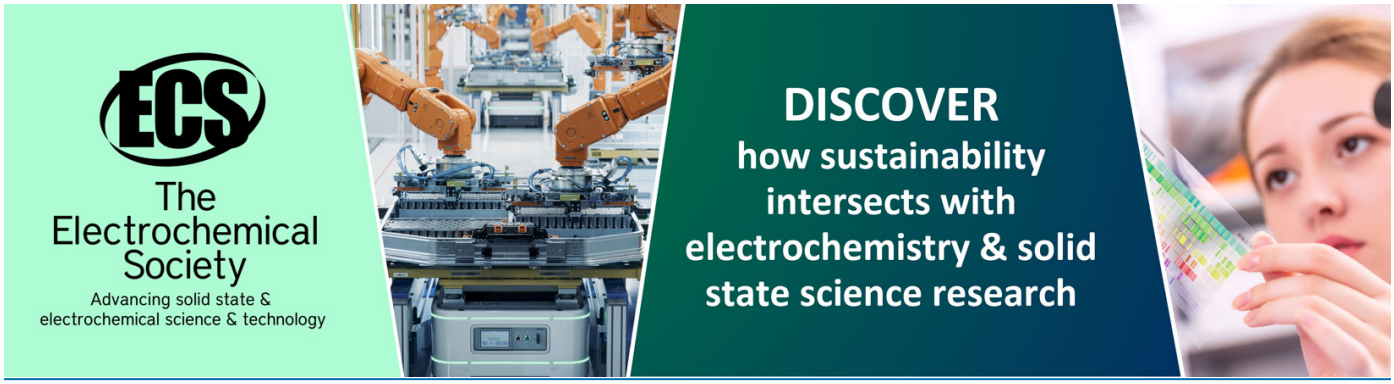
Transition of Learning Physics Technology Using Virtual Practicum to High School Physics Teachers in Aceh Barat District



Transition of Learning Physics Technology Using Virtual Practicum to High School Physics Teachers in Aceh Barat District

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Abstract. Practicum is one of the essential learning aspects of physics learning that is required in the 2013 curriculum. The problem of High School Physics teachers in West Aceh Regency is the limited facilities and infrastructure for the Physics laboratory. The development of Information Technology (IT) enables the Virtual Laboratory of Physics is implemented using a smartphone device. Technology transfer using IT in learning is carried out for High School Physics teachers in the West Aceh district. The method used is physics training using virtual experiments. The training participants are all High School Physics teachers in West Aceh District. The aim of the activity is to train physics teachers' ability of IT which can be applied in learning activities at High Schools in the West Aceh district. The results of the activity were that 100% of the participants could master IT technology using a Smart Phone for a virtual practicum on Wave material. Therefore, they feel that there is an increase in their pedagogical ability in carrying out their duties and the optimists can apply this in the learning process in their place of duty. 75% of trainee teachers believe that the application of virtual practicum methods in learning can improve students' understanding of physics subject matter; 12.5% of participants were not sure and 6.25% of participants were not sure that learning Physics using the virtual experiment method could improve students' understanding. The benefits of the activity are expected to increase the human resources of High School Physics teachers in West Aceh district in utilizing the Virtual Laboratory so that it supports the physics learning process using practicum methods and online learning.

1. Introduction

Physics is a natural science that studies the interactions between matter and energy. The concept of science is obtained through experiments and empirical conceptual approaches. Understanding the material will be easier if the material is obtained through practicum [1] because the learning process through practicum is proven to improve science process skills [2] which directly affects the improvement of student physics learning outcomes [3]. Through the practicum, students can learn actively by directly practicing the material they are learning so that students can more easily understand the Physics learning material being taught [4].

Learning Physics by applying the scientific approach where the experimental method is one of the learning processes that must be carried out in every school refers to the 2013 curriculum [5]. However, the physics laboratory facilities and infrastructure actually needed for experimental activities are very limited in West Aceh District. There are even high schools that do not have laboratory facilities yet, due to the damage that occurred during the 2004 Tsunami and which have not been repaired [6]. As a result, physics learning is generally carried out using the conventional method (one-way learning). This situation is one of the factors causing the low quality of education in Aceh because several studies have found that

the implementation of the conventional method in learning has lower results compared to other learning methods [7,8,9,10].

The virtual laboratory model is a solution that can be applied to overcome the limitations and unpreparedness of physics laboratory facilities in Aceh [11,12]. By utilizing this model, experimental learning methods can be carried out by utilizing technology that is rapidly developing today [13]. In the current industrial era 4.0, many Physics virtual laboratory applications are available on the Google Play Store to support practicum in learning. Therefore, current physics teachers need to have teaching skills using a virtual laboratory model, so that physics learning using experimental methods can be carried out, even though real laboratory facilities and infrastructure are limited.

