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Improvement of Teacher Competence with Training in Using Trainer Arduino in SMK Multimekanik Masmur Pekanbaru

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***Abstract*—The problem found in this study is the level of teacher competence not in accordance with the readiness in facing the Industrial Revolution V 4.0. The purpose of this study is to improve teacher competence in** SMK **Multimekanik Masmur Pekanbaru by providing training in the use of** Trainer **Arduino**. **The method used in improving teacher competency is to provide seminars and training for** Trainer **Arduino and to be evaluated using Pretest and Posttest. The number of participants in this study** was **15 people. From the** treatment **given, an increase in teacher competence was obtained by 24, 41%. The highest competency improvement in participants was 31.82%, while the lowest competency improvement was 15.63%**

Keywords— Teacher Competence, Training, Trainer Arduino

I. INTRODUCTION

Based on Law Number 14 of 2005 concerning Teachers and Lecturers, in article 10 paragraph (1) states that "Teacher competence referred to in Article 8 includes pedagogical competence, personality competency, social competence, and professional competence obtained through professional education" [1]. There are several indicators of the achievement of activities that will be used as a reference in seeing the improvement of teacher competency in this study. Indicators taken as a reference in improving teacher competence are pedagogical competencies and professional competencies. Pedagogical competence is the ability of understanding of students, the design and implementation of learning, evaluation of learning outcomes, and the development of students to actualize their various potentials. Professional competence is the mastery of extensive and in-depth learning material, which includes the mastery of curriculum material in school subjects and the scientific substance that houses the material, as well as mastery of the structure and methodology of the science.

The government has launched version 4.0 of the Industrial Revolution where everything has been based on automation by utilizing technology and the Internet of Think. Therefore, it is necessary for education sector especially in technology schools to accompany the development of technology, especially leading to the Industrial Revolution version 4.0.

In welcoming the technological development accompanied by the insistence on the Industrial Revolution V 4.0, where the revolution V 4.0 allows higher productivity and efficiency of resources, teachers must equip themselves with wider learning material. Teachers must leave the conventional ways of learning, and provide the latest innovations. The expected innovation is the existence of methods or learning media that are expected to refer to the Industrial Revolution V.4.0.

Problems in this study were obtained based on interviews and observations conducted at several schools in Pekanbaru. From observations that have been carried out, the teacher's competence in responding to the industrial V 4.0 revolution has not been sufficient. This is influenced by teaching materials that are understood by teachers to be still sourced from old teaching materials. Besides the instructional media used by teachers are not in accordance with the Industrial Revolution approach V.4.0. Based on these problems, treatment can be given in the form of providing training in trainer Arduino to improve teacher competency.

Trainer Arduino is considered as a solution for increasing teacher competency because the use of Arduino is more widely used in industry. If we look at the curriculum at SMK especially Electronic Technology, microcontroller learning still uses the AVR type. On the other hand, in industries in Pekanbaru, the use of Arduino is more applied as a control.

In previous studies, self-development activities are part of the activities of Continuing Professional Development (PKB). There are three PKB activities, namely self-development, scientific publications, and innovative work. The research raised self-development because self-development is the basis for increasing competence before teachers make scientific publications and innovative work [2]. In addition, in other studies the lesson study program can be implemented because of the support of cooperation between teachers, school principals, and the role of coordinators in developing programs. For teachers, this program is very useful in

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learning in the classroom, as well as being able to improve their competency [3].

The purpose of this research is to increase human resources in the world of electronic technology, increase student interest in electronics, training in introducing the development of microprocessors and microcontrollers, Introduction to Trainer Arduino, Introduction to teachers about electronic sensors that can be used in everyday life and improve the quality of graduates of the Electronics Technology school as well as improve teacher competency by providing training in trainer Arduino at the SMK Multimekanik Masmur Pekanbaru.

