

Electrical fall (EFA) as a learning media for electromagnetic induction

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Abstract. This study aims to analyze the feasibility of EFA (Electrical FALL) as a learning media in physics learning. The research method used is the development of ADDIE model which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The steps in this study are: 1) Curriculum analysis, field analysis, and library analysis; 2) Making a learning media design called EFA; 3) Realizing the design of EFA learning media; 4) Validation of experts; and 5) evaluation of research results. The results of this study indicate that the appraisal of the feasibility of EFA props by validators is 91.67%, the value of the worksheet of the students exceeds the minimum specified criteria of completeness, and the review of students who have used EFA tools is very good. The conclusions of this study are that EFA is suitable for use as a learning media. This study recommends that further research be conducted to determine the effect of EFA use on some students' skills, such as critical thinking skills, process science skills and so on.

1. Introduction

The curriculum used in schools is the 2013 curriculum. The 2013 curriculum objectives are expected to provide a balanced of cognitive aspects, affective aspects, and psychomotor aspects [1]. This curriculum is very suitable for the learning process of physics because one of the goals of Saint education is to teach students to be directly involved in acquiring scientific concepts that are carried out by means of investigation or experiment so that students can integrate skills, knowledge, and attitudes to get results expected [2]. But, several obstacles in the implementation of the 2013 curriculum, such as the limited infrastructure means that the curriculum has not been maximized. This deficiency has a direct impact on the achievement of physics learning goals because the characteristics of physics lessons one of which is interconnected between several concepts [3] there are several physical concepts that are abstract, such as the lesson of electromagnetic induction so that it requires a means to support learning.

One way to overcome this problem is that teachers make or develop their own means of supporting physics learning in the form of learning media. The use of media in the learning process, especially teaching aids, can make abstract concepts concrete [4] can visualize them [5], so that the media improve understanding of the lessons being learned. Learning like this will increase the motivation and enthusiasm of students in carrying out physics learning where the motivation of students in learning physics is still low [6] so that learning media can be used as a medium for learning other than thick books [7].

The results of observations made in several schools concluded that the learning media for electromagnetic induction needed to be developed because it could not achieve achievement indicators



in the 2013 curriculum. One of these indicators is "analyzing the factors that influence electromagnetic induction". Existing tools only show the phenomenon of electromagnetic induction. Setyo Warjanto has conducted research on the learning media of electromagnetic induction where the device has shown a variable effect on speed against the induced emf produced [8], but the use of a fan as a magnetic drive makes the value of the motion speed still qualitative. Therefore, the development of learning media on electromagnetic induction is needed.

The desired development is the development of learning media that can show the influence of several variables on induced emf such as speed and number of turns in quantitative terms. To solve this problem, researchers developed Electromagnetic Induction with Neodymium Magnets made by Wood & Sebranek [9]. Then the research was conducted to analyze the feasibility of the media developed as learning media to be used in schools.

2. Method

The type of research used is research and development using ADDIE development model which consists of 5 stages, namely: Analyze, Design, Develop, Implement, and Evaluate [10]. 1) The analyze phase contains curriculum analysis, field analysis, and literature analysis, 2) the design stage contains the design sketches from the learning media that will be developed, 3) the stage of development contains the making of the media and tests are conducted to analyze the level of feasibility as a learning medium, 4) the implementation stage contains media testing in schools that are tested directly by students, 5) the evaluation stage contains the overall evaluation at each stage to improve the developed media.

The feasibility test by expert validation is carried out by giving an assessment questionnaire containing indicators of the feasibility of physics teaching aids based on guidelines for making physics teaching aids issued by the Ministry of Education and Culture [11]. These indicators consist of seven aspects, namely: linkages with teaching materials, suitability with the intellectual development of students, equipment resilience, accuracy of tools, efficiency of tools, safety for students, and aesthetics. To get the feasibility value, the value of all items is averaged to find the overall total value and the value represented in percent form. The final value is obtained using the equation below:

$$M_x = \frac{\sum X}{N} \times 100\%$$

Note:

M_x : value in percent

$\sum X$: total value of research results

N : the maximum amount of value

[12]

The value of each validator is combined entirely and is averaged to get the value of the validation test, then converted to an assessment statement for the feasibility of the product produced based on the experts in accordance with table 1.

Table 1. Interpretation of device feasibility scores

Interval (%)	Criteria	Information
$75 < \text{skor} \leq 100$	Very good	Feasible without revision
$50 < \text{skor} \leq 75$	Good	Feasible the revision
$25 < \text{skor} \leq 50$	Pretty good	Less feasible
$0 < \text{skor} \leq 25$	Not good	Not feasible

[13]

Field testing is carried out by examining the use of EFA media by students in schools. The results of this test are analyzing the students 'understanding in each phase of the practicum seen from the value of

the students' worksheets and the reviews or responses of students regarding EFA media after they use it seen from the questionnaire responses of students.