Based on preliminary information obtained from the head of the Physics Teachers Association (MGMP of Physics) in West Aceh district, the description of the situation for learning Physics in West Aceh Regency includes:

a. Physics teachers in high school are still lacking skills in using physics laboratory equipment.
b. Conventional learning methods are still widely applied in the physics teaching and learning process
c. Lack of equipment in the laboratory.
d. The physical condition of the laboratory space is inadequate.

Therefore, the transfer of learning technology using virtual laboratory learning methods is very appropriate to be carried out immediately in the district.

Transfer of learning technology using the virtual laboratory method for high school physics teachers in West Aceh district is carried out with the aim of training mastery of IT which can be applied in learning activities at high schools in West Aceh district. The benefits of the activity are expected to increase the human resources of Physics High School teachers in West Aceh district in the use of virtual laboratories, thus supporting the Physics learning process using practicum and learning methods. In the long term, it is expected that it can improve the quality of school graduates who can compete with other regions.

2. Method

This activity used a training method in which physics teachers at high schools in the West Aceh district are trained directly with the supporting devices (learning tools) that have been prepared (Figure 1). The number of participants was 16 people, consisting of physics teachers from public and private high schools in the West Aceh district (Table 2). The location of the activity was carried out at the MGMP office of West Aceh district, Meulaboh in 2019.

The subject chosen in this activity is the Physics Learning of Wave material using virtual laboratory experimental methods. This material is one of the subjects that are abstract in nature and there are no practical equipment facilities in Senior High School in West Aceh district, so it needs to be visualized in the form of a virtual laboratory [13]. After mastering this subject, it is expected that teachers can train independently on other subjects. Activities are carried out using the inquiry learning model. Teachers are directed to be able to use the application in learning. The implementation of activities is equipped with modules, worksheets, and evaluation instruments. The activity stages are carried out as follows:

1. Introducing the application that available on Smart Phone devices and downloading it on the google play store
2. After the teachers can run the application, the activity continues to use it in the physics learning process by using an experimental method using a virtual laboratory.
3. Carry out the experiment according to the instructions on the worksheets.
4. Analyze data and make conclusions.
5. Evaluation of activities

As illustrated in the flow chart below:

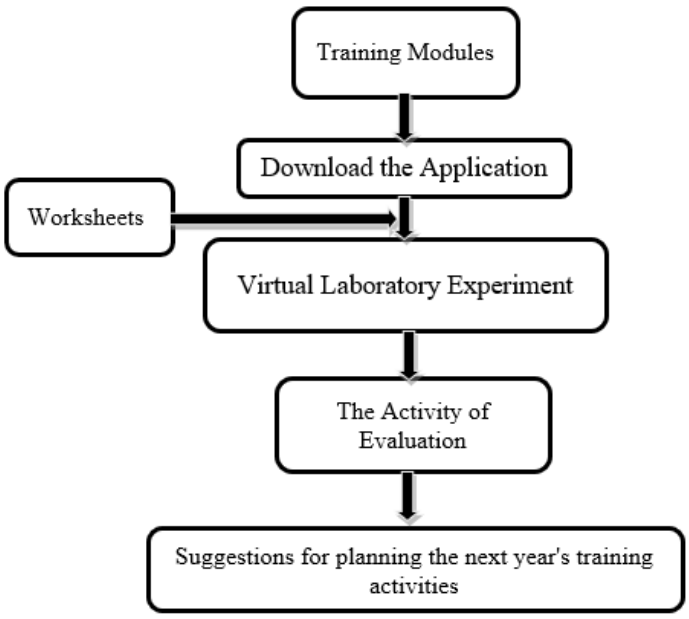

Figure 1. The Stages of Training Activity

The evaluation of training is carried out to determine the ability to absorb training material from the participants. The data were obtained by a questionnaire. The calculation of the participant's answer score is done using equation [14]:

$$P = \frac{\text{the total score of each question}}{\text{maximum score}} \text{ x } 100\ \%$$

The results of the questionnaire analysis were interpreted qualitatively using the criteria in Table 1.

Table 1. Criteria of Training Activity Result

No.	Percentage (%)	Criteria
1	86-100	Very good
2	76-85	Good
3	60-75	Enough
4	55-59	Less
5	≤54	Very Less

3. Result and Discussion

The transfer of technology using Smartphone devices in physics learning with the virtual laboratory experimental method was attended by 16 Physics teachers in high school, West Aceh district (Table 2). The results of the activity will be presented in the following description:

Table 2. Senior High School Physics teachers in West Aceh district and their professional qualifications who participated in the training activities.