II. DATA AND RESEARCH METHOD

A. Trainer Arduino

Trainer Arduino is a learning media developed using an Arduino microcontroller. Trainer Arduino can be used in Basic Programming, Digital Systems, Sensors and Transducer subjects, and Microcontrollers. So far, the use of microcontrollers as learning media in schools in Pekanbaru still uses the AVR type. It is hoped that with this renewal, it can upgrade teacher competencies which have so far been based on conventional media in learning.

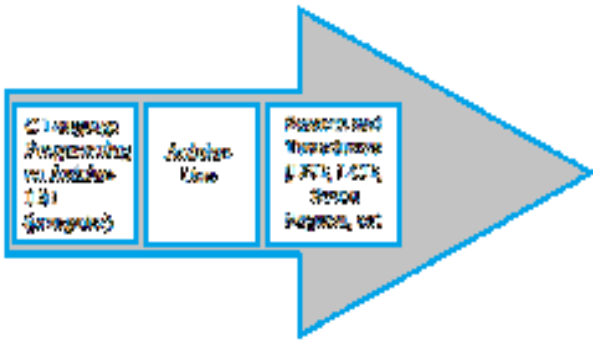

Figure 1 Arduino Trainer Work System

Trainer Arduino consists of several sensors and transducers. An important component of the trainer is the Uno Arduino Microcontroller. There are many types of Arduino depending on their size and use, namely Arduino Lilipad, Arduino Uno, Arduino Nano, Arduino Mini and others. What makes the difference in some types of Arduino is the ability of work power and storage. The workings of the trainer Arduino can be seen in Figure 1.

In the Trainer Arduino, the use of sensors and transducers becomes a reference as a learning medium. The user will learn programming using Language C [4]. In its application, sensors and transducers can work where the user modifies commands in the form of a programming language and sent to Arduino. Figure 2 is a form of Arduino Uno

Figure 2 Arduino Uno

Figure 2 is an Arduino type Uno that is widely used in the world of automation. Arduino Uno has 14 digital pins and 6 analog pins. On digital pins, there are 6 pins that can be used as PWM. Arduino Uno has an operating limit of 5 V.

In the trainer Arduino, Arduino can be connected to several sensors available, including LED, LDR, LCD, Seven Segment, Temperature sensor, timer sensor, Dot Matrix and humidity sensor. The trainer Arduino drawings used in the training can be seen in Figure 3:

Figure 3 Trainer Arduino

Figure 3 is an example of Trainer Arduino used for teacher competency training at SMK Multi Mekanik Masmur.

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No	Schedule of activities	Time
1	Microprocessor and Microcontroller	09.30 - 10.15
2	Application of Microcontrollers in Industry	10.15 – 11.00
3	Microcontroller against the Industrial Revolution V 4.0	11.00 – 11.45
4	Introduction to Arduino IDE	13.30 – 13.45
5	LED programming	13.45 - 14.05
6	LCD programming	14.05 - 14.25
7	Ultrasonic Sensor Programming	14.25 – 14.45
8	LDR Sensitive Programming	14.45 – 15.05
9	Temperature Sensor Programming	15.05 – 15.20
10	Water break	15.20 - 15.45
11	Seven Segment Programming	15.45 – 16.05
12	Combined multiple sensor programming	16.05 – 16.25

B. Research Data

The data taken in this study are the results of Pretest, Posttest, and evaluation given to participants. Pretest results were carried out before the training, while posttest and evaluation were carried out after the training of trainer Arduino. The roadmap in this study is as follows:

