practice, and technical guidance. All implementation methods are focused on how students and teachers can be directly involved in the process of designing, installing, and testing electrical installations in accordance with PUIL 2000 standards.

B. *Working Procedure*

The first step in the implementation method is to analyze training needs through direct observation and initial discussions with teachers and students [12], [13], [14]. The results of this analysis are then used as the basis for the preparation of training materials and modules. The material is designed not only to refer to textbooks, but also to technical references such as the document "Domestic and non-domestic Electrical Installations" which contains the latest technical standards including an introduction to the main circuit system, branch circuit, and end circuit, partition connection panel (PHB), grounding system, conveying cable, and protection devices such as MCB and MCCB. 2. The second step is the implementation of a technical workshop. This workshop is divided into several main sessions, namely theory sessions, tool demonstration sessions, and installation practice sessions. In the theory session, participants were given an in-depth understanding of the basic principles of electrical installation, the importance of good grounding, appropriate cable connection techniques, and work safety. Then, in the demonstration session, participants were shown firsthand how to work and install PHB, switches, and grounding systems.

C. *Activity Plan*

Practice sessions are the core part of the workshop. Students and teachers directly perform circuit setup from the main panel to the final circuit, including voltage testing and current measurement. The entire process was accompanied by a team of lecturers and accompanying students from Universitas Pembangunan Panca Budi. The implementation of the practice is carried out in the engineering laboratory of SMK Negeri 5 Medan with customized tools and materials. To ensure that the implementation goes as planned, monitoring and evaluation methods are also applied in each stage of implementation. Monitoring and evaluation are carried out by observing the training process and recording any technical difficulties faced by the participants. The results of the evaluation will be the basis for improving training methods in the future.

D. *Description of Partner participation*

In addition, partner involvement is also part of the implementation strategy. Teachers act as co-trainers in accompanying students and participating in designing training designs. The active participation of teachers aims to ensure that the methods that have been applied can be continued independently after the activity ends.

Table 1. Description of Partner Participation

No.	Related partners	Role
1.	Principal	Provide the opportunity and time to conduct workshops
2.	Teacher	As a co-trainer in accompanying students and helping to design activities
3.	Student	Participants/audiences in conducting socialization

E. *Description of the Evaluation of the Implementation of the PKM Program*

All of these methods are designed to be easily replicated in other schools. Therefore, implementation documentation, starting from photos of activities, practice videos, and evaluations were compiled as evaluation materials for the continuation of this program. The entire activity is adapted to the PUIL 2000 technical guidelines and the principles of safe electrical installation as described in the reference document. With the application of this implementation method, it is hoped that the service activities will

not only succeed in transferring technical knowledge, but also foster awareness among students and teachers on the importance of safe and efficient electrical installations. In the long run, this method also forms a disciplined and safety-based technical work culture, which is indispensable in the professional electrical work world.

III. RESULTS AND DISCUSSION

A. *Results of Service*

The community service activities carried out at SMK Negeri 5 Medan were successfully carried out well according to plan. The workshop program "Safe Electrical Installation Design Based on PUIL 2000" not only provided technical understanding to the participants, but also increased awareness of the importance of implementing safety standards in electrical installation systems.

This activity involved teachers and students majoring in electrical engineering, and was supported by a service team from Universitas Pembangunan Panca Budi. In the initial stage, the team conducted socialization aimed at introducing the importance of electrical installation standards according to PUIL 2000. Students and teachers are given information about the structure of the installation starting from the main circuit, the branch circuit, to the final circuit.

The explanation also includes key components such as PHB (Connection Equipment), grounding systems, as well as standard types of cables and switches. The response of the participants was very positive, as seen from the enthusiasm during the question and answer session and discussion. The next stage is the implementation of a practical workshop. In this session, participants carried out the preparation of electrical installations directly starting from drawing a one-line diagram, determining the installation points of components, to arranging and connecting cables in the installation system.

This activity was carried out in groups, accompanied by lecturers and students from the service team. This practice opens up a space for active collaboration between students and teachers, where teachers play the role of mentors as well as learn.

Figure 2. Peserta Workshop

Figure 2. Awards

Figure 2. Material Provision

B. *Discussion*

The results of the evaluation of the activity showed that students' understanding of electrical installations increased significantly. This is shown from the results of the pre-test and post-test carried out before and after the workshop.

