



The comic *isomorphic physics* series of vibrations and waves to increase the learning interest of junior high school students

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ABSTRACT

Independent learning needs to be supported by independent learning media so that student's interest in learning is increasing. Low interest in physics at junior high school level causes students to be indolent to learn. Therefore, supporting learning media are needed that can foster students' interest in learning physics. This research focuses on developing a product in the form of an *isomorphic physics* comic for the Vibration and Waves series which is an independent learning media. This study uses the DDDE development model, namely the stages of decide, design, develop, and evaluate. Following the development stage used in this study, it carried out a feasibility and effectiveness test. The results of the feasibility test analysis using SBI (ideal standard deviation) obtained an average score of 85 which was interpreted into the product quality criteria in the "Very Good" category. Furthermore, the effectiveness test was carried out by testing on a small scale, and then the results were analyzed using simple statistics to obtain the results that 91.7% of students expressed "interest" in learning to use "isomorphic physics" comics. Thus, the use of "the isomorphic physics" comic series Vibration and Waves in physics learning at the junior high school level can increase students' interest in learning.

Keywords: Comic, Isomorphic, Wave and Vibration, Learning Interest.

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INTRODUCTION

Science is essential to learn. Science learning allows students individually and in groups to search, explore, and discover concepts and principles thoroughly and tangible. As one of the branches of science, physics instills ideas closely related to daily life (Sari et al., 2018). These concepts can be developed by students

in solving physics problems (Dinata et al., 2018). Learning is said to be successful if students have understood the concepts learned, relate them to daily life, and solve various problems in their daily lives (Setiaji & Dinata, 2020).

The continuity of learning in schools is considered not yet (Docktor & Mestre, 2014).

Observations in junior high school physics classes result in the fact that the learning methods used by teachers are less varied. Teachers combine lecture methods with discussion and presentation methods only. The use of more dominant lecture methods makes learners accustomed to hearing, recording and memorizing the given material. This condition causes a lack of interest in studying physics (Saryoko & Susilowati, 2018).

In addition, interviews with students reveal information that many students do not understand the concept of the material that has been studied, especially vibration and wave material. Therefore, the learning carried out should attract students so that knowledge in the classroom can improve understanding concepts. The emergence of problems requires educators to change the learning process by using the proper learning media (Bahri et al., 2018; Yadiannur & Supahar, 2017). The appropriate media is a medium that is easy to understand learners (Mardiana & Kuswanto, 2017), both in terms of appearance and exciting content, and following the development of learners (Dinata et al., 2017). Textbooks containing unattractive images and imagery are highly disliked by students (Pramana & Dewi, 2014; Taufiq et al., 2016; Wahyuningsih, 2012). Empirically, students like picture books with exciting colour blends and are presented in a look that looks real like cartoons (Haroky et al., 2019). Following these criteria, comics are a suitable medium for learning with the tendency of students who have been described.

Comics are one of the leading learning media compared to other media to increase the knowledge of students (Buchori & Setyawati, 2015). Comics can attract interest to improve learners' interaction in the learning process (M. S. I. Rahayu et al., 2021). Good interaction can maximize the achievement of learning objectives. Comics in junior high school physics learning in Merauke has never been presented as a medium in learning. Comic media is rarely used because of the unavailability of comics that match physics materials and the lack of time to use cartoons in learning activities in the classroom.

Comics as a learning medium has a vital

role. It can attract students' learning interests and make it easier for students to remember the lesson materials they receive (Fauziah & Kuswanto, 2021). The observations show that teachers are used to using learning media in students' worksheets and learning videos. Therefore, researchers are trying to develop comics as a companion medium in learning. Comic presentation is adapted to the arrangement of images and colours with the storyline to be easy to understand by students.

Comics are an efficient learning medium in conveying information through visual communication design (Priyadi & Kuswanto, 2021). Various levels of disciplines can also use comics because they serve as a medium of information and entertainment media (Sari et al., 2019), as well as readily accepted by readers (Ratnaningtyas et al., 2019). The comics that researchers developed in the study are stories that are arranged through photos. This technique is known as *Photonevela*, a comic or illustrated story that uses pictures instead of illustration images (Rahayu et al., 2018). The general characteristic of *photonovel* is easy to make, simple, low cost, according to the emotional of the learner, easy to prepare and be used, reasonable care, and the theme is lifted from the daily life of the learner (Ariyani et al., 2018) so that it is easy to understand.

The developed *photonovel* contains physics material on waves and vibrations using colloquial and communicative language for learners. The problems in *photonevela* have isomorphic properties that include different languages but have similar problem solutions (Sari et al., 2018). Isomorphic issues can be used to test the understanding of concepts and observe the development of learners (Sari, 2020). Thus, it can be concluded that isomorphic problems have different languages but have similar problem solutions that can test the understanding of concepts and observe the development of learners.