3. Result and Discussion

Learning media that has been successfully developed is called Electrical Fall or can be shortened to EFA. The results of this media development are having several advantages over existing media. These advantages include smaller EFA media size so as to facilitate storage and use, the measuring instruments used by EFA devices are easily found in schools in Indonesia, EFA media is coated with wood coating so that it looks neater, and important development is located on the use of windings in the same amount. The development that occurred in the EFA media was in accordance with the statement of Nana Syaodih Sukmadinata [14] where the steps of research and development are carried out to develop a new product or refine an existing product.

Media EFA is used in electromagnetic induction practicum to analyze the factors that cause electromagnetic induction in Faraday's law. EFA media design that has been developed can analyze the effect of magnetic motion velocity on induced emf generated quantitatively, so that students can learn by looking directly at the phenomenon of the influence of several variables. This is in accordance with Sukarno et al [15] where learning media make students interact directly with the object being studied, especially to see the physical phenomena or the process of getting concepts. EFA tools can be seen in Figure 1.



Figure 1. *Electrical Fall (EFA)*

The feasibility test was carried out by three expert validators, namely two physics education lecturers from UIN SGD Bandung and physics teacher MAN 1 Kota Bogor. The assessment was carried out after the validators saw the use of EFA media. The results of the assessment of the three validators based on the indicators in each aspect can be seen in table 2.

Table 2. Nilai hasil uji validasi ahli

No	Validator	Persentase nilai total
1	First validator	90 %
2	Second validator	90 %
3	Third validator	95 %
Average		91,67 %

Based on table 2 which is compared with table 1, the final score of the total value of all three validators which is 91.67% has a very good predicate. The conclusions from the expert validation test stated that EFA media was suitable to be used for electromagnetic induction practicum at school. Based on aspects fulfilled by EFA media in the assessment of expert validation tests, EFA media is expected to help achieve the lesson learning indicators of electromagnetic induction especially to concretize the phenomenon of electromagnetic induction which is abstract as well as the learning media functions according to Sudjana & Rivai [16] where learning media can help to conclude the lesson of abstract electromagnetic induction.

The value of the Student Worksheets that have been done by the participants is analyzed to determine their level of understanding related to the electromagnetic induction practicum using EFA. This analysis is carried out by comparing their scores with the specified minimum completeness criteria. The minimum completeness criteria is 70. Value all groups as shown in Figure 2.

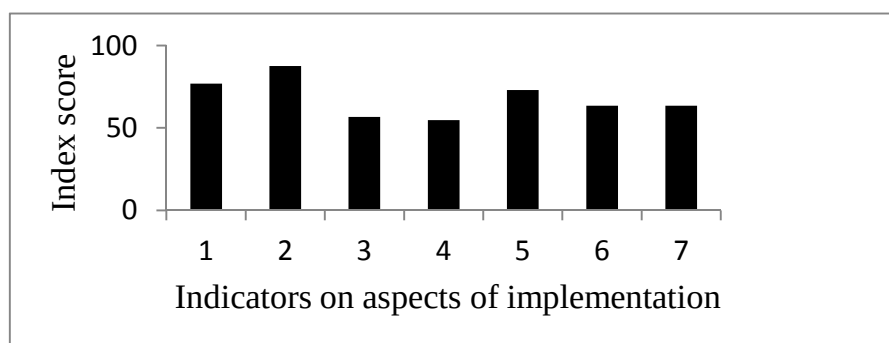


Figure 2. Graph Assessment of student worksheet

The value of all groups as in Figure 2 shows the value that exceeds the defined The minimum completeness criteria value. This is also done by Keke T. Aritonang [17] where by comparing the minimum completeness criteria and the values obtained, the success of learning according to the specified criteria can be seen. The results of the worksheets of students concluded that students understood the practicum using EFA.

The results of the student questionnaire will be discussed in each aspect of the assessment. The assessment results for each aspect are shown in Table 3. The percentage of students' questionnaire results is that the implementation aspect is 68% with good predicate, sustainability aspect is 81.3% with very good predicate and acceptance aspect is 68.75% with very good predicate. Conclusions from the results of the field trial stated that the participants' review after using EFA media was good.

Table 3. Results of questionnaire percentage of students in every aspect

Aspect	Persentase	Kategori
The implementation	68 %	Good
The sustainability	81,3 %	Very good
The acceptance	68,75 %	Good

The results of the assessment of implementation aspects stated that the average student who has used EFA agrees that EFA is easy to assemble, easy to use when practicum, the phenomenon shown by EFA is clear, the practicum guide or student worksheets are clear and easy to understand, EFA practicum does not require long time and they agreed the EFA tool accelerated their understanding of electromagnetic induction. This is like what Suryani and Agung said [18] that learning media as a tool to realize an effective teaching and learning situation and like what Emda said [19] that learning media can increase the recognition and understanding of the material being taught. Assessment of the implementation aspects of each indicator can be seen in Figure 3.