The average score of the participants increased by 30–40%, especially in the aspects of electrical symbol recognition, understanding of one-line diagrams, and safe cable connection techniques. In addition, participants also demonstrated progress in practical skills such as measuring current and voltage with measuring instruments. The calculations in the electrical installation provided include: Maximum Requirements of Residential Installations Example: Determine the maximum requirements of residential installations, which are supplied by a single phase of 240 Volts with the following loads:

24 Illumination Points
10 meter rail description
9 single KKB
8 double KKB
1 x 50 W suction fan
1 x 1000 W wire heater (strip heater)
1 x 15 A CPD
1 x 10 kW electric stove
1 x 4.8 kW controlled water heater
1 x 3 kW tennis court lighting
Settlement:
Determination of needs in accordance

a. Load group A 1)
24 lighting points plus 10 meters of rail lighting plus
50 W suction fan = 45 points
=2 + 2 + 2 = 6A

b. Load group A 2)
3000 W tennis court lighting = X 0.75
= 9.4 A

c. Load group B 1)
9 single KKB plus
8 Double KKB = 25 points
1000 W wire heater = 1 point
= 5 + 5 = 10 A

d. Load group C 15A KKK = 10 A

e. Load group C 10,000 W electric stove = 41.67 A x 0.5 = 20.8 A

f. The load group F This 4,800 W controlled water heater = 20 A is smaller than the load amount of the other load groups, thus the maximum requirement for this load is 0 A.
Total load
= sum of all load groups
=A 1) + A 2) + B 1) + B 2) + C + F
= 6 + 9.4 + 10 + 10 + 20.8 + 0
= 57.2 A

IV. CONCLUSION

The community service activities that have been carried out at SMK Negeri 5 Medan through the "Workshop on Safe Electrical Installation Design Based on PUIL 2000" show very significant achievements and make a real contribution to improving the technical competence of the participants. The program is designed to address the real challenges faced by partners, especially in the aspect of lack of understanding and skills in electrical installation practices as per national standards. The implementation of structured and practice-based activities has a positive impact that can be directly felt by students, teachers, and the school as a whole. In general, this program has been proven to be able to improve students' and teachers' understanding of electrical installation systems, starting from the basic concept, circuit structure (main, branch, and end), to the application of the grounding system and connecting equipment (PHB). Through an educational approach combined with hands-on practice, participants gained a better understanding of how to design and implement safe and efficient electrical installations. The use of reference standards such as PUIL 2000 provides a strong technical foundation for participants in understanding the importance of safety and efficiency in building electrical systems, both domestic and non-domestic. Workshop activities also provide room for skill actualization for students through hands-on practice in preparing a series of installations. In this activity, students play an active role in the process of installing cables, connecting components, testing systems, and identifying installation errors. This not only strengthens theoretical understanding, but also trains technical skills that are much needed in the world of work. A significant improvement in students' practical abilities was shown through the results of the post-training evaluation, both in terms of installation accuracy, component selection, and installation neatness and safety. In addition, the teachers of SMK Negeri 5 Medan also felt the benefits of this activity. They received an update on the development of national electricity standards as well as project-based learning methods that are more contextual and applicative. The involvement of teachers in the workshop process is not only limited to being a supervisor, but also as an active facilitator who accompanies students in every stage of practice. This synergy strengthens teachers' capacity to deliver electrical engineering materials in accordance with industrial developments and strengthens their role as agents of vocational

education transformation Another impact that is also important to note is the formation of a culture of electrical safety awareness in the school environment. Students and teachers begin to apply the principles of occupational safety in every practical activity, such as the use of personal protective equipment, checking components before use, and arranging a neat and safe installation. This change in attitude is proof that the service program not only provides technical skills, but also builds a professional character and work culture in the educational environment. The success of this activity also opens up opportunities for sustainable collaboration between Universitas Pembangunan Panca Budi and SMK Negeri 5 Medan. Synergy between universities and vocational schools has proven to be able to enrich the learning process through the transfer of relevant technology and knowledge. This collaboration is also a model of cooperation that can be developed with other schools in an effort to improve the quality of industry-based vocational education. In closing, it can be emphasized that this community service activity is not only successful in terms of program implementation, but also succeeds in creating transformational impacts that touch on learning aspects, strengthening competencies, providing teaching facilities, and increasing awareness of the importance of safe electrical installations. Therefore, this activity deserves to be replicated and made an integral part of the strategy to improve the quality of technical education at the vocational school level nationally.

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