Learning science with *photonovel* media is very effective in improving learning and understanding the concept of learners (Rahma et al., 2016). Other research revealed that the implementation of education using *photonovel* could improve environmental care attitudes

and express opinions (Widyaningrum & Prihastari, 2018). Related to the development of photonovel, previous research (Ariyani et al., 2018) revealed that photonovel could be used as a supporting medium in the study of physics.

This study aims to develop an "isomorphic physics" comic series of vibrations and waves. The research questions are:

1. What are the characteristics of the "isomorphic physics" series of vibrations and waves?
2. How is the feasibility of the "isomorphic physics" series of vibrations and waves for junior high school students?
3. How is the effectiveness comic "isomorphic physics" series of vibrations and waves increasing the learning interest of junior high school students?

RESEARCH METHOD

This research is a type of research and development using a DDDE model (Figure 1) consisting of decide, design, develop, and evaluate stage (Ivers & Baron, 2002). The small-scale trial activity was carried out at SMP Negeri 11 Sota with 24 students as respondents. This research began with the deciding phase by analyzing the needs that aim to examine the problem more deeply and continued by studying the theory to find solutions to the issues found. The solutions found were then formulated in a product creation guideline as a reference for development.

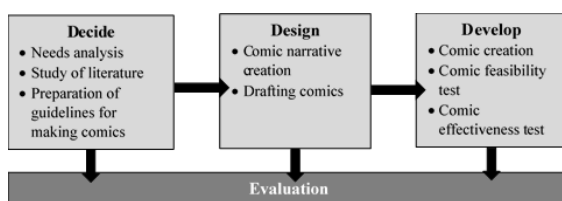


Figure 1. DDDE stage in making comic

The next stage is to design a product developed in the form of comic narrative. The design is guided by guidance that has been created in the previous step. After that, there is a development stage that aims to develop the product and the implementation of comic fea-

sibility test (Husna et al., 2021; D. K. Sari, 2021; Yektyastuti & Ikhsan, 2016). The feasibility poll indicators can be found in Table 1.

Tabel 1. Indicators of product feasibility questionnaire

| Aspect | Indicators |
|----------|--|
| Material | <ul style="list-style-type: none"> • Content comprehensiveness • Content accuracy • Material scope • Question practice |
| Language | <ul style="list-style-type: none"> • Language organization • Readability |
| Medium | <ul style="list-style-type: none"> • Comic design • Visual quality |

Once the product has been adapted to the guidelines, the product is tested on a small-scale class. The implementation of comic trials ends with the provision of learning interest questionnaires as data to obtain information on the effectiveness of products to learners' interests. The effectiveness test questionnaire consists of 10 (ten) statement items divided into 5 (five) positive statements and 5 (five) negative statements developed from 4 (four) indicators. The results of practicality and effectiveness tests are then analyzed and refined at the evaluation stage.

The data obtained from development research consists of due feasibility data, practicality data, and effectiveness data. All three are in good product condition (Nieveen, 1999; Sari, 2020; Sari et al., 2018). Although in this study, there was no test of the practicality of the product. The test results were then analyzed using the ideal Standard Deviation analysis technique (Widoyoko, 2009) and percentage. The average score obtained is then compared with the product quality criteria following the ideal standard deviation as in Table 2.

Furthermore, the percentage score is interpreted to determine whether or not the product is good. The percentage category (Bahri et al., 2020; D. K. Sari et al., 2021) can be seen in Table 3.

Table 2. Product quality criterion

| Score Range | Criterion |
|--|-----------|
| $X \leq X_i + 1.8 S_{b_i}$ | Excellent |
| $X_i + 0.6 S_{b_i} < X \leq X_i + 1.8 S_{b_i}$ | Good |
| $X_i - 0.6 S_{b_i} < X \leq X_i + 0.6 S_{b_i}$ | Adequate |
| $X_i - 1.8 S_{b_i} < X \leq X_i - 0.6 S_{b_i}$ | Bad |
| $X \leq X_i - 1.8 S_{b_i}$ | Poor |

Table 3. Interpreted of percentage score

| Percentage (%) | Category |
|----------------|-----------|
| 0 – 20 | Poor |
| 21 – 40 | Bad |
| 41 – 60 | Adequate |
| 61 – 80 | Good |
| 81 – 100 | Excellent |

RESULT AND DISCUSSION

The implementation of the activity begins with the analysis of needs, namely observing, reviewing the literature, and compiling the comic's creation guidelines for vibration and wave materials. The results of science teacher interviews and classroom observations showed that science teachers still lack variation in using learning methods. It makes learners accustomed to hearing, note down and memorizing the material provided. This situation leads to a lack of understanding of the concept of learners. Most of them are less interested in following the learning, as a result of which the learners do not understand the concept of the material obtained, especially vibrations and waves.

