The feasibility of electrostatic teaching material: Oriented to conceptual understanding

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Abstract. Conceptual understanding is one of the important things in physics learning. Many factors affected the conceptual understanding of students; one of them was the book. Based on the data from the implementation of a questionnaire on junior high school students, their learning resources (books, etc.) have not been able to help them understand many concepts of physics including the concepts of electrostatics. Some abstract concepts in physics make them more difficult to understand physics. This study aimed to develop electrostatic teaching material-oriented to conceptual understanding for junior high school students. We use the ADDIE model, i.e., analyze, design, development, implementation, and evaluation. The result of this study shows that the teaching material is feasible to use in learning based on the feedback from validators.

1. Introduction

Conceptual understanding is the ability of students in recording and back transferring of some information from learning, which can be used in solving, analyzing, and interpreting the problem and can be reflected from the results of learning outcome [1]. Conceptual understanding is one of the important things in physics learning because such understanding is required to make sense of physics phenomena. Physics consists of many concepts that are related to each other [2]. A good understanding of physics concepts will help students to connect one concept with another and prevent them from misconceptions.

Electrostatics is a branch of physics which deals with the phenomena associated with stationary charges [3]. Electrostatics is studied by students at the 9th grade of junior high school. Electrostatics is a difficult topic to understand due to its abstract concepts. Previous studies show that students encounter misconceptions in learning the concept of electrostatics [4]. Based on data from the implementation of a questionnaire on 9th of junior high school students, their learning resources (books, etc.) have not been able to help them in understanding the concept of electrostatics. Their books are still focusing on the physics formula rather than the concepts of physics, so the students tend to memorize the formula rather than to understand the concepts.

Many factors can affect students’ conception. One of them is teaching materials. Teaching materials are all kinds of information needed by students to be studied, arranged to support learning activities and to achieve the competences [5]. Teaching materials are divided into several types such as text or
printed, visual, audio or combination of them. The printed teaching materials (i.e. textbook, module, students’ worksheet, etc.) are widely used in learning. Previous studies show interactive teaching material can enhance the conceptual understanding of students [6,7]. Students will understand the concept of electrostatics easily from examples in everyday life [8], doing experiments [9], attractive illustrations, and conceptual questions that will be available in the developed product.

In this study, we will develop a printed teaching material which is oriented to the conceptual understanding to help students to understand the electrostatic concept. The developed teaching material has some features such as examples in everyday life that will be linked to the concept of electrostatics, simple experiments that can be carried out directly by students in the classroom, interesting illustrations that will help students to understand abstract concepts, and conceptual questions that will evaluate the concepts that have been understood by students. These features will be able to assist students in understanding concepts and direct students to the right concepts.

2. Methods
This study was the research and development method. The development model refers to The ADDIE model, which includes 5 stages of Analysis, Design, Development, Implementation, and evaluation as shown in figure 1. The ADDIE model is a product development model. Creating products using ADDIE model remains one of the effective tools because the ADDIE model is merely a process that serves as a guiding framework for complex situations, it is appropriate for developing products and others learning resources [10]. In this study, we only carried out the development process until the validation of material and media experts and the research procedures were conducted in SMPN (junior high school) 2 Kota Jambi. The subjects of this study were students of 9th grades at SMPN 2 Kota Jambi.

The first stage of this study is to Analyze the difficulties, i.e. analyze the students’ textbook, interview the teacher about the problems in learning, and implement the initial questionnaire for students. The next stage is to design the teaching materials. The third stage is developing the teaching material according to design. In this stage the teaching material will be validated by material and media experts. The validation results in the form of comments and suggestions that will be used to improve the developed teaching material.

Figure 1. The ADDIE model [Robert Maribe Branch].

3. Results and discussion
Based on the analysis of students’ learning resources (books, etc.), we found that the books have not been able to help the students in understanding the concept of electrostatics. The problems arise because of their book still focusing on the physics formula rather than the concepts of physics. The developed teaching material is oriented to conceptual understanding. The teaching material is presented with an attractive layout and color, included examples of the application of
electrostatics concept in everyday life, attractive illustrations, simple experiments, and conceptual questions to help students to understand electrostatics concept easily. Here, we will show a snapshot of the developed teaching material.

Figure 2 shows the front cover design of developed teaching material, the front cover displayed the title of teaching material, then addressed to respondents who will use the product, the cover also showed a picture of lightning as one example of the application of Static Electricity in daily life.

Figure 3. Example of electrostatics concept in daily life.
Figure 3 shows the hair brushing activity with a plastic comb. Hair brushing is an activity that is often done by students in their daily lives. Hair brushing activities will be associated with the concept of electrostatics and explained using attractive illustrations and pictures, making it easier for students to understand the electrostatic phenomena that occur when combing hair.

