

Research Article

Development of Physics Teaching Materials Based on the Prediction, Observation, Explanation, Elaboration, Writing, and Evaluation (POE2WE) Learning Model Assisted by Google Site

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Abstract.

This development research aims to: 1) Develop physics teaching materials based on the POE2WE learning model assisted by the Google site. 2) Analyze the feasibility of physics teaching materials based on the POE2WE learning model assisted by Google site. 3) Analyze the improvement of student learning outcomes by implementing physics teaching materials based on the POE2WE learning model assisted by Google site. 4) Analyze teacher and student responses to physics teaching materials based on the POE2WE learning model assisted by Google site. This is a research and development study that applies the ADDIE model with 5 steps, namely analysis, design, development, implementation, and evaluation. The validation results from media experts on the feasibility of physics teaching materials, based on the POE2WE learning model, assisted by Google site averaged 90% with a very feasible category. The validation results of material experts with an average of 86% and the validation results of language experts with an average of 92%, were said to be very feasible. In small-group testing, an average of 90% was obtained and in large-group testing 85.67% was obtained, which was categorized as very feasible. Teacher and student responses to the developed product were very good for use with an average of 90% and 91%. The validation and trial results show that the physics teaching materials on the concept of electromagnetic induction based on the POE2WE learning model assisted by Google site are very suitable to use in the learning process.

Keywords: teaching material development, POE2WE learning model, Google Site

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1. INTRODUCTION

The 21st century presents technological developments in various aspects of life, especially in the field of education, which is essentially a process to obtain added value from the output produced so that it is useful and also influences and changes the

order of human life that is not technologically illiterate. Human delay in operating and mastering technology affects human delay in advance. The industrial revolution era is closely related to various digital-based information, so the consequences that must be accepted by every human being are to have various skills including 1) the ability to master technology and media; 2) the ability to communicate effectively; 3) have critical thinking; 4) problem-solving ability; and 5) the ability to cooperate [1, 2]. [3] said that the revolution era demands every educational institution to prepare every teacher and student to have data literacy, technology, and human resource capabilities.

The use of smartphones as a result of the development of digital-based information in the world of education is very normal and used by most students. The results of observations conducted on class XII students at Madrasah Aliyah Negeri 1 Kota Tidore Kepulauan show that almost 90% of students have smartphones or cell phones as a means of communication. Most students use smartphones as a medium for socializing in cyberspace (Facebook, Instagram, Twitter, WhatsApp, and TikTok) or as a medium for playing offline or online games. Students are more focused on social media and their online games than on their learning materials, and it can even be said that students are addicted to smartphones for things outside their use as a learning medium or source of learning. [4] said that smartphones have positive impacts on their users including making it easier for students to hone their creativity and intelligence.

Furthermore, [5–7] said that pedagogical benefits from smartphones need support including for students' language mastery, in the sense that by using smartphones properly, students' language mastery is increasing. Meanwhile, [8] in their research concluded that the use of smartphones with intensity hurts the development of student behavior, both social, moral, and religious behavior. With these advantages and an understanding of the negative impact of smartphones, they can be utilized by teachers to be used as a means or medium of learning for students.

With various learning problems and with various advantages of smartphones, teachers with all their creativity can use smartphones as one of the media or sources of learning for students. The teaching materials developed by the teacher are one form to overcome the lack of student learning resources or can complement individual student learning materials [9]. Technological advantages can be used to design electronic learning materials. Electronic teaching materials make it easier for teachers to deliver learning materials and can make students more active and interactive in learning activities. [10] explained that electronic teaching materials are learning media that contain material, methods, limitations, and assessment methods that are made in sequence to achieve the expected student abilities.

In the electronic module, the learning material is packaged in its entirety, allowing students to learn independently and more actively according to their learning abilities. One platform that can be used to develop electronic teaching materials to facilitate the teaching and learning process is Google Sites. Google Sites can be used to easily create a learning website because it does not require special skills such as web coding and web design in managing and creating it [11]. Learning using Google Sites provides many benefits such as more interesting learning, easier access to learning materials, and storage media that is not easily lost [12]. Google Sites allow the teaching materials developed to integrate news in the form of video and text.