No	School Name	Teacher's Name	Gender	Degree	Graduated
1.	SMA Negeri 1 Meulaboh	Suhartatik	Female	Bachelor	UNY
2.	SMA Negeri 2 Meulaboh	Srimisbah, S. Pd	Female	Bachelor	FKIP Fisika Unsyiah
3.	SMA Negeri 3 Meulaboh	Dra. Zuraidah, M. Pd	Female	Master	FKIP Fisika Unsyiah/ PPs Unsyiah
4.	SMA Negeri 3 Meulaboh	Lismawati, S. Pd	Female	Bachelor	FKIP Fisika Unsyiah
5.	SMA Negeri 3 Meulaboh	Safrida, S. Pdi	Female	Bachelor	Tarbiyah PMIPA UIN
6.	SMA Negeri 1 Meureubo	Yulianty, S. Pd	Female	Bachelor	FKIP Fisika Serambi Mekkah
7.	SMA Negeri 1 Meureubo	Eka Ratna Jaya, S. Pd	Female	Bachelor	FKIP Fisika Unsyiah
8.	SMA Negeri 1 Meureubo	Rosmanidar, S. Pd	Female	Bachelor	FKIP Fisika Unsyiah
9.	SMA Muhammaddiah 6 Meulaboh	Nurmalahayati, S. Pd	Female	Bachelor	FKIP Fisika Unimed
10.	SMA Negeri 1 Arongan Lambalek	Roudiatur Rahmi, S. Pd	Female	Bachelor	FKIP Fisika Unsyiah
11.	SMA Negeri 1 Samatiga	Dedek Juliana, S. Pd	Female	Bachelor	FKIP Fisika Unsyiah
12.	SMK 1 Setia Bakti	Maisarah, S. Pd	Female	Bachelor	FKIP Fisika Unsyiah
13.	SMK Negeri 2 Meulaboh, Lapang	Cut Fonny Nazira, S. Pd	Female	Bachelor	FKIP Fisika Unsyiah
14.	SMK Negeri 2 Meulaboh, Lapang	Erlita	Female	Bachelor	FKIP Fisika Unsyiah
15.	SMK Negeri 4 Meulaboh; Suak Sigadeng	Nasriyetie N	Female	Bachelor	MIPA Fisika
16.	SMA Negeri 2 Kaway XVI; Pasie Kumbang	Agustia Warni, S. Pd. I	Female	Bachelor	Tarbiyah PMIPA UIN

3.1 Responses of the Training Participant to the Instructors' abilities and services.

The participants' responses to the services provided by the instructor in the implementation of the training are summarized in Table 3. All the participants (100%) felt the services and guidance provided by the instructors were very good. The ability of instructors to provide good explanations is due to their relatively long experience in learning. They are senior lecturers in the Department of Physics Education,

FKIP Unsyiah. Preparation in the form of modules and worksheets are also arranged in a simple, so as to help understanding of the material for participants. Participants' questions during the discussion were also responded to well. This situation caused the training participants to feel satisfied with the instructor's guidance and services in carrying out activities.

Table 3. Responses of the Training Participant to the Instructors' abilities and services.

No	Statements	Yes	Uncertain	No	Criteria
1	The guidance provided by the instructor is easy to understand	16	0	0	Excellent
2	Tutors provide sufficient time for discussion and question and answer	16	0	0	Excellent
3	The material provided by the tutor during the training is easy to understand	16	0	0	Excellent
4	The way the tutor listens, responds, and explains answers so that it can facilitate and understand the training content	16	0	0	Excellent

3.2 The Effect of Community Service on the Improvement of Teachers' Pedagogical Ability and understanding of the subject

The implementation of the training provided is expected to provide additional knowledge and skills of physics subject teachers at Senior High School in West Aceh district in mastering IT technology, especially the application that available on smartphone devices. The results of the evaluation using a questionnaire are summarized in Table 4.