![Figure 3](image_url)

**Figure 3.** Hair brushing activity with a plastic comb.

Figures 4 and 5 show an explanation of the concept of electrostatics using attractive figures and illustrations, simple experiments that can be carried out directly by students while in class, and conceptual questions used to enhance students' concepts.

![Figure 4](image_url)

**Figure 4.** Display material content and simple experiments.

The developed teaching material is validated by material and media experts to increase the quality of the developed product. Validation is done until the teaching material is said to be feasible by material and media experts. Validation is done using a Likert scale; the answer choices are: Strongly Disagree.
(1), Disagree (2), Agree (3), and Strongly Agree (4) [11]. Result data obtained from the validation of material experts and media experts are:

Table 1. Validation by material experts.

| Aspects                                         | Percentage | Mean percentage |
|-------------------------------------------------|------------|-----------------|
|                                                 | Expert 1   | Expert 2        |                |
| The suitability of the material with the learning objectives | 75%        | 87,5%           | 81,25%         |
| The accuracy of the material with the contents   | 100%       | 75%             | 87,5%          |
| Aspect-oriented conceptual understanding         | 100%       | 75%             | 87,5%          |
| Language component                               | 100%       | 100%            | 100%           |
| Total percentage                                 | 89% (very valid) |

Table 1 shows the results of the validation from the material experts. We can see the suitability of the material with the learning objectives gained 81.25%, the accuracy of the material with the contents 87.5%, aspects-oriented conceptual understanding 87.5%, and the language component gained 100%.

Table 2. Validation by media experts.

| Aspects                               | Percentage | Mean percentage |
|---------------------------------------|------------|-----------------|
|                                       | Expert 1   | Expert 2        |                |
| The cover design                      | 87,5%      | 100%            | 93,75%         |
| The design of teaching material       | 90%        | 95%             | 92,5%          |
| Presentation component                | 100%       | 62,5%           | 81,25%         |
| Total percentage                      |            |                 | 89% (very valid) |

Table 2 shows the results of the validation from media experts. The cover design of teaching materials obtained 93.75%, the design of teaching material 92.5%, and the presentation components obtained 81.25%.

4. Conclusion
The development process of teaching material consists of analysis, design, and development. In the development stage, the developed teaching material is validated by material and media expert to see the feasibility of the developed product. Based on the result of validations, it can be concluded that the developed teaching material is feasible to use. It can be seen from the result of material and media validation. Each validator provides a rating with a score 89% for the value of the material and 89% for media value.

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References
[1] Gunawan G, Nisrina N, Suranti N M Y, Herayanti L and Rahmatiah R 2018 Virtual Laboratory to Improve Students’ Conceptual Understanding in Physics Learning In Journal of Physics: Conference Series 1108(1) p 012049
[2] Septiani V, Syuhendri, and Sudirman n.d. Pengembangan Bahan Ajar Teks Perubahan Konseptual Materi Suhu Dan Kalor Berbasis Teori Perubahan Konseptual Jurnal Inovasi dan Pembelajaran Fisika pp 119-209
[3] Halliday D, Resnick R n.d. *Fundamental of Physics 10th ed* (United States of America: Wiley) p.745

[4] Khasanah U and Setiawan A 2015 Survey Konsepsi Mahasiswa Calon Guru Fisika pada Konsep Listrik Statis Menggunakan TKLS dengan format Tes Pilihan Ganda Respon Terbuka *Prosiding Simposium Nasional Inovasi dan Pembelajaran Sains* **88** pp 569-72

[5] Muhidin A and Faruq U A 2018 *Pengembangan Bahan Ajar* (Tangerang: UMPAM Press) p 140

[6] Tien L T and Osman K 2012 Penggunaan Modul Multimedia Interaktif dengan Agen Pedagogi dalam Pembelajaran Elektrokimia: Kesan terhadap Pemahaman Konsep dalam Elektrokimia *Sains Malaysiana* **10** pp 1301–1307

[7] Miswadi SS and Haryani S 2013 Pengembangan perangkat pembelajaran berbasis masalah untuk meningkatkan soft skill dan pemahaman konsep *Jurnal Pendidikan IPA Indonesia* **2(2)**

[8] Wan Ng and Nguyen V T 2006 Investigating the integration of everyday phenomena and practical work in physics teaching in Vietnamese high schools *International Education Journal* **7** pp 36-50

[9] Lee M C and Sulaiman F 2017 *Conference: 9th International Conference on Business, Management, Law and Education* (Kuala Lumpur : Malaysia) p 244 - 249

[10] Branch R M 2009 *Instructional Design: The ADDIE Approach* (United Stated of America: Springer) p 2