In addition, theories are collected through literature studies to obtain solutions to the problems faced. Based on the study results, empirically, students tend to prefer picture books with an exciting mix of colours and presented in a look like a tangible cartoon (Buchori & Setyawati, 2015). Media that matches the criteria given are comics. Comics are also defined as one of the leading learning media compared to other media to increase learners' knowledge (Haroky et al., 2019). Comics can attract interest to improve the interaction of learners in the learning process. Based on observations and interview, comics have never been used in the learning process.

Another purpose of the literature study is to determine the subject matter, Core Competencies, Basic Competencies, and learning objectives. The next activity is to arrange a guide to making photonovel. This guide aims to explain the development of isomorphic physics photonovel media, including understanding, objectives, product specifications, and indicators of isomorphic problems developed and used. Thus, the comics developed contain content in vibration and wave material for junior high school students.

This material is associated with a narrative that tells about the daily life of Merauke teenagers. Things attributed to examples of vibration, such as when riding a motorcycle with the use of a ruler. Examples of waves such as gasing games, waves generated by water ripples while fishing, and singing. Phenomena that are close to the daily life of these learners have similarities in terms of concepts, principles of problem-solving and problem-solving measures (Sari et al., 2019) so that it can be said to be isomorphic.

In addition to containing the interconnectedness of vibration and wave materials that are isomorphic, comic making is also adapted to core competencies, essential competencies, and learning objectives. The depth of the material is adjusted to the cognitive level of junior high school students. The core competency in this comic is "understanding knowledge (factual, conceptual, and procedural) based on its curiosity about science, technology, art, culture, related phenomena, and visible phenomena".

The primary competency contained in this photonovel is to "understand the concept of vibration, wave, sound, and hearing as well as its application in the sonar system in animals and daily life". The purpose of learning in this photonovel is contained in the indicators of learning. The learning objectives expected to be achieved in this learning are "learners can understand the concept of vibration and waves and apply them in daily life". In addition, the comic also uses communicative language. The language in the narrative is adapted to the col-

loquial language of Merauke teenagers.

Based on the things that have been presented, it can be concluded that the main characteristics in the comic of isomorphic physics of the series of vibrations & waves include containing vibration and wave materials whose application is isomorphic. It also follows the level of cognitive abilities of junior high school students. This characteristic is shown on the cover page describing the type of comic (comic of isomorphic physics/ *forfis*) and the material contained in the comic (vibration and wave). The characteristics of the isomorphic problems differ in context but using the same concept in solving process. The goal is to help learners understand the safety and differences of two or more issues.

The characters used in the comic consist of 5 characters. The comic narrative is about the occurrence of physics in everyday life. The problems raised are related to vibrations on the motor when passing through a perforated road, a game of *gasing* using ropes by looking at the waves of yarns formed, ripples of water waves, and explanation of the association of problems with the material Vibration and Waves junior level. The developed comic cover display is presented in Figure 2.



Figure 2. The cover of comic “isomorphic physics”

The developed comic arrangement consists of the front page, table of contents, core competencies, essential competencies, learning objectives, characters greeting, comic usage instructions, comic content and developer profiles. The experts then reviewed the comic created based on the guidelines for making photonovelas and narratives. The review aspects are material, language, and media. There were 20 statements on the feasibility test assessed by the reviewer. By the many statements, the criteria for the comic feasibility test are presented in Table 3. It corresponds to the ideal average score for 20 statements is 60, and the ideal standard deviation (S_{Bi}) is 13.3.

Table 4. Criteria of comic’s feasibility

| Score Range | Criteria |
|------------------------|-----------|
| $X \leq 83.94$ | Excellent |
| $67.98 < X \leq 83.94$ | Good |
| $52.02 < X \leq 67.96$ | Adequate |
| $36.06 < X \leq 52.02$ | Bad |
| $X \leq 36.06$ | Worst |

The average score of the feasibility test analysis is 85. Per Table 3, it can be concluded that photonovel of isomorphic physics of vibration and wave material falls into the category of "Excellent". In addition, based on the three experts' review, the conclusion that the photonovel physics isomorphic material vibrations and waves are "worth using with revision".

