Need analysis for the development of mobile virtual laboratory in junior high school for electricity and magnetics topics

Rani Oktavia*, Rahmah Evita Putri and Khairil Arif

Department of Science, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, Jl. Prof Hamka, Padang 25131, Indonesia

*oktanivia2034@fmipa.unp.ac.id

Abstract. Science is compulsory subject at the junior high school level. Mastery of science material by students is highly prioritized so that students have the skills to solve daily problems related to science. One of the ways to develop this skill is by doing practical work. Electricity and magnetism are science subject matter that students should follow in the form of practical work because this material has a lot to do with problems in everyday life. However, the limited duration of learning time at school makes some science subject matter that should be studied in the form of practical work cannot be implemented. This happens because of the large amount of material that must be taught in accordance with the demands of the curriculum. Other factors that lead to not carrying out practical work are incomplete science laboratory facilities, inadequate teacher experience, and conditions that do not allow learning to occur directly in schools. The Mobile Virtual Laboratory is a virtual laboratory that can be accessed by students via an Android-based mobile phone so that students can learn practical work anywhere and anytime. This article describes an analysis of the needs of the Mobile Virtual Laboratory in teaching science in junior high schools for electricity and magnetism.

1. Introduction

As a form of science, science or natural science is formed from the interrelation between attitudes and scientific processes, the investigation of natural phenomena, and scientific products [1]. Permendiknas no. 22 [2] concerning Competency Standards and Basic Competencies of the Education Unit Level Curriculum, explaining that science is related to how to understand nature systematically, so that science is not only limited to mastering a collection of knowledge (scientific products) in the form of facts, concepts, or principles alone, but more as a process of discovery. The science learning process should emphasize providing direct experience to develop competence in exploring and understanding nature scientifically. To provide direct experience to students, practical activities are needed in science learning. Practical work is a learning activity that aims to give students the opportunity to test and apply theories using laboratory facilities or outside the laboratory.

Wollnough and Allsop [3] suggest four reasons for the importance of practical work in science learning, namely 1) practical work can generate motivation in science learning; 2) Practical work develops basic skills to do experiments; 3) practical work becomes a vehicle for learning a scientific approach, and 4) practical work supports learning material. Given the importance of practical work activities in science learning, practical work activities should be carried out to support the achievement
of student competencies. However, several conditions in the field caused practical work activities not to be carried out as they should. One of the main obstacles to not carrying out practical work activities in schools is the lack of laboratory facilities [4]. In addition, based on the results of a survey of researchers at the UNP Laboratory Construction Junior High School, practical work activities are often constrained due to the lack of skills of teachers in carrying out practical work, especially for learning materials that do not match the educational background of the teacher concerned, and insufficient time available to carry out laboratory activities in schools. Other special conditions, such as a pandemic that does not allow direct learning to occur, are also an obstacle in carrying out practical work in the laboratory.

The virtual laboratory is one solution for teachers who have problems carrying out practical work in science learning. A virtual laboratory is defined as an interactive environment for creating and conducting simulation experiments [5]. It is hoped that with the virtual laboratory students will have the opportunity to take part in practical work wherever and whenever without having to go to the laboratory.

This article describes a needs analysis for the development of a mobile virtual laboratory in science learning in junior high schools, especially on the topic of electricity and magnetism. The needs analysis includes curriculum analysis and student analysis. The aims of this research was to see the need for mobile virtual laboratory development to be effective with student’s conditions and curriculum needs.

2. Research Method
This research is a type of qualitative research. Qualitative research is a research procedure that produces descriptive data in the form of written or spoken words from people and observed behavior [6]. Sugiyono (2014) states that qualitative research is used to examine natural conditions [7]. This research approach uses a descriptive approach to analyze the curriculum and students' circumstances. Sources of data in this study consist of primary data sources and secondary data sources. Primary data is data obtained or collected directly in the field by people conducting research, while secondary data is data obtained or collected by people who conduct research from existing sources [8]. The primary data source in this study was the science teacher at the SMP Pembangunan Laboratorium UNP. Sources of secondary data in this study are observational data on the implementation of learning which includes basic competences mapping, syllabus preparation, and documents used in teaching materials.

The research procedure is described in the following chart:

![Figure 1. Research Procedure](chart)

Data collection was carried out using interview and observation techniques. Data analysis refers to the qualitative analysis stated by Miles and Huberman. The stages used in data analysis are: data reduction, data display, conclusion, and verifying[9].

3. Result and Discussion

3.1. Curriculum Analysis
Based on the syllabus excerpt above, it can be seen that for the material of static electricity, dynamic electricity, and magnetism practical work activities are needed to support the achievement of student competencies. This can be seen from Basic Competencies 4.4, 4.5, and 4.6. In Basic Competency 4.4 students are required to be able to observe symptoms of static electricity in everyday life. Symptoms include the phenomenon of lightning, a plastic ruler that can pick up pieces of paper after rubbing it into your hands, or the phenomenon of small shocks to the television just after turning it off.

