



## Increasing Teacher Competency through Training on Non-Destructive Testing Methods for Welding (NDT) for Teachers in Kulonprogo Regency

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### ABSTRACT

The purpose of this community service is to provide knowledge and skills related to the method of non-destructive testing for welding (NDT). It is expected that all participants will be able to independently carry out non-destructive testing of welding results that will be taught to vocational high school students in Kulon Progo Regency. This community service was conducted through lecture, discussion, simulation, and assisted practice. Those activities were done to make it easier for participants to understand the materials presented. After all the activities were completed, an evaluation was carried out on both the ability and understanding of partners and the evaluation of the activities that have been carried out. The results of this activity show that before participating in the training participants ability related to non-destructive testing of welding results is low. Then, after the program was carried out, there is a significant increase in mastery of the theory and practice of welding testing, ranging from visual testing, penetrant fluids, magnetic tests, to ultrasonic tests.

## 1. Introduction

Teachers cannot rely solely on the skills acquired during college or past experience in carrying out teaching duties. The ever-changing world of education demands them to always be ready to respond to new dynamics [1]. Adaptation is important because teacher performance plays a very vital role in determining the quality of education, both in terms of the process and student learning outcomes [2]. In this role, teachers not only deliver material, but must also be able to plan, implement, and assess learning effectively to achieve optimal educational outcomes. The quality of learning produced by teachers directly affects students' abilities and contributes to improving the overall quality of education [3].

To respond to the demands of changing times, improving teacher competency is a crucial factor. This improvement includes the development of skills, attitudes, and abilities that must be continuously honed [4]. In facing the challenges of the modern world, teachers need to be able to adapt to technological, social, and cultural developments that affect students' learning methods.

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Changes in student characters also require teachers to be more flexible in understanding the needs and uniqueness of their students. The principles of professionalism and lifelong learning are important foundations for teachers to remain relevant and qualified in their roles as educators [5]. However, although teacher competency improvement is essential, various issues may be faced by the teachers. Limited resources such as time and budget are the main challenges. The teaching tasks, coupled with administrative burdens, make time for self-development increasingly limited [6]. In addition, access to quality training is often limited by cost, location, or the availability of appropriate programs. Teachers' motivation to continue to develop also varies, with some teachers feeling quite satisfied with the abilities they already have, while others strive to continue learning and improving their skills. Support from schools, colleagues, and other related parties is essential to overcome these issues, especially in dealing with changes in curriculum or education policies that require adjustments from teachers [7].

As a concrete example, welding engineering teachers in Kulonprogo Regency face major challenges in developing their competencies. The heavy workload and limited budget for training are the main issue. One proposed solution is to get training in the field of welding results inspection using non-destructive methods (Non-Destructive Testing/NDT). This effort is important because it allows teachers to master welding testing techniques that comply with modern industry standards. By participating in this training, it is hoped that teachers can improve their technical competencies, so that they can integrate the latest technology into the learning process at school. Ultimately, this training aims to improve the quality of welding engineering education, prepare students with relevant skills to get into the workforce, and increase the competitiveness of vocational high school graduates in the future.

## **2. Method**

This community service consists of two main parts, namely training and mentoring. In the training, participants were taught methods of inspection and testing of non-destructive welding results (NDT). The testing methods provided include:

### **2.1. Visual testing**

The participants were provided with the theory and practice of visual inspection of welding results regarding welding defects [8]. Defects were identified and then studied during the pre-, during, and post-welding processes. With the ability to carry out visual observations, it is hoped that analytical skills will improve as welding technique skills.

### **2.2. Testing with penetrant fluid,**

Inspection was done after participants learned to inspect visually [9]. The training participants learned theories of inspection with penetrant fluid, recognized inspection materials and tools, prepared materials and tools, and carried out inspection procedures properly and correctly.

### **2.3. Conducting magnetic test**

This inspection technique is taught after participants were able to inspect with the visual method [10]. They were taught about the inspection using magnetic test, recognizing inspection materials and tools, preparing materials and tools, and carrying out inspection procedures properly and correctly. At last, they needed to carry out the measurement process after the initial process that determined the inspection results.

### **2.4. Ultrasonic testing**

This procedure was taught after participants learned about the ultrasonic test method [11]. Training participants were taught about theories of inspection using magnetic test, recognizing

inspection materials and tools, preparing materials and tools, and carrying out inspection procedures according to applicable standards.

### 3. Results and Discussion

#### 3.1. Results

This community service activity was carried out well and smoothly on June 10-13, 2024. The training and mentoring activities were carried out at the Wates Campus, Faculty of Vocational Studies, UNY. As many as 15 teachers coming from the Kulon Progo Regency area participated in this community service. The results of this activity are:

- a. Participants understood the material on the method of inspection and testing of non-destructive welding results (NDT).
- b. Participants have skills in carrying out inspection and testing of non-destructive welding results.
- c. Participants have the awareness to always apply the principles of the right inspection method in every welding test.