The teaching materials developed with the assistance of the Google site are combined with the use of the POE2WE learning model. The POE2WE (Prediction, Observation, Explanation, Elaboration, Write, Evaluation) learning model is a model developed to determine students' understanding of a concept with a constructivist approach to achieve learning objectives. This model requires students to actively observe or experiment to discover a concept and provides opportunities for students to construct their knowledge, communicate their thoughts and write down the results of their discussions so that students can more easily master the concepts taught [13–16].

With the descriptions of the importance of teaching materials developed by teachers to complement student learning resources, it is necessary to develop physics teaching materials based on the POE2WE learning model assisted by Google site. Teaching materials based on the POE2WE learning model are designed neatly and completely because, in addition to physics material or concepts, there are also media in the form of learning videos and student activity sheets. With well-designed learning materials filled with interesting content and illustrations, it will stimulate students to use learning materials as learning materials or as a source of learning.

2. METHOD

This research is a development study using the ADDIE model, which consists of five development steps: 1) analysis; 2) design; 3) development; 4) implementation; and 5) evaluation. This research aims to: 1) Develop physics teaching materials based on the POE2WE learning model assisted by Google site; 2) analyze the feasibility of physics teaching materials based on the POE2WE learning model assisted by Google site; 3) analyze the improvement of student learning outcomes by implementing physics teaching materials based on the POE2WE learning model assisted by Google site; and 4) analyze teacher and student responses to physics teaching materials based on

the POE2WE learning model assisted by Google site. The resulting product design is then validated by three expert validators. The results from these validators are then used to revise the product that will be used for field trials with students. Small group trials were conducted on 10 students, and large group trials were conducted on 36 students, not including students who had undergone small group trials using a time series design. The instruments used were validation sheets to validate the resulting product, test questions used to see the improvement in student learning outcomes after implementing the resulting product, and questionnaires used to obtain teacher and student responses to the resulting product.

The research results in the form of validation results from each expert are then analyzed using the following percentage formula:

$$\bar{X} = \frac{\sum X}{n} \times 100 \% \quad (1)$$

Meanwhile, to see the improvement in student learning outcomes, the normalized gain equation [17] is used.

$$\langle g \rangle = \frac{\% \langle Sf \rangle - \% \langle Si \rangle}{100 - \% \langle Si \rangle} \quad (2)$$

To see the responses of teachers and students to the developed product, the following percentage equation is used:

$$\text{Percentage} = \frac{\text{Total Score Acquired}}{\text{Maximum Score}} \times 100 \% \quad (3)$$

3. RESULT & DISCUSSION

The first stage of developing physics teaching materials based on the POE2WE model assisted by Google site is to analyze the curriculum by looking at the material that will be made into teaching materials, namely Electromagnetic Induction. Electromagnetic induction material is material that falls into the abstract category that is difficult for students to understand, so teachers need to choose the right strategy and learning media to teach this material to students. The next step in the initial stage is to formulate learning outcomes and learning objectives by considering basic competencies. An initial study was conducted to find information about learning resources, learning models, and learning media used in the physics learning process. The results of the initial study

showed that the teaching materials used were package books or student books and teachers did not make separate teaching materials as a source of independent student learning and the learning model used by teachers was still a dominant conventional model compared to an innovative model, and the learning media was still limited. This causes students to easily get bored and often not focus on the teacher's explanation, students are less involved in the learning process so students have the opportunity to socialize through their cellphones even if done secretly. These findings are also supported by the results of [18] who said that students will face difficulties in carrying out their duties if they do not use smartphones, so they experience uncontrollable emotions. This condition causes students to be not proficient in solving a problem that contradicts the skill needs in the 21st century. Learning efforts made will become useless when students are not focused on carrying out the learning process. Dependence on smartphones can also occur in students who always rely on smartphones to complete all school assignments without thinking at all. This results in a lack of student activity in reading, a lack of awareness of the importance of learning, and a decreasing enthusiasm for learning.