Based on aspects, experts' results of the study of material aspects show a percentage of 78% by Expert 1 and 84% by Expert 2 and Expert 3 (Figure 3). Table 3 stated the results obtained by reviewer 1 assessed the material in the category of "Good", and Reviewer 2 and Reviewer 3 evaluated the product to be in the type of "Excellent". This data confirms that the developed comics meet the criteria of completeness of content, content, material coverage and practice of the question.

The next aspect analyzed is the language aspect. Based on the data obtained, the percentage of the score given is 85% (Expert 1), 90% (Expert 2), and 100% (Expert 3). This data is interpreted based on Table 3, showing that the language used in comic is in the cate-

gory "Excellent". It indicates that the language used meets the criteria of language organization indicators and readability. The percentage aspect of the language can be seen in Figure 4.

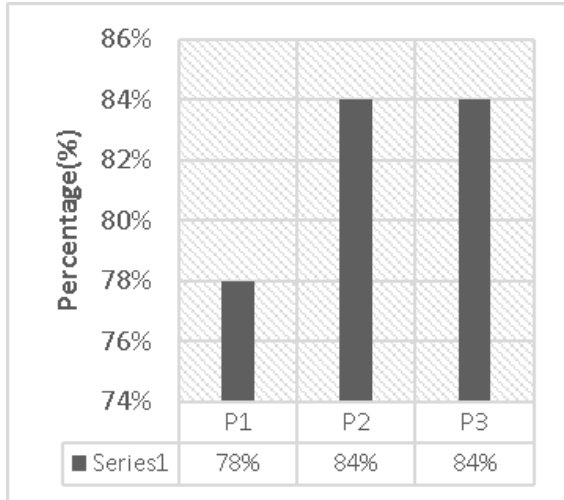


Figure 3. The percentage of the material aspect

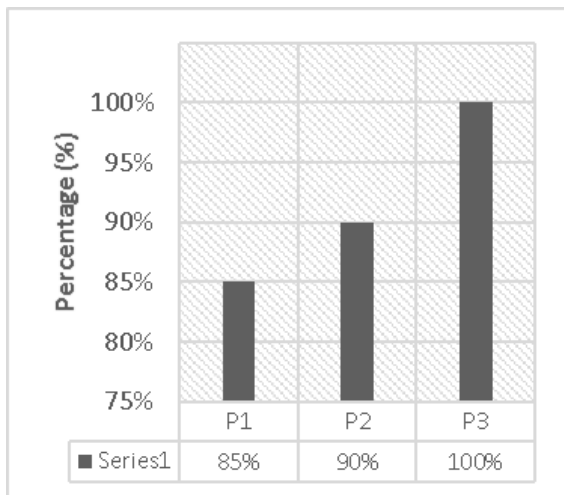


Figure 4. Percentage of language aspect

The last aspect that is assessed is the media aspect. This aspect relates to the visual appearance of the comic. Indicators that must be evaluated were design and visual quality. Based on the data obtained, the percentage of reviewers' assessments is 90% by Experts 1, 80% by Experts 2, and 83% by Experts 3 (Figure 5). It means that the score given by Expert 1 is in the "Good" category, and the score given by Expert 2 and Expert 3 is in the "Excellent" category. This developed product has met all three aspects of the product feasi-

bility test.

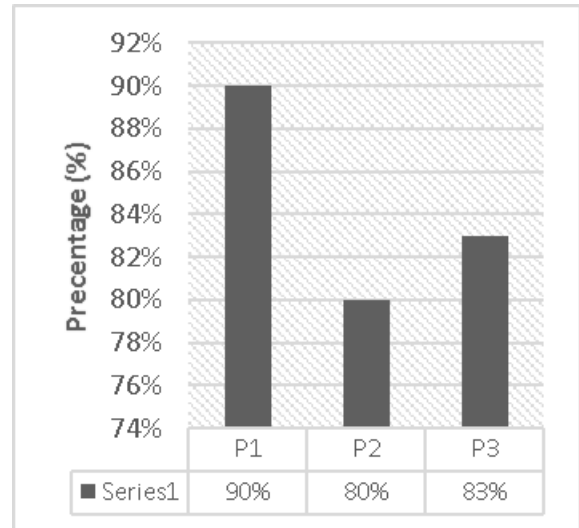


Figure 5. Percentage of media aspect

With the advice and suggestions of experts, then revisions were made to the comic. The recommendations include the consistency of using "shape" in conversation balloons and the addition of wave material. Scene before revision can be seen in Figure 6. The revised results of the acquisition of material to the comic are presented in Figure 7.