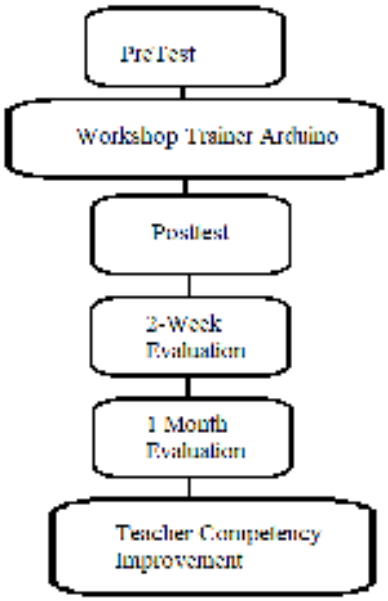

Figure 4 Research Roadmap

C. Pretest

Assessment with the pre-test procedure is in the form of question, which is posed before starting a lesson. The question asked is the material to be taught at the time (new material). Giving a pretest is usually done at the beginning of the opening lesson. The purpose to carry out a pretest in this study is to see the extent of participants' knowledge about the microcontroller, trainer arduino and transducer sensors before being given treatment (training). Each participant was given a multiple choice question sheet consisting of 40 items. The questions consisted of 15 microcontroller questions, 5 Arduino IDE questions, 5 programming problems and 15 sensor and transducer questions

Table 1 Training Schedules

D. Training on the use of trainer Arduino

The training was held at the Computer Laboratory of SMK Multimekanik Masmur Pekanbaru. The training lasted for 1 day. The training was attended by 15 participants consisting of teachers and laboratory assistants. Participants came from Audio Video Engineering, Software Engineering, and Network Computer Engineering study programs.

The training started from 09.00 AM to 05.00 PM. Before the training began, participants were given a 30-minute Pretest to see the extent of the teacher's competence with Arduino type microcontrollers and transducer sensors. The material presented during the training can be seen in Table 1. After the training was given, the activity was closed with a posttest in the last session.

E. Post-test

Assessment with the post-test procedure is the form of questions given after the lesson/material has been submitted. In other words, a post test is a final evaluation when the material taught on that day has been given in which a teacher gives a post-test with the intention of whether students have understood about the material just given that day. Posttest aims to see the results of activities that have been carried out. The results of the post-test can provide information on whether the objectives of the activity have been achieved or not. In this study, the items used as posttest are the same as questions on pretest. Each participant was given a multiple choice question sheet consisting of 40 items. The questions consist of 15 microcontroller questions, 5 questions Arduino IDE, 5 programming questions and 15 sensor and transducer questions. The posttest is expected to see an increase in teacher competency after being given trainer Arduino training. After the training is carried out, the Arduino trainer and the jobsheet are submitted to the school to be studied independently.

Figure 5 Training of Trainer Arduino Section

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F. Evaluation 2 weeks after training

Evaluation is done to see whether the teacher learns the trainer independently at school. The first action evaluation action took place 2 weeks after the training was given. Participants were given a question sheet to answer. The questions given are the same as the pretest or posttest questions. It is hoped that in this 2-week evaluation there would be an increase in teacher competence compared to the results of the tests in the previous posttest.

G. Evaluation 1 Month after training

One month post training evaluation aims to see how far the achievement of increasing teacher competence after 1 month after training. With trainers facilitated at school, it is expected that there would be a significant increase in teacher competence after one month of training

III. RESULTS AND DISCUSSION

The evaluation aims to see an increase in teacher competency based on the score of the pretest and posttest. The evaluation was also carried out 2 weeks and 1 month after the service activities were carried out. Evaluation is carried out to see whether the teacher learns independently by means of a trainer provided by the service team. The form of evaluation carried out is the same as evaluation during the pretest. The results of the pretest, posttest and evaluation can be seen in Table 2. From the table it can be seen that there is an increase in the teacher's pedagogical competencies found in the community service activities. To see the curve for increasing teacher competency, it can be seen in Figure 7