The second stage of development is the design stage, which is the stage of designing physics teaching materials based on the POE2WE model assisted by Google site, starting from collecting all references or reading sources related to the concept of electromagnetic induction, the POE2WE learning model and learning videos related to the teaching materials to be developed. The teaching materials developed are a combination of several elements, namely text made in pdf form and then uploaded to Google Drive, quiz questions made in Google form, and videos integrated with YouTube that serve to make it easier for students to learn independently anytime and anywhere. The teaching materials developed are presented in a language that is easily understood by students, this is in line with the results of research conducted by [19] which concluded that students who learn using teaching materials developed by teachers result in students being more directed to learn and independently study subject matter and result in increased student creativity. In addition, at this stage, teacher and student response instruments and product validation instruments for material experts, media experts, and language experts were also designed, which were then validated by experts to see the feasibility of the teaching materials used and suggestions given by validators for improvement or revision of the teaching materials developed.

The development stage is carried out after the planning stage, where at the development stage product validation is carried out by material, media, and language validators. The data obtained from validators were then analyzed and it was found that on average

media experts said that teaching materials developed with media used were very feasible with a percentage of 90%. This research result is supported by previous research from [20] who said that innovation in Google site-based learning media is very feasible for use in physics learning because Google site media can be accessed by students anytime and anywhere which can be used as a source of independent learning. Furthermore, [21, 22] concluded that Google Sites-based learning media developed are feasible, effective, and efficient for use in high school physics learning because they can improve students' mastery of concepts and critical thinking abilities. In line with research results obtained by [23, 24] stated that Google site as a learning medium has meaning for teachers and students in learning because Google site can provide a pleasant atmosphere in the learning process, avoid student boredom, make learning more interesting, make it easier for students to learn and understand material, and make it easier for teachers to deliver learning material.

The validation results from the concept or material aspect with 3 validators found that physics teaching materials based on the POE2WE model assisted by Google site are very suitable for use with a percentage of 86%. While language aspect analysis results stated that on average teaching materials developed were very suitable for use with a percentage of 91%. This research result is in line with research conducted by [2] who said that the POE2WE learning model is feasible and effective for use in physics learning because presenting material using the POE2WE model is very good and interesting to learn and receives positive responses from students towards learning with POE2WE model. Students become active in learning because with the POE2WE model students are required to solve problems independently by conducting experiments then looking for theories that support experimental results then linking material in daily life [25].

Meanwhile, the results of research by [26] concluded that the POE2WE learning model contributed positively to improving religious attitudes, nationalism, integrity, cooperation, and student independence in learning. The POE2WE learning model can make students the subject in learning. Students are active in discovering a concept through direct observation or experimentation, not from memorizing material books or explanations from teachers. This model allows students to be active in the learning process and provides opportunities for students to construct their knowledge, communicate their thoughts and write down the results of their discussions so that students can better master and understand the concepts that will have an impact on improving student learning outcomes.

A summary of the results of the feasibility test analysis of the developed physics teaching materials can be seen in Table 1.

TABLE 1: Result of Scoring Data by the Experts.

Scoring Aspect	Score Average	Category
Graphical Feasibility	90 %	Very Feasible
Content Feasibility	86 %	Very Feasible
Delivery Feasibility	86 %	Very Feasible
Language Feasibility	91 %	Very Feasible

The research data obtained is then used as a basis for revising the physics teaching materials product based on the POE2WE model assisted by the Google site according to the suggestions given by the validator team. Product revision aims to produce a quality product according to the needs of teachers and students. The following is a description of suggestions from the validator team.

TABLE 2: Feedback from the Validator Team.

