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Article

Development of Interactive Learning Media to Improve Students' Conceptual Understanding Through *Series Parallel Electricity Diorama* (SPE)

Afifah Al Munawaroh[1*], Alfian Wahyu Saputra[2], Dewi Masita Febri Antari[3], Aziza Karenina[4]

[1,2,3,4]IAIN Ponorogo, Ponorogo

almunwaroh31@gmail.com

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ABSTRACT

Natural science is a field of science that studies the causes and effects of events in nature, which means the method of learning about nature systematically, so that science is not only the acquisition of a collection of knowledge in the form of facts, concepts, and principles, but also a process of discovery. Physics is a branch of science that studies the properties and interactions of time, space, energy, and matter. Diorama media is a media that combines various symbolic and realistic materials to create a three-dimensional representation. In dynamic electricity material, it is very important to understand the concept. In this modern era, the development of learning media is very diverse and innovative. Teachers and education experts have developed many learning media, both digital and non-digital, to help students more easily understand concepts and make learning less boring. The purpose of this journal is to explore how the principle of parallel-series circuit can be used to create dynamic electricity diorama learning media. The method used is based on Borg and Gall research and development and supported by qualitative descriptive analysis. The research conducted shows that the three highest validation results are usage, appearance, and design with a percentage of 78%, 90%, and 84%. The two lowest verification results are Media and Material with a percentage of 68% and 78%. The conclusion from the validation results is that the series-parallel electrical diorama (SPE) is feasible to be developed to the next stage.

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INTRODUCTION

Natural science is a field of science that studies the causes and effects of natural events. Refers to the systematic way humans study nature, so science is not just the acquisition of a set of knowledge in the form of facts, concepts, or principles, but also a process of discovery,

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destruction (Fitriani et al., 2017). Trianto (2010) further emphasizes that science is a science that studies phenomena through a series of processes called scientific processes, the process is built based on a scientific point of view and the results are divided into three most important products derived from factors that can be presented as concepts, principles or theories.

Physics is a branch of science that studies the properties and interactions of time, space, energy, and matter. Helmi et al (2017) further emphasized that physics is a branch of natural science that includes concepts, principles, theories and/or laws related to existing natural phenomena. Physics is not only theory but also direct calculation formulas and practices. Physics is one of the sciences that plays an important role in the world of education, especially in teaching at school.

According to Hak (Widodo, 2005), physics is a fundamental science because it is the foundation for the development of science and technology. One of the topics studied in physics is electrodynamics. To learn electrical circuits, you need to clearly understand the basic theories and formulas, then the learned theories and formulas can be applied into practice. But often students have difficulty in learning electrodynamics. Since electricity has become one of the most popular forms of energy over time and is available in everyday life, it is important to teach this material in schools. Since the subject of electrodynamics in physics is abstract so that it cannot be observed directly, learning materials are needed to help students clearly understand the subject being studied.

The purpose of an electrical circuit is to provide power to another device or type of electrical device. These devices are called loads. Before a load operates, electricity must follow an entire path from the source to the load and back to the source. This electrical path is called an electrical circuit. Two types of circuits are commonly used to provide electrical power to devices: series circuits and parallel circuits (Field and Solie, 2007). To facilitate the understanding of the purpose of using series-parallel circuits, learning materials have been made, especially diorama.

Learning media plays an important role in the implementation of learning. Arif S Sadiman et al (2012) argue that "media" means intermediary or introduction. On the other hand, Azhar Arsyad (2014) argues that media is a learning resource that facilitates educational communication or discussions about learning media and cannot be separated from the images and objects in the media, explaining that 'actions or attitudes are necessary for teaching. given. The role of educational media is very important because it is related to the activities and reactions of students' interests in carrying out the learning process (Haryono & Harjito, 2016). There are many means available for learning. One of the most widely used ways of learning is by using diorama. Diorama is a media that mimics the works displayed in the art museum. Although diorama has a very important role in education, but its utilization in schools is still not optimal (Gkouskou and Tunnicliffe, 2017).

Diorama media is a three-dimensional presentation that combines various symbolic and realistic materials, such as specimen images, and often uses reflected light to display natural perspective effects (Jalinus & Ambyar, 2016). Diorama media can provide direct experience to students, help them understand the material, make them active in learning activities, and make learning activities more interesting (Wafa & Rizkyana, 2019). Dioramas are often miniature shapes or objects placed on a stage or pedestal and displayed in three dimensions. According to Prastowo (2016), the advantages of using diorama media for learning are: (1) Suitable for teaching physics, biology, history and many other subjects, (2) provide an overview of the situation (status) of the subject according to the original text, creating conditions for students to appreciate it. The use of learning materials in the form of dioramas allows students to directly recognize the use of electrical circuits in everyday life so as to further enhance the understanding of the concept.