Table 4. The absorption of learning skills using the virtual experimental method by Physics teachers at Senior High School in West Aceh District

No	Statement	Yes	Uncertain	No	Criteria
1	In your opinion, were the preparations for this training activity well prepared by the implementer?	16	0	0	Excellent
2	Can you participate in this training smoothly?	15	1	0	Very Smoothly
3	Was this training activity useful and added to your skills?	16	0	0	Very Useful
4	Can you apply physics lessons using virtual experimental methods obtained from this training in the implementation of tasks and improve your pedagogical abilities?	16	0	0	Very Confident
5	Are you sure that learning Physics material that you will implement with the virtual laboratory experimental method can facilitate understanding of Physics material?	12	2	1	Very Confident

Based on the questionnaire answers from the participants, it was found that all participants (100%) stated that the training activities carried out were well prepared. Therefore, almost all participants (93.75%) were able to attend the training smoothly. The remaining 1 participant or 6.25% of the participants experienced problems. Based on observations during the implementation of activities, the

teacher is not familiar with using a smartphone device with the Android operating system. Communication activities carried out so far use old mobile devices with the Symbian operating system. The instructor pays special attention to the teacher. In addition, other participating teachers who nearby also gave directions. At the end of the implementation of activities, the participant teachers who experience problems with the initial activities can follow the instructions given by the instructor.

The materials obtained during the training add to their skills stated by 100% of the participants. Teachers gain additional knowledge and skills, especially related to the use of smartphones in learning physics. They have not previously obtained this information, so they feel a significant additional knowledge. They believe that the skills acquired in this training can be applied in the classroom where they work, so as to improve their pedagogical skills. The use of Smartphone devices as learning media is not an obstacle. In general, students already have and are used to using it [15]. The positive effect that may be obtained is to increase the usefulness and function of the tool in catch-up activities.

The perceptions of the participants on the effect of teaching physics using virtual laboratory experimental methods in making it easier for students to understand physics subject. 75% of participating teachers are optimistic that using the virtual experimental method has an effect on facilitating students' understanding of the material. The reason given by the optimistic participating teachers was that virtual experiments can clarify/detail the stages of natural phenomena being taught so as to improve students' critical thinking skills [16]. The appearance of virtual laboratory animations is quite interesting so that can increase students' interest in learning and creative thinking skills [17]. In addition, this application in virtual experimental learning is something new for senior high school students in the West Aceh district. Thus the learning process becomes more interactive and interesting [18].

12.5% of participants stated that only part of the students could improve their understanding. One training participant teacher (6.25%) had another opinion; the use of virtual laboratories in physics learning is not able to improve students' understanding of the subject matter. The teachers argued that students' understanding of physics subject matter apart from being influenced by external factors (in this case learning methods and media) was also influenced by internal factors, namely students' intellectual abilities, and the way students processed or digest physics material in their minds [19].

3.3 Perception of the Training Participants' Physics Teachers on Other Physics Subjects.

All teachers participating in the training (100%) stated that learning with the practicum method using a virtual laboratory could be developed for other physics subject matter (Table 5). They argue that abstract matter exists in almost all subjects of physics. Based on the information obtained in the discussion activities, the training participants argued that the animations shown in the virtual video help to detail the processes of natural phenomena that are difficult to explain using the lecture method. The visuals displayed to motivate students to keep learning so that it helps students develop their imagination to understand concepts [20]. Thus, students will absorb more material.

Table 5. Perception of the Training Participants' Physics Teachers on Other Physics Subjects.

No	Statements	Yes	Uncertain	No	Criteria
Which physics materials can be developed using virtual laboratory methods?					
1	Basic concepts of mechanics, both related to kinematics and dynamics	16	0	0	Really can
2	Magnetic electricity concepts (related to static, dynamic, electric circuits, etc)	16	0	0	Really can
3	Advanced physics concepts (relativity, photoelectric effect, atomic spectrum, atomic model, etc)	16	0	0	Really can
4	Physics materials that require practicum activities in the laboratory	16	0	0	Really can

Based on the data above, all participants believed that many other physics materials could be developed using this virtual experimental method. After this training activity, it is hoped that the participants can develop learning using this virtual laboratory independently and be implemented in their respective schools.

4. Conclusion

The transfer of physics learning technology using the experimental virtual laboratory method for physics teachers at senior high school in West Aceh district can be controlled by 100% of the participants. This activity gave the effect of increasing pedagogic abilities stated by 100% of participants. 100% of participants believe they are able to apply the skills gained from training in learning in the schools where they work. 75% of the training participants believed that the application of the virtual practicum method in learning Physics was able to improve students' understanding of physics subject matter. 12.5% of the participants were not completely convinced and 6.25% stated that they were not sure that the application of teaching physics using the virtual laboratory method could improve students' understanding of the material. They assume that the understanding of learning material is not only influenced by method factors but also by other external and external factors. 100% of participants are optimistic that the learning method obtained from the training can be developed for all other physics subject matter. All the participants are satisfied with the services provided by the service team and expect to carry out similar activities for other physics subjects.

Acknowledgement

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