Feedback	Scoring Aspect
The cover of the teaching material is made more interesting by displaying images according to the concept of electromagnetic induction. A learning video is needed at the beginning of the material. The color of the product needs to be changed. The link to the teaching material is made simple for easy access. Core and Basic Competencies are made separately. Learning objectives are given a numerical order. Example questions and practice questions must be available in every sub-concept and made more varied. Physics content is deepened. The use of capital letters needs to be considered. Writing must follow EYD (<i>Ejaan Yang Disempurnakan / Perfected Spelling System</i>) rules. Pay attention to punctuation marks. The use of prepositions needs to be considered.	Graphical Feasibility Content & Delivery Feasibility Language Feasibility

The product that has been developed and validated or tested for feasibility by the validator team is then revised according to suggestions to obtain a quality final product in the form of physics teaching materials based on the POE2WE learning model assisted by the Google site, especially in electromagnetic induction material. The next stage is the implementation stage, where this stage is carried out on a limited or small group trial, namely 10 students. The trial was conducted using the final teaching material product and then a test was conducted to see the improvement in student learning outcomes. Student learning outcomes have improved with an average gain of 90%, which can be seen in Figure 1.

After conducting a trial on a small group, it was then continued with a trial on a large group. The result of the large group test obtained an average gain of 85.67%, which can be seen in Graph 2.

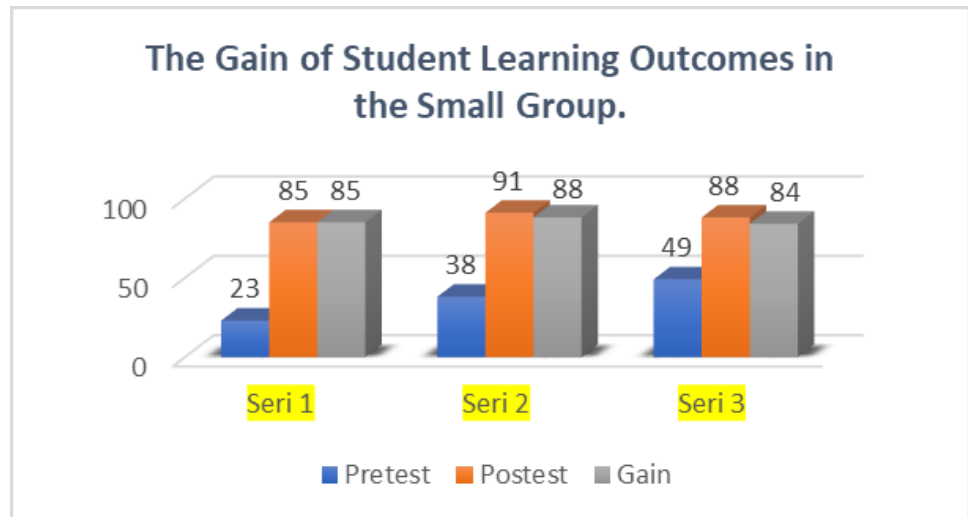


Figure 1: The Gain of Student Learning Outcomes in the Small Group.

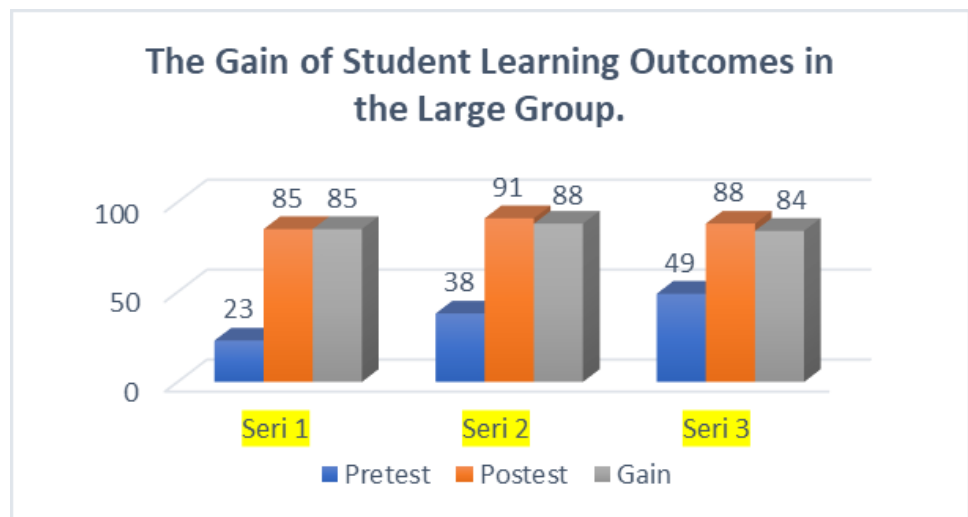


Figure 2: The Gain of Student Learning Outcomes in the Large Group.

