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The EMF Induction Experiment Set Trial for High School Students Productive Performance Skill

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ABSTRACT

The aim of this work is to test the instrument box integrated with emf induction experiment set to emerge productive performance skills of students. The emf induction experiment set is used to show the emergence of magnetic field around the wire carrying electrical current and also shows the emergence of the induced current caused by magnetic flux changes. The emf induction applications in everyday life are found in the galvanometer, multimeters, an electric motor and a bicycle dynamo. The induction test using emf set showed that for the similar frequency and amplitude, the closer the distance among the coils of audio frequency signal generator (AFG), the loader sound produced by the speaker, and vice versa. As conclusion the emf induction experiment set can be used in physics learning process to grow the productive skills of high school students.

Key Word: experiment set, emf induction, productive skills of students

INTRODUCTION

The challenge for every institution is prepare students in globalization to earn a decent living through a learning process meaningful provide useful experience. Improved knowledge, skills, attitude change, behavioral, skilled performance is needed to improve the productivity of each generation.

Common issues in physics teaching in senior high school is how the right way to convey the concept of physics so that the student can use the concept as inspiration to solve problems in everyday life. How does the student have communication capabilities. How do students have the mindset of a creative, innovative and productive. Based on the interview to physics teachers senior high school, problems in learning physics tend to be familiar with the provision of information, procedures use sophisticated laboratory, text book oriented, less relevant in everyday life, it is difficult raises students' creativity, understanding of the material is low and the skills students less developed.

Learning for experience is expected to inspire students in problems solving. Physics content covers a wide range of concepts, principles and laws affect the mindset of students in problems solving. Characteristics of the physics content requires students to always foster an attitude of curiosity and open to the scientific arguments and habits of thought analysis. The ability of students for finishing a scientific activity through the correct procedures and effectively requires creativity.

The use of experiment set in learning as a tool to increase the ability and skills. The learning process is characterized by several factors, such as the objectives, materials, methods, tools and evaluation. Ways and techniques to present teaching materials and learning objectives require methods and tools so that students can understand the teaching materials more easily and applicable.

The EMF Induction Experiment Set demonstrated experimentally Lorentz who discovered the phenomenon of the existence of other quantities that appear when an electric current is passed through the magnetic field is the magnetic force. Electronic equipment and lab instrument that is pretty much use this Lorentz concept among others galvanometer, multimeters and an electric motor. Furthermore, Faraday hypothesized that electrical current can be induced by a changing magnetic field in an area. The concept was applied to the bicycle dynamo. Faraday showed that the electromotive force is the force created at the ends of a conductor or a coil is proportional to the rate of change of magnetism flux surrounded by a conductive loop or coil. Electromotive force in a coil is equal to the speed of change in flux through the circuit. Electromotive force arising will cause the current fight against the causes of electromotive force itself. This law is the law of Lenz reduced from the law of conservation of energy.

Skills productive performance is a collaboration between science process skills, critical thinking skills, skills of scientific work and independence. Indicators of productive skills in this study consisted of designing the experiment, stringing tool, make observations, take the data, data analysis and raise the idea of inspiration.

METHODS

This study was carried out following the design of research and development include preliminary studies, design, development, validation and testing programs (Gall & Borg, 2003) as shown in Figure 1.

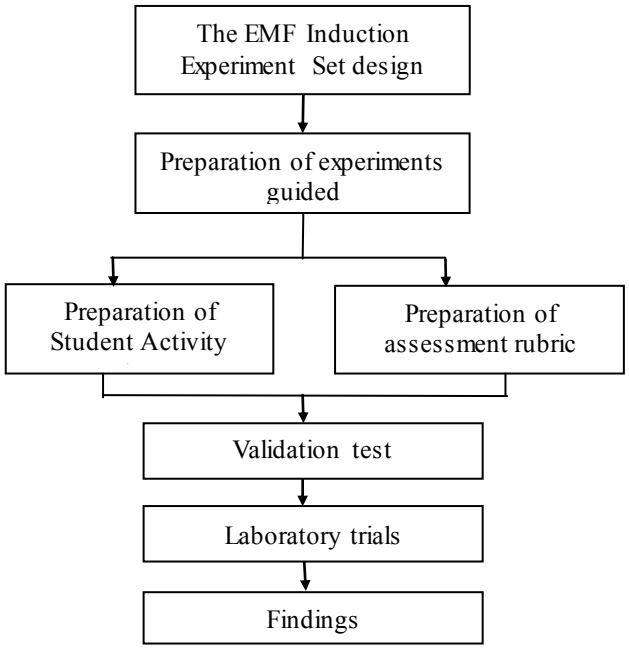

Figure 1. Research procedure

Methods of pre-experimental design with one group pretest-posttest design used in this study (Fraenkel & Wallen, 2007) as in Table 1.