#### 3.2. Discussion

This training and mentoring activity is specifically designed to improve teacher competency in the field of welding testing using non-destructive methods (Non-Destructive Testing/NDT). With the increasingly urgent need to provide technology-based education and industry standards, this training is divided into two main parts: training and practical mentoring. The main objective of both activities are for teachers to master welding testing techniques with industry standards, which can later be applied in the learning process at school, and prepared to produce graduates who are better prepared to face the challenges of the world of work.

At the training stage, participants were taught four main NDT methods, namely visual testing, testing with penetrant fluid, magnetic test, and ultrasonic test. Each method presentation began with an in-depth theoretical explanation, where participants were given basic knowledge about the concepts, tools, and procedures used in these testing techniques. The process is presented in Figure 1 below.



**Fig. 1.** Presentation about NDT Theory

Visual testing was the first method taught because this method functions as a basic step in identifying welding defects that can be seen directly [12]. The participants were required to hone their observation skills, learn the causes of welding defects, and improve technical analysis skills that will be useful in teaching welding techniques to students. By mastering this visual testing, training participants could understand the pre-, during, and post-welding processes better.

In the next stage, the training continues with the introduction of more complex testing methods through penetrant fluid and magnetic tests. These two methods provide participants with deeper insight into identifying welding defects that are below the metal surface, which cannot be detected by visual testing alone [13]. In this session, participants were taught to use more sophisticated tools and carry out testing procedures in accordance with industry standards currently being promoted. In addition, they also learned how to make accurate measurements to determine the quality of the weld being tested. Mastery of this method not only improved participants' knowledge but also technical skills in operating the tools and materials needed in the testing process. Later on, these skills can be used to teach more comprehensively at vocational high schools [14].

Furthermore, the ultrasonic test method was introduced as a sophisticated technology that can detect deeper welding defects without damaging the material [15]. Ultrasonic testing is very relevant to the development of technology in the industrial world today, so participants showed a high interest in mastering this method [16]. Through this training, participants not only understood the basic concepts of ultrasonic technology but were also trained to use related tools efficiently and appropriately. After all, this training aimed to introduce cutting-edge technology, which teacher can used to teach students as part of modern engineering education that is relevant to today's industrial needs.

Assisted practice conducted after theoretical training provided an opportunity for participants to apply the knowledge and skills they have learned in real conditions [17]. In this assistance stage, participants received direct guidance in using NDT tools in the field, with situations and conditions that resembled real industry. This assistance is important to ensure that participants not only understand the testing theory, but are also able to apply testing procedures independently and accurately in the field. The results of this assistance activity show that participants were able to conduct inspections using the methods taught properly and correctly, which increased their confidence in applying welding testing techniques in the real world. The assisted practice process is presented in Figure 2.



**Fig. 2.** Assisted Practice

Overall, this training and mentoring activity successfully achieved its goal of improving teacher competency in non-destructive welding testing techniques. This improvement is shown by the increasing understanding, skills, and analytical abilities of participants in each stage of the training. Teachers who participated in this activity are then expected to be able to pass on the knowledge and skills they have acquired to students in schools. Therefore, graduates of the welding engineering

education program will have better competency and be ready to compete in the ever-growing world of work, especially in the industrial sector that is increasingly dependent on modern technology.

#### 4. Conclusions

There are a number of important takeaways from the community work that was carried out. First, there was a clear demand for this kind of technical expertise in the community, since 15 people signed up for the training program. Individuals eager to improve their abilities in welding inspection and testing made up the participants, therefore this figure shows the future reach and influence of programs like this. Secondly, prior to the instruction, the participants' abilities were rather low. This discovery reveals that they are lacking in expertise, especially when it comes to welding inspection methods and Non-Destructive Testing (NDT). The need of offering accessible and effective training opportunities to fill this knowledge gap was highlighted by the fact that most participants were unfamiliar with the basic ideas and practical applications of NDT procedures. Thirdly, this demand was adequately met by the training. At the conclusion of the training, every single participant had a thorough grasp of the subject matter. The participants' enthusiasm for learning and putting what they've learned into practice, along with the high standard of the training, are the driving forces behind this outstanding result. Lastly, the participants really nailed it when it came to welding testing, both theoretically and practically. This necessitates an in-depth familiarity with a wide range of testing procedures, including but not limited to optical, penetrant, magnetic, and ultrasonic examinations. These developments have not only improved their technical competences, but also given them the tools they need to guarantee the integrity and security of welded constructions. The training program was a success because it provided participants with knowledge and skills that will help them in their careers and in the community at large.

#### Conflict of interest

The authors declare no conflict of interest.

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