For this Basic Competency, practical work activities in the laboratory or just a small simulation in the classroom are needed. In special conditions that do not allow face-to-face learning in this competency class it can still be achieved with small experiments by students without the need for laboratory equipment.

At competency 4.5 students are expected to be able to present the results of designs and measurements of various electrical circuits. Practical activities that make it possible to achieve this competence are making electrical circuits and using electric measuring devices (ammeters and voltmeters). This activity requires teachers to hold practical work in the laboratory because it requires...
electrical components. Not carrying out this practical work can result in students not understanding the basic skills in electricity that will later be needed at the high school level. In addition, if this practical work is not carried out, theory learning becomes less meaningful because students do not understand directly about electric circuits and how to use electric measuring instruments so that the students consider the Han theory as memorization material. Another consequence that might arise if this electrical circuit practical work is not carried out is the assumption of students that learning science is a difficult subject that will be increasingly difficult to eliminate. Furthermore, students will be less enthusiastic in learning so that it will have an impact on students’ low test scores.

At competency 4.6 students are expected to be able to make simple works that take advantage of the properties of electromagnetic induction. To be able to make this simple work, students must first have the skills to make magnets. This skill of making magnets can be done in the laboratory with several techniques.

The curriculum analysis that has been carried out is intended to get an idea of the importance of developing a virtual laboratory to facilitate students to keep getting practical work experience even with various limitations. On the topic of electricity and magnetism, it can be seen that if the practical work is not carried out then: 1) The expected competencies of competencies 4.5 and 4.6 are not achieved; 2) The students’ mindset was formed that science is a difficult subject because it only deals with concepts and calculations; 3) The low score of students due to the mindset of students who think science is a difficult subject; 4) Students lose enthusiasm in learning because they do not know the benefits of the knowledge they are learning.

3.2. Student analysis
Student analysis was carried out to see the condition of students in science learning. Based on observations made in the field, it was found that students were less enthusiastic in learning science if it was not accompanied by practical work activities. Students consider science learning which only discusses concepts and calculations is a tedious activity. In addition, the science subject becomes heavy because it only deals with formulas and numbers. Based on interviews conducted at school before the Covid-19 pandemic, students sometimes did not understand what they were learning. Students do not know what is the use of them learning a concept so that the learning that is carried out becomes less meaningful. Meaningful learning is learning with clear objectives, learning that allows the people involved to do more meaning to the world around them, learning about things that are more realistic which is marked by more active, constructive, deliberate, authentic and cooperative learning. Meaningful learning occurs when students can relate the concepts they learn to facts in the field.

There are four reasons about the importance of practical learning, one of which is that practical learning generates learning motivation, so students who are motivated to learn will be serious in learning something[12]. In addition, practical activities can support the subject matter by providing opportunities for students to find and prove theories.

Based on observational data conducted at the SMP Pembangunan Laboratorium UNP and the results of interviews with science teachers, practical work on electricity and magnetism is rarely done. This is due to several things, including the short duration of learning available at schools, the lack of competence of teachers in managing practical work, especially if the science teacher's educational background in schools is not suitable with electricity and magnetism. This did not only happen at that school, but also happened in several other schools in Padang City. If this is allowed to continue, it is certainly not good for the quality of science learning in schools.

In addition to several causes of obstruction of practical work activities in schools, today the Covid-19 pandemic has made learning in schools impossible. With forced conditions learning activities must be carried out online. This results in practical work activities increasingly impossible to carry out.

Based on curriculum analysis and student analysis, the virtual laboratory is considered very appropriate to be a solution for not carrying out science practical work activities in schools, especially on the topic of electricity and magnetism. There are several benefits that can be obtained by having a virtual laboratory, including reducing time constraints, reducing geographic problems, increasing the
quality of experiments, and increasing the effectiveness of learning[13]. In addition, it is hoped that with a virtual laboratory students will have the opportunity to do practical work either through or without internet access so that these students do not need to attend to take part in practical work in the laboratory[14].

The virtual laboratory developed can be designed to resemble practical work activities in the laboratory so that it can help students achieve the expected competencies. For the topic of electricity and magnetism, the virtual laboratory being developed is expected to represent direct practicum activities to achieve competences 4.5 and 4.6. Practical work about electrical circuits, using electric measuring instruments and how to process experimental data is an overview of dynamic electricity practice. As for the topic of magnetism, a virtual laboratory that shows how to make magnets can be designed.

4. Conclusion

Based on the curriculum analysis and student analysis carried out, a virtual laboratory needs to be developed as a solution to the problem of not carrying out practicum activities in schools, especially during the Covid-19 pandemic. The virtual laboratory is expected to be a solution so that science learning becomes more effective in achieving the competencies specified in the curriculum even though learning is not carried out directly in schools.

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