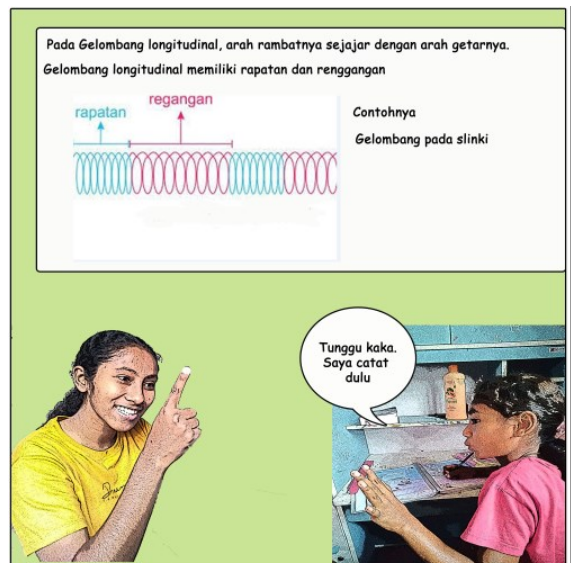


Figure 6. Scene before revision

The revised product was then distributed to students in physics learning. This comic was used as a supporting learning resource. After that, students were given a questionnaire of product effectiveness to the students' interest

in physics learning. The results of the analysis using simple statistics converted in percentages showed that 91.7% of students expressed interest in learning physics using comics "isomorphic physics" series of vibrations and waves, while 8.3% of students expressed no interest in using the comics in learning. The graph of the percentage of interest is presented in Figure 8.

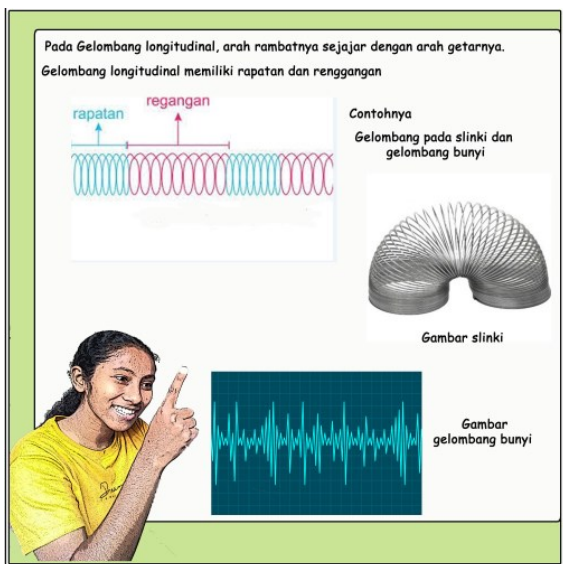


Figure 7. Revision of material on the comic

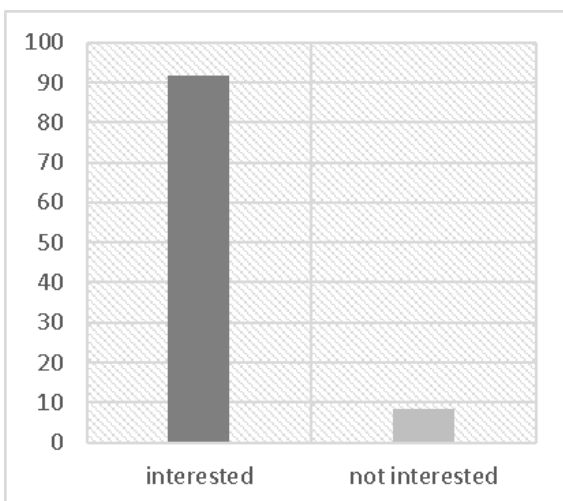


Figure 8. Graph of the percentage of interest

The isomorphic physics comic developed is declared appropriate to the criteria of feasibility and effectiveness. It means the product produced has met two of the three measures of a good product that is feasible, practical, and effective (Nieveen, 1999). This study has not

been able to carry out practicality tests which are limitations in this study. Product development meets at least two criteria so that educational products can be declared feasible (Rahma et al., 2016) for use in learning.

CONCLUSION

The comic "Isomorphic Physics" is a comic that contains isomorphic physics problems. This comic includes issues related to vibrations and waves with adjusted characteristics of the research location. The development of this comic was carried out by carrying out due feasibility and effectiveness. The results of the analysis of students' interest in using "isomorphic physics" comics were 91.7%. The analysis results showed that the developed comic had met the criteria of feasibility and effectiveness in increase learning interests.

The use of learning media using comics in the form of comic is very interesting for students. Therefore, comic is a suitable choice of learning media used in learning physics. The hope for further researchers is to be able to develop comic series in the form of comic on other physics materials. Further research should develop a comic that meets the requirements of feasibility, practicality and effectiveness.

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