According to Siti Mawaddah and Ratih Maryanti (2016), understanding is the ability to explain and interpret something, able to provide explanations, for example, more complete and complete explanations, able to provide more creative explanations. According to Suherman's (2003) concept definition, a concept is an abstract idea that allows objects to be grouped into examples and non-examples. Therefore, understanding a concept does not only mean knowing it but also mastering various learning materials that help students express the concept in such a way that they can verbally understand and apply its meaning. . Concept understanding has a significant impact on student performance. The easier it is for students to understand the material during learning activities, the better the learning results will be. We can conclude that conceptual understanding is the level of students' ability to understand the content and explain it in their own words. What are the results of the Parallel Electrical Diorama (SPE) product line development?

When it comes to electrodynamics, it is important to understand these concepts. Mastering many concepts will help students solve problems better. This is because rules are needed to solve problems and the rules are based on one's ideas (Ayu Putri Fajar, et al. 2019). When students have a better understanding of the concept of dynamic electricity, they will be better able to learn the material and be able to review and explain the content more comprehensively and creatively. Learning media in the form of dioramas can improve students' concept understanding in the field of dynamic electricity. A learning media in the form of SPE diorama (Series Parallel Electricity Diorama) must be validated in order to find out the extent of development carried out and analyze what deficiencies the diorama has. Then the validation results obtained will be a reference and evaluation to enter the next stage until it can be used to support the learning process of dynamic electricity teaching materials for teachers and students at school. The purpose of this journal is to understand the process of developing dynamic electricity diorama learning media in the form of the use of parallel series circuit principles and improve students' concept understanding of the application of dynamic circuits in everyday life.

METHODS

The research was conducted using the research and development (R&D) method. Sugiyono (2009) argues that research and development methods are research methods used to produce certain products and test the effectiveness of these products. Borg and Gall proposed a research and development model consisting of 10 main steps. According to Sugiyono (2016), the stages of research and development are as follows: 1) Information gathering and research, 2) Planning, 3) Development of initial product prototypes, 4) Design validation, 5) core product evaluation, 6) primary field testing, 7) operational product evaluation, 8) field testing, 9) final product evaluation, 10) spectrum transformation and application. However, during the research process, we only conducted 5 steps, including: 1) Collecting and researching information, 2) Planning, 3) Developing initial product samples, 4) Design validation.

Qualitative descriptive analysis and quantitative descriptive analysis are the two data analysis methods used in our research. Qualitative input and suggestions from learning material experts and learning media experts regarding how to improve the product can be used to develop and improve the product. Quantitative data in the form of 1) validation evaluation scores in the form of (material, media, design, appearance, usage), 2) media expert evaluation scores, 3) validation scores by media experts, 4) evaluation scores based on expert design, 5) appearance evaluation scores, 6) usage rating scores. 6) usage rating score.

Quantitative data collected through data collection tools that include validation sheets, methods, materials, design, usability, form, and confidential data collection tool sheets, analyzed using qualitative descriptive analysis techniques. This analysis was done to ensure the validity of the diorama material and the data obtained were analyzed using a Likert scale. In addition, the formula used to determine the suitability of a diorama stand is :

$$P\ (\%) = \frac{\text{validation result score}}{\text{total score}} \times 100\%$$

The results of the analysis are in accordance with the level of media validity criteria, material, design, curriculum suitability and effectiveness of use according to Sugiyono, 2016 in the table below :

Table 1. Validity criteria

Criteria	Presentase
Not valid	0%-20%
Less valid	21%-40%
Fairly valid	41%-60%
Valid	61%-80%
Very valid	81%-100%

RESULTS AND DISCUSSION

The results of the research that has been carried out obtained five validation results, namely 90% appearance, 84% design, 685 media, 78% material and 78% usage. The validation results of the five aspects are written into the table as follows. After doing validation to the validator of the results of the research we did got suggestions for the development of diorama media at a later stage.

Table 2. Results of diorama validation

Validation Aspect	Presentase	Criteria
Media	68%	Valid
Material	78%	Valid
Design	84%	Very Valid
Display	90%	Very Valid
Usage	78%	Valid

After validating the validator, the following suggestions were obtained from the design and use validator. The design aspect is suggested to tidy up the wiring on the diorama. Aspects of use are advised to use LED lights to obtain a more flexible and compact media size, and better diorama directly plugged into the outlet to obtain more power so that the lights are brighter than using 2 small batteries. In table 2, it can be concluded that there are 3 aspects of validation with the highest score, namely display 90%, design 84% and use 78% and there are 2 aspects of validation with the lowest score, namely media 68% and material 78%.