In addition to being given a test, in this trial, teachers and students were also given a questionnaire to see the response of teachers and students to the resulting teaching materials. Here are the results of the analysis of teacher and student responses to physics teaching materials based on the POE2WE model assisted by Google Sites.

The results of the analysis of student and teacher responses on average can be concluded that physics teaching materials based on the POE2WE learning model assisted by Google site are easy to understand, interesting to use both independently or in groups, and can motivate student learning.

Evaluation is the final stage of developing physics teaching materials based on the POE2WE learning model assisted by Google site from the ADDIE development model. At this stage, the final product is revised after obtaining responses from teachers and

TABLE 3: The Result of Teachers and Students' Response Analysis.

No	Statement	Teachers' Response Percentage	Students' Response Percentage	Category
1	The text or writing in the teaching material is easy to read and understand.	100	96	Very Good
2	The images presented are visible.	90	91	Very Good
3	The videos presented are relevant to the material and help in understanding the material.	100	81	Very Good
4	The quizzes presented are relevant to the material and interesting.	90	93	Very Good
5	The developed teaching material motivates students to learn independently.	81	92	Very Good
6	The appearance of the teaching material is very interesting	90	88	Very Good
7	The sentences used in the teaching material are easy to understand.	82	94	Very Good
	Average	90	91	Very Good

students. Teachers and student representatives were interviewed after data analysis was carried out, this was done to ensure that the data obtained was truly valid data or appropriate data and to obtain input or suggestions for the teaching materials developed. The results of the interview can be concluded that both students and teachers gave very positive responses to the developed physics teaching materials and gave suggestions including electromagnetic induction material is abstract material so concrete examples need to be given, writing needs to pay attention to punctuation marks and adjusted to EYD, and images must be made clearer with colors that are not too striking or adjusted to their original color. These inputs or suggestions are used as a basis for making final revisions to the product for publication on Google site which can be used as a source and medium of learning for students. This is in line with research by [27], which concluded that using Google sites as a learning medium is very possible because Google sites can combine various information in one place such as videos, presentation materials, attachments, text, and others and allows it to be shared according to user needs. Other research results say that utilizing Google Sites will be able to improve analytical thinking abilities because it makes it easier for individuals in the learning process and increases individual concentration when teachers deliver lesson content, but using Google Sites needs to be understood by its users [28, 29]. In addition, students or other users are also given the freedom to express ideas after

reading content on Google sites to be assessed as a discussion topic in the learning process [30].

The description of the research results and supported by various research results can be said that the development of physics teaching materials based on the POE2WE learning model assisted by Google site is very suitable for use in class XII students of MAN 1 Tidore Kepulauan, especially electromagnetic induction material. In addition to being used as physics teaching materials by students, it can also be used as a learning medium by teachers when teaching electromagnetic induction material. This is because the teaching materials arranged using the syntax of the learning model will guide students to do what is in each syntax of the model and can easily be accessed on student smartphones. The teaching materials developed are very much in line with the development of 21st-century learning.

4. CONCLUSION

Based on the research results and the discussion described, it can be concluded that the development of physics teaching materials based on the POE2WE learning model assisted by Google sites received a very good response from teachers and students, so the developed physics teaching materials are very suitable and effective for use by class XII students of MAN 1 Tidore Kepulauan, especially in electromagnetic induction material. Some things that need to be done for further development research are suggested to develop physics teaching materials based on the POE2WE learning model assisted by Google site on other concepts.

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