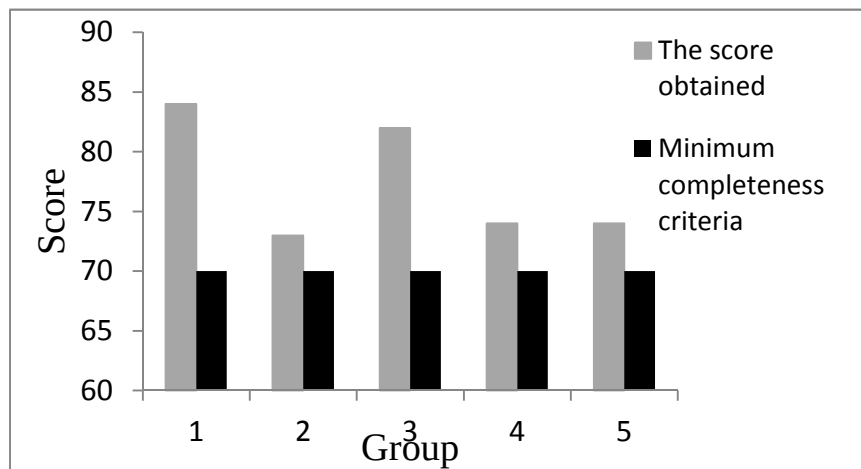


Figure 3. Graph Assessment of indicators on aspects of implementation

The results of the questionnaire on the assessment of media sustainability aspects stated that the average student agreed that AFA was easy to clean, not easily damaged, and harmless. They also agreed that this media is very important to help their understanding so that this media is recommended for use in the lesson of upcoming electromagnetic induction. Assessment of sustainability aspects in each of the indicators can be seen in Figure 4.

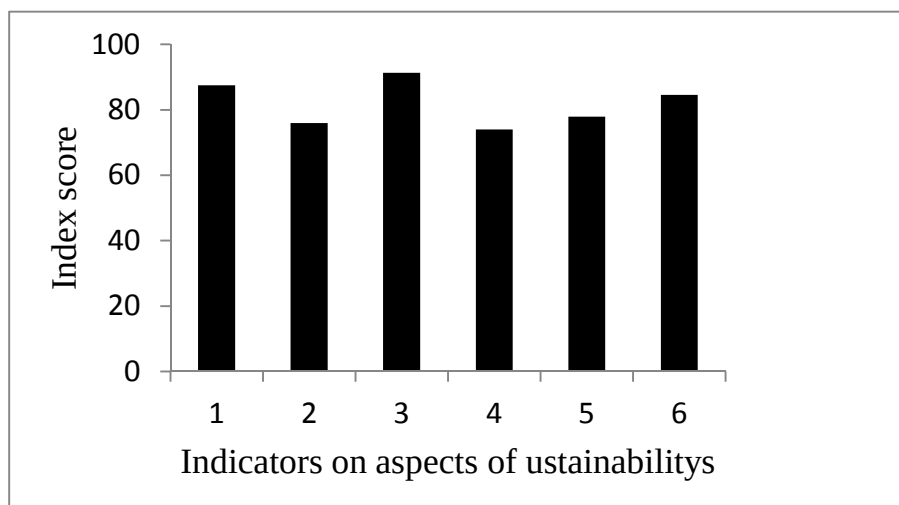


Figure 4. Graph Assessment of indicators on aspects of sustainability

The results of the questionnaire on the assessment of the acceptance and attractiveness aspects stated that the average student agreed that the color and shape of the EFA was interesting and pleasing to the eye so that good media could influence students' psychology [20]. Suryani dan Agung said [18] that one of the functions of learning media is to arouse students' motivation, this motivation can arise because of the interesting learning media that makes curious students want to try it. Learning like this is expected to help teachers and students in learning more visual, interactive, interesting, easy and fast to understand [21]. The assessment of the acceptance aspects of each indicator can be seen in Figure 5.

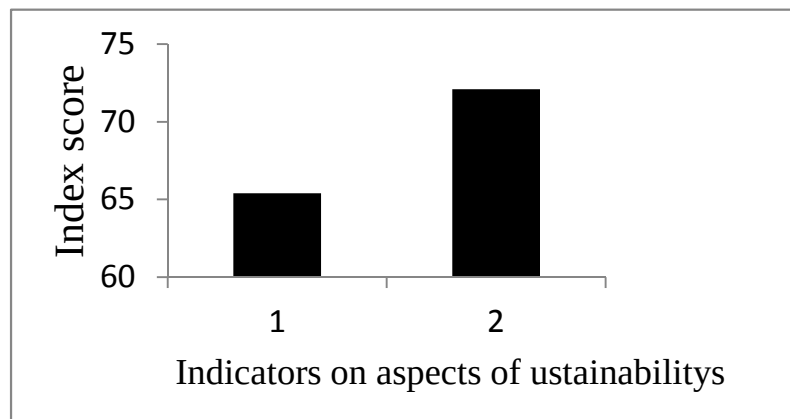


Figure 5. Graph Assessment of indicators on aspects of sustainability

4. Conclusion

The conclusion of this research is that EFA learning media is worthy of use as a learning medium for electromagnetic induction material. The use of EFA is expected to be an alternative media for schools that have difficulties in procuring media for classroom learning.

Acknowledgements

Our thanks go to the editors and reviewers in AASEC, the Research Institute of UIN Sunan Gunung Djati Indonesia and the Universitas Pendidikan Indonesia. That has facilitated the implementation of this research and publication.

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