Figure 1. Series Parallel Electricity Diorama

The design validation aspect is used in assessing the suitability of diorama design and series and parallel circuits with the application and the real situation. Design neatness and accuracy of series and parallel electrical circuits are aspects that are focused on this assessment. Assessed from the arrangement of electrical circuits in the diorama whether it can describe the application of electrical circuits in the actual environment. It aims to increase students' understanding of the application of electrical circuits in life. A good diorama design can make learning fun. Fun learning includes free play and guided play. Fun learning is child-centered, constructivist, positively affective, and hands-on (Lillard, 2013). An appropriate diorama design can create an immersive learning environment and can influence the learning approach (Rillero, 2016).

The design validation aspect is high because of the selection of illustrations and good colors on the diorama display. In diorama learning media, an attractive design can increase students' involvement in learning. When the diorama is well designed, students tend to be more interested in engaging in the subject matter because they more easily understand and absorb the information. Attractive design can help people understand complicated concepts. Diorama has visual elements that are well organized so that students can understand the material presented. The attractive design aspect of diorama can enhance the learning experience. When students are engaged and inspired by the creative design, they tend to remember the subject matter more easily. Thus, attractive design in diorama learning media not only beautifies the appearance, but also has a significant impact in improving the effectiveness of learning and student experience. Another impact of a good diorama design is to encourage students' meaningful understanding that occurs when students are directly involved and there is mutual interaction between teachers and students (Rusdi et al., 2022).

Display of learning media can be defined as any kind of materials or tools used during the learning process to help students understand and master the subject matter. The display aspect itself focuses more on the visual appearance of the diorama such as color, background, shape, and placement of ornaments. The selection of the right color combination can make the diorama can create an atmosphere in accordance with the theme or topic of learning more vividly. The harmony of the color composition of each ornament and background makes the diorama more interesting. Supported by the proper placement of ornaments that can make the diorama look more real. The diorama media display seems real because we use a complete parallel series electrical circuit starting from cables, switches, batteries and lights, and also electrical energy has long been known to the public because electricity is a vital human need in carrying out daily life used in various sectors (Ashari and Faisol, 2020).

Aspects of display validation classified as high there is the accuracy of the color selection chosen against the background in use so as to make the diorama more attractive to students. The appearance of the SPE diorama is quite interesting, it becomes one of the solutions to the problems of science learning, namely learning that tends to be monotonous and insufficient practicum facilities (Hasbi et al, 2015). The selection of colors on the diorama of electrical and parallel circuits is very interesting and in accordance with the accuracy of the layout of each ornament or object on the diorama of electrical and parallel. The impact of the high aspects of design validation is the appearance of the diorama is able to make students more involved and enthusiastic in learning. A good display of learning media also helps improve the retention of information, so that students more easily remember what they have learned. Lastly, the high validation aspect of the display of diorama learning media has a great potential to increase

students' interest and their understanding of the subject matter because the variation in display and teaching methods offered by the learning media can help reduce students' boredom towards the subject matter and make learning more interesting and fun.

The safety factor in the use of learning media is one important aspect because it concerns the safety of students. In the aspect of use that is assessed, among others, about the ease and safety of the use of series and parallel electrical diorama. The security aspect is very important because the diorama of series and parallel electricity is related to the flow of electricity, so the learning media should always be considered safe when used in learning. In addition to its own security, the material of manufacture of this diorama is also included in the aspect of use. In the diorama is more emphasized by using used goods that are not used. In addition to reducing waste by reusing it aims to make the material for making dioramas can be easily obtained and reduce the cost of making it more affordable. The use of diorama learning media can be done in laboratories and libraries, where many libraries also provide learning media such as dioramas to support student learning (Shepherd C.E, 2021).

The validation aspect of use is high because the parallel electricity diorama media can be used well and easy to make. The materials used in the manufacture of dioramas utilize used goods that are around so that it can be cheaper and environmentally friendly. The use of 3-dimensional diorama as a science learning media is very effective in the direction of increased student learning outcomes, besides that the diorama is adjusted to the components and designs that are tailored to the material being taught (Prabowo and Wulandari, 2018). The impact of using learning materials that are easy to use can increase the effectiveness of learning and teaching, so that students and teachers can focus on the core content of learning materials without being distracted by the complexity of learning materials. The use of learning materials requires careful attention to the safety of student use, therefore the Series Parallel Electricity (SPE) Diorama is made from materials that are safe and easy to find in the environment. The development of learning media is used very effectively in learning, this is in accordance with the views of Aini in Maliasih (2015), that the development is considered effective if the purpose of developing information media is achieved and gets good feedback from students.