Table 1. One group pretest posttest design

Group	***Pretest***	***Treatment***	***Posttest***
Experiment group	O_1	X	O_2

Description:
O_1 : pretest
O_2 : posttest
X : The use of the EMF induction experiment set

Pretest obtained from the performance evaluation The EMF Induction lab manual. Treatment is given through practical activities using the EMF Induction Experiment Set charged productive performance skills. Posttest obtained from the lab performance appraisal using The EMF Induction Experiment Set. The research instrument uses observation of productive performance sheets and validation expert sheets.

Data of observation and data analysis contained in the student activity sheet is used to determine the accuracy of the EMF induction experiment Set to be used as a practical tool. Observation sheet used to measure the performance of the productive skills of students and the ability to explore for inspiration. Validation sheet is used to know the expert recommendations regarding the feasibility of the EMF Induction Experiment Set for use in the process of physics teaching.

Expert validation results were analyzed based on the percentage of each indicator statements and recommendations. Quantitative data about the performance of the productive skills of students were analyzed by calculating the normalized gain (Hake, 1998). Data observation and analysis of the data were analyzed based on the findings of the data on lab activities The EMF Induction Experiment Set. Student learning outcomes were analyzed using normalized gain test, namely:

$$\langle g \rangle = \frac{\langle \%S_f - \%S_i \rangle}{\langle 100 - \%S_f \rangle}$$

(Hake, 1998)

Description:
$\langle g \rangle$: gain normalized
$\langle S_f \rangle$: the average score *posttest*
$\langle S_i \rangle$: the average score *pretest*

Great value of gain normalized <g> categorized as follows:
$\langle g \rangle \geq 0{,}7$ = high
$0{,}7 > \langle g \rangle \geq 0{,}3$ = middle
$\langle g \rangle \leq 0{,}3$ = low

RESULT AND EXPLANATION

Results of laboratory scale tests on the use of The EMF Induction Experiment Set using the speaker shown in Table 1.

On the frequency, amplitude and the same range, the closer coil speaker AFG and the harder sound produced by the speakers. Conversely the farther distance AFG coil and coil speaker, the weaker the sound is generated. Results of laboratory scale tests on the use of Induction EMF experiment set the use of LED are shown in Table 2.

When using the LED as an indicator, the closer the coil AFG and LED then the LED will flash. Conversely the farther distance AFG coil and LED then the LED will be extinguished. The more coils at AFG at close range LED goes out. Based on the results of this

trial, the media expert recommends that the EMF induction experiment set can be used as a practical tool for the concept of electromotive force. The research instrument used was a test and observation sheet. Results pretest, posttest and gain normalized shown in Table 3.

Table 1. The EMF Induction Experiment Set using Speaker

No.	Coil		Distance (cm)	Sound Loud/Weak
	AFG	Speaker		
1.	180	360	near (5cm)	loud
			far (10 cm)	weak
2.	180	540	near (5cm)	loud
			far (10 cm)	weak
3.	360	540	near (5cm)	loud
			far (10 cm)	weak
4.	360	180	near (5cm)	loud
			far (10 cm)	weak
5.	540	180	near (5cm)	loud
			far (10 cm)	weak
6.	540	360	near (5cm)	loud
			far (10 cm)	weak

Based on the description of the data analysis obtained values normalized gain of 0.53, this value includes the medium category. Improving student learning outcomes is higher after using the EMF induction experiment set. This shows that the EMF induction experiment set is provide an understanding applicable to students so that students are able to understand the concept of motion of the electric force in the conceptual theory or in procedure.

Data from the observation sheets on the skills of student performance consists of five indicators and each indicator consists of five descriptors assessment can be seen in Table 4.

Productive performance indicators adopted skills of science process skills, scientific working skills, critical thinking skills and independence. Based on observations, students are able to experiment design, make observations and raise the idea.

Table 2. The EMF Induction Experiment Set using LED

No.	Coil		Distance (cm)	On/Off
	AFG	Speaker		
1.	180	360	near (0,5 cm)	On
			far (2 cm)	Off
2.	180	540	near (1 cm)	On
			far (2 cm)	Off
3.	360	540	near (0,5 cm)	On
			far (2 cm)	Off
4.	360	180	near (0,5 cm)	Off
			far (2 cm)	On
5.	540	180	near (0,5cm)	Off
			far (2 cm)	Off
6.	540	360	near (0,5cm)	Off
			far (2 cm)	Off

Table 3. Description of Pretest, Posttest and Normalized Gain

Description of experiment group	***Pretest***	***Posttest***	***N-Gain***
The highest score	75	90	
The lowest score	35	35	
Average	45.67	74.37	0.53
Standard deviation	10.58	15.29	

Activity shown students, among others: (1) prepare tools and materials, (2) a plan of experiment, (3) identify the amount is known, (4) identify the magnitude being measured, (5) make observations in accordance with the working steps or working procedures, (6) conduct repeated observations, (7) is able to express ideas or arguments in accordance with the results. Instead, students have not been able to string instruments and analyze data. Activities that have not been shown students, among others: (1) the student has not been able to assemble the tool correctly, (2) clarify the relationship between frequency, amplitude, distance and hard or weak sound, and (3) explain the relationship between the coils, the distance and lights.