Table 2 Value of Participants in Training of Arduino Trainer

No	Name	Pre Test	Post test	2-Week Evaluation	1 Month Evaluation
1	Participant 1	52,5	72,5	75	77
2	Participant 2	67,5	75	77,5	80
3	Participant 3	65	77,5	80	80
4	Participant 4	65	70	75	77,5
5	Participant 5	60	75	77,5	80
6	Participant 6	57,5	70	72,5	80
7	Participant 7	70	80	80	85
8	Participant 8	75	85	90	95
9	Participant 9	60	80	80	87,5
10	Participant 10	55	65	67,5	75
11	Participant 11	52,5	65	67,5	75
12	Participant 12	65	75	80	85
13	Participant 13	62,5	85	85	90
14	Participant 14	65	80	80	85
15	Participant 15	70	85	92,5	95

Figure 6 Graph of Teacher Competency Improvement

Figure 7 shows information on increasing teacher competence during the activity. The blue curve is the result of pre-test before the training was carried out. The brown curve is the result of post-test after workshop on trainer Arduino was carried out. The grey curve is the result of activity evaluation done 2 weeks after the workshop.

The yellow curve is the evaluation result of community service, 1 month after the activity.

Participants who gained maximum competency improvement at the time of the Posttest were participants 8, 13 and 15, while participants who received the lowest competency improvement were participants 10 and 11.

To see the percentage increase in overall teacher competency, the following formula can be used:

$$Percentage\ Increase = \frac{Final\ Score - Initial\ Score}{Initial\ Score}\ x\ 100$$

In general, a significant increase in competence occurred between the pretest and posttest. When compared with the increase in 2 weeks or one month after the activity, the percentage increase in competence from pretest to posttest is 17, 25%. Teacher competency improvement from post-test to 2-week evaluation is an increase with the smallest percentage of 3.36%, while the percentage increase from 2 weeks evaluation to 1 month evaluation is 5.41%. From the results of the evaluation after the training, it can be concluded that the teacher has a low competency increase if given independent learning.

To see the percentage of teacher competency improvement in the trainer arduino training and workshop activities as a whole, the value used is the pretest value and the evaluation value of 1 month. The selection of 1-month evaluation scores is taken as a reference in seeing the improvement in teacher competencies aimed at seeing whether the teacher continues to study independently in school.

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Using the formula above, a percentage increase in teacher competency can be calculated. The final value is the evaluation value 1 month after the activity. While the initial value is the pretest value before the activity is carried out. It is expected from the results of these calculations, described the percentage increase in teacher competence, especially in the use of microcontrollers. The percentage increase can be seen in Table 3.

Table 3 Percentage of Teacher Competency Improvement

No	Name	PreTest	1 Month Evaluation	% Increase
1	Participant 1	52,5	77	31,82
2	Participant 2	67,5	80	15,63
3	Participant 3	65	80	18,75
4	Participant 4	65	77,5	16,13
5	Participant 5	60	80	25,00
6	Participant 6	57,5	80	28,13
7	Participant 7	70	85	17,65
8	Participant 8	75	95	21,05
9	Participant 9	60	87,5	31,43
10	Participant 10	55	75	26,67
11	Participant 11	52,5	75	30,00
12	Participant 12	65	85	23,53
13	Participant 13	62,5	90	30,56
14	Participant 14	65	85	23,53
15	Participant 15	70	95	26,32
Average Increase				24,41

Based on the table a significant increase in participant 1 where there was an increase in competence of 31.82%. The ncrease with the smallest percentage in participant 2 is 15.63%. The average increase in teacher competency in these service activities is 24.41%. For more details, you can see the curve in Figure 8.

Figure 7 Percentage of Teacher Competency Improvement

IV. CONCLUSION

The conclusion that can be drawn is that the provision of Trainer Arduino training is considered successful in increasing the competency of SMK Multimekanik Pekanbaru teachers. The percentage increase in teacher competence was 24.41%. Trainer Arduino training can upgrade teacher competencies in preparing for the Industrial Revolution V 4.0. Good training can improve teacher competence optimally when compared to independent learning teachers.

Suggestions that can be taken from this study are to provide regular training to teachers as much as possible. With good and structured training according to the needs of the times, it can improve teacher pedagogical competence.

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