Learning media is a technology used by teachers as a more meaningful and interactive learning tool. The presence of learning materials is expected to help students understand the material maximally and apply it in everyday life, thus creating a learning atmosphere that is not monotonous or boring. There are various types of support, but we use dioramas. The limitations of learning materials and practical tools have some negative impacts on the learning process of sequential and parallel materials. These negative impacts include :

Many teaching and learning activities still use the lecture method, the teacher is still teacher-centered rather than student-centered, the main learning source is the exercise/packaged book and the learning materials used are limited. The teaching and learning process focuses on the pictures and text content of the LKS book. Students who sit at the back are busy talking about other things outside of what is being taught, students just look down and are silent (Kiswandari, 2016).

The media validation aspect of the series and parallel electrical diorama is classified as low because the media has a color contrast that is less precise and interesting from each component of the diorama and the size of the diorama is less proportional between the base, ornament and parallel series electrical circuit. The impact of the shortcomings that have been mentioned before is that students become rather difficult and use the diorama because the size of the base is quite large and students will also be concerned about the colors of the diorama

that are less contrasting because it causes the aesthetic power to decrease. Nevertheless, the diorama is able to attract the attention of students because students become curious about what the function of the diorama so that it can cause curiosity and critical thinking of students of parallel series electrical circuit material. The use of SPE diorama media in learning is student centered where students play an active role with the teacher only as a facilitator (Prasetyaningsih, 2022).

Diorama of series and parallel electricity is enough to illustrate the use of electrical circuits in everyday life and students can also distinguish parallel series electrical circuits through switches and lights that have been installed. Efforts made to overcome the shortcomings in the media aspect is to make the size of the diorama base that is more proportional to the oranments that are in it, besides the selection of ornament colors must also be considered in accordance so that the aesthetic value of the diorama is better. Interesting learning media can have a positive impact on student learning motivation. This is evident from the results of research conducted by Jasmiati that learning media affects student learning motivation by 28, 19% (Jasmiati, 2018). The reason why students do not have curiosity about science material is because learning is centered on the teacher with the diorama of SPE is expected to focus on students so that students become eager to learn (Santhi et al, 2020).

Materials are any documents (information, tools or texts) that are systematically organized and represent a set of skills that students acquire and use during the learning process, with the aim of planning and examining the implementation of learning. In addition, teaching materials also refer to all types of teaching materials that teachers use in the learning process. Materials can be written and created by teachers or experts in the field of education to support student learning activities at school (Bawamenewi, 2019). Developing teaching materials that are linked to subjects and in accordance with student needs ensures active, creative, effective and interesting learning, thereby achieving the expected learning objectives optimally and satisfactorily. According to Baiti, integrated teaching materials based on a contextual approach, integrated into students' lives and often experienced in their environment, is a way to develop appropriate teaching materials (Baiti, 2018). Students are expected to be able to solve problems because the material presented through dioramas can improve conceptual understanding and adaptive thinking (Setiawan et al., 2018).

The material validation aspect is classified as low because the diorama of parallel series electricity has not fully explained about the material of parallel series electricity and only limited to distinguish the visible use of parallel series electrical circuits and props have not fully contained all the information about parallel series electrical circuits because there are no instructions for use that can be used by teachers and students. The impact of the shortcomings in the material aspect is that students become confused about how to use the diorama and student understanding of the diorama material is less thorough because the diorama only shows the difference between series and parallel electricity. Material plays an important role in education by explaining the concept so that students can understand what the teacher says. (Wahyudi et al, 2020). Efforts to overcome the shortcomings of the material aspect of the diorama is by showing where the electrical energy is channeled until the lamp lights up by giving paper labeling the flow of electricity from the power source to the lamp, as well as making instructions for the use of dioramas for teachers and students so that no errors occur in the operation of the diorama. In a series circuit, the lights turn on simultaneously and in parallel circuits alternately (Susanto et al, 2018).

CONCLUSION

The journal discusses the development of a diorama learning media called the Series Parallel Electricity Diorama (SPE Diorama) for teaching dynamic electricity. The development process follows a research and development (R&D) method and goes through various stages such as information gathering, planning, prototype development, design validation, and material validation

The results of the research show that the diorama received high validation scores for display, design, and usage, with percentages ranging from 78% to 90%. These aspects are crucial in making the diorama effective in enhancing students' concept understanding and engagement in learning. However, the diorama received lower validation scores for the media (68%) and material (78%) aspects, indicating room for improvement in terms of color contrast, proportionality, and completeness of information in the diorama.

The journal emphasizes the importance of using engaging and effective learning media to improve students' understanding of complex subjects like dynamic electricity. Diorama learning media is seen as a valuable tool that can make learning more interesting and memorable, as it offers an immersive and interactive experience for students.

In conclusion, the development of SPE Dioramas is a promising step in improving the teaching of dynamic electricity and increasing students' conceptual understanding through interesting and visually appealing learning media. However, there is still room for improvement in the development of SPE dioramas.

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