Use of the EMF induction experiment set an analogy electromotive force and other forms of practical

tools electromotive force. Conceptual understanding of students can be seen through the ability of students expressed analogy concepts of physics in everyday life (Ceroni, 2014). Learning abstract concepts like quantum physics in high school can be accepted and understood by the students using the analogy (Hastenreiter R, 2015).

Table 4 Productive Performance Observations Skills

Indicator	Average	Description
Experiment design	75	Students are able to prepare the arrange and materials, student have not been able to make observation data
Arrange instrument	65	Student able to use arrange and materials properly and student have not been able to assemble the arrange independently
Observation	78	Student able to make observations on the trial in accordance with the working steps or procedures, student capable of performing repeated experiments, and student able to identify the magnitude of the measured and the amount that will be analyze
Data analyze	60	Student has not able to data analyze correctly, yet abundance with a relationship of data with other data
Create idea	75	Student able to express ideas or arguments about the understanding of the electromotive force concept

Generally project is accepted as the most effective instructional method in increasing researching and group working skills in the literature. It thought that the use of project method more frequently during teacher training process will also enable these teacher candidates to educate students who have high team working and researching skills (Celik, Onder & Silay, 2011). The use of this induced emf lab to habitual action for makes plans, monitor their learning and make judgments about their learning, this will cause them to be inclined to meaningful learning (Gurcay, 2013).

The ability of the students to follow the learning process depends on the composite of characteristic cognitive, affective and psysiological factors that serve as relatively stable indicators of how a learner perceives, interacts and responds to the learning environment (Zajacova, 2013). The activity is performed is effective to improve the students' motivation and enables them to be active during the learning process. As a result, the laboratory activity can be used as an alternative to activities in the literature (Karsli & Ayas, 2014).

The ability to design and assemble the experimental results of performance skills in the form of group work. Teamwork is notable for its quickness and intensity that allow setting a high standard of quality and complicating further tasks (Tatyana N *et al*., 2015). However, this does not apply to certain concepts. Teachers mentioned that students had difficulties in the conceptual understanding of variable current, capasitors, coils, transformers and circuit elements in the electricity and electronic unit. The challenges that were experienced in general stemmed from various factors such as students lack of knowledge in terms of concepts, excistence of misconceptions, difficulties in comprehending abstract concepts, deficiencies in mathematical operations and insufficiency of time allocated to the course leading to incomplete teaching tasks (Aykutlu, *et al.,* 2015). The use of group learning and the EMF induction experiment set have helped to significantly improve the retention and knowledge of teachers learning physics (Chetty, 2015).

The use of experiment set usage examples for students to use the correct procedure. The demonstration experiment is a means of visibility, the organizations promotes students' perception of material, understanding memory, implementation of creative activity of students, helps increase interest in the study of physics and the creation of learning motivation (Massyrova *et al*., 2015). For student helps him to determine what is important, suggest him some scheme, he can follow on his own experiment (analogy) and it is way how he realise what he does not know, what he needs to improve (Hodosyova *et al*., 2015). Concepts of physics should be supported with applied activities. It is essential that physics should direct students' thoughts usefully by showing and how the rules and concepts of physics are used with the help of design objects (Zadeh & Setir, 2015).

CONCLUSION

Use of the EMF induction experiment set to inspire students have productive skills in everyday life. Based on the results of laboratory scale tests that the frequency, amplitude and the same range, the closer coil speaker AFG and the harder sound produced by the speakers. Conversely the farther distance AFG coil and coil speaker, the weaker the sound is generated. When using the LED as an indicator, the closer coil AFG and LED then the LED will flash. Conversely the farther distance AFG coil and LED then the LED will be extinguished. The more coils at AFG at close range LED goes out. Based on the results of this trial, the media

expert recommends that the EMF induction experiment set can be used as a practical tool for the concept of electromotive force. Based on the limited test results, student learning outcomes has increased 53% after using the EMF induction experiment set. Results observation productive performance of students indicate that students are able to do performance, especially in designing an activity or experiment, observe the trial and put forward arguments and inspiration through creative ideas in applying the concept of electromotive force.

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