"Tempera-Tour": Developing an Alternative Comic as Media Learning for Temperature and Heat Topics Through Traveling Story

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Abstract. This study aims to develop comics on the theory of temperature and heat by incorporating the traveling storyline in its delivery. Comics are designed to be used as physics learning media for class XI high school. This development consists of four stages, namely: define, design, develop, and disseminate. The defining phase is carried out a need’s analysis to determine the urgency of the additional physics learning media in the form of comics. The design stage is in the form of compiling the comic storyline. The storyline presented follows the comic elements as story media. The development phase was carried out, making comic sketches and validated by several experts. The last stage is the distribution of products spread to high school. Based on the results of the feasibility test, obtained an average percentage of achievements for material experts 86%, learning media experts 89%, literary experts 81.25%, and graphic-design experts 88.4%. The average overall value obtained shows that the quality of the physics comic score interpretation of the temperature and heat material is rated very well. Based on the feasibility test and the trial of this comic product, it is declared feasible to be used as a physics learning media.

1. Introduction
The learning process currently involves a lot of media and visual technology. Visual media that are commonly applied to display still images such as film strips, photo slides, drawings or paintings and prints [1]. Visual media can improve memory because information relating to past experiences can be collected and restated through material and visual messages [2-5]. In accordance with previous research that learning media can utilize various types of representations, and visuals become one of the representations that even support contextual learning [6]. Visual media as a learning medium is believed to be very effective because it can improve the memory of students so that a learning goal can be achieved in learning [7]. Science learning cannot be separated from the media and teaching materials used. However, the media and teaching materials circulating in the field are not in line with the government's expectations concerning integrated science material [8]. The subject of Physics in high school often consists of abstract concepts that require high imagination. The concept of physics is more fun when it is packaged in the form of pictorial visual media, especially in visualizing abstract concepts. Images can overcome the limitations of space and time because not all objects, objects, or events can be brought to class, and not always children can be brought to the object/event [9].
The results of the needs analysis questionnaire of 73 respondents found that 68.5% claimed to dislike reading physics books. The dislike arises because of the difficult material (17.8%), the book presentation technique that is less interesting (61.6%), and the difficult language to understand (20.5%). Based on the data obtained and the analysis conducted, it can be concluded that learning media are needed with the visualization of images to attract the attention of students. One of these learning media can be in the form of comics. Comics have a high potential interest for teenagers (students). Because 100% of students support learning comics as a learning resource for students, these results are consistent with the explanation in Wired Magazine that comics can be the key to educating people who are reluctant about science [10]. Similar research also explains that to increase more diverse involvement in informal science learning, the development of science comics is needed [11].

The results of an interview with one of the Supervisors at Gramedia Matraman obtained data on average book sales in December 2018. The data that the writer got was the turnover for comic books in that month was 7,367 comic books sold. As for the general book sales turnover in the sense of comics such as hobby books, agriculture, and craft, only 333 books were sold that month. Comics ranks second at the top of all Gramedia bookstore websites, which are accessed at 22:15 WIB on January 10, 2019, with 2411 comics. Enthusiasts for buying this comic according to Mr. Bondan are not only from teenagers but also adults. It means that the interest of teenagers towards comics is still high so that comics can be used as an alternative learning media in visualizing the concepts of physics.

Previous research has been carried out in the presence of comic books on Newton's legal material, which includes the notion of force, friction force Newton's First Law, Newton's Second Law, and Newton's Third Law. This comic was made using Coreldraw and Photoshop applications with A5 book sizes and A4 80-gram paper used. The contents in this comic are also in the form of colored pictures to make it more interesting for students to read [12]. The next research is the making of comic strips from Galileo Galilei using a Comicker application that can be downloaded through Google Play. After the comic is ready, the comic results can be saved in the handphone gallery [13].

Therefore, this research makes comics as a learning media. The design of comic, using fiction story and giving thematic about traveling.

2. Methods
This research was conducted in November 2018 - July 2019 using the Research and Development method, which refers to the 4-D (Four D) development model.

2.1. Steps
The research and development model that is used refers to the 4-D model. The four stages, namely Define, Design, Develop, and Disseminate [14].

2.2. Define
This stage is to determine and define the comics that will be developed. The comics that will be developed are learning comics. At this stage, it consists of a literature study that aims to find out some of the problems that occur in current education and analysis of students by distributing questionnaires.

2.3. Design
The product design stage is comics as a learning medium consisting of several stages, namely the stages of designing comics, the stages of making scenarios, and the stages of sketches. In this study, comics was develop using the scenario of fiction story, different from previous design [15-16] that develop comic with scientist historical and cartoonist matter.
2.4. Develop

The development phase that aims to produce comic products that have been designed based on the Design stage. At this stage also went through several stages, namely the line art stage, the coloring stage, the lettering stage, and the packaging stage.

Figure 1. Cover comic sketch stage

Figure 2. a) Linear stage; b) Coloring stage, c) Lettering stage
The development phase is designed to produce products that are designed based on the Design stage. At this development stage, it also went through several stages, namely Barisart (thickening sketch), coloring, coloring, and packaging.

2.5. Disseminate
The purpose of this stage is to disseminate comic products. The results of this physics comic book will be distributed to the Jakarta State High School 30 library and can be borrowed by both students and teachers.

3. Discussions
This research produced a physics comic book on the temperature and heat content in high school. After that, there is an introduction and a table of contents in the comic to make it easier for students to read this comic. Then there is the introduction of characters in the comics-making; it is easier for students to understand the storyline. The contents of this comic into three sub-chapters namely Turkey, University and Cappadocia, which can be seen in Figure 3. Finally, in this comic, there is a bibliography, which is a reference for researchers in making this comic.

Figure 3. Sub-chapter contents of the comic

The comic product developed has two cover pages, front and back, which can be seen in Figure 4.
Comics developed are also complemented by supporting additional information such as a preface, table of contents, and character characters. The preface in this comic provides an explanation of the existence of assistance and support from various parties towards the making of comics as well as supporting advice. The table of contents in this comic presents pages per chapter to facilitate the reader in reading this comic. Portrayals of characters also need to be made in comics to make it easier for readers to understand the storyline. Information supporting comics can be seen in Figure 5 below.

The comic that was developed promotes its worthiness. Test the feasibility of the material, learning media, graphics, and language 86% with "very good" interpretations. This value is obtained based on material in accordance with the competencies in the curriculum, completeness of materials in accordance with competency indicators, breadth of materials in accordance with basic competencies, materials that are in accordance with competency indicators of competence, facts and concepts / principles / laws / laws Presented accurately or not wrong concepts, procedures used in accordance with scientific principles, materials that are in accordance with the development of physics and the
development of (current), material related to daily life and interesting presentation and in accordance with the cognitive level of students.

Table 1. Results of Validation Tests by Material Experts

| No. | Aspect                        | Percentage of Achievements | Interpretation |
|-----|-------------------------------|----------------------------|----------------|
| 1.  | Dimension of knowledge        | 86%                        | Very good      |
| 2.  | Finesse and contextual        | 83%                        | Very good      |
| 3.  | Presentation                  | 88%                        | Very good      |
|     | Average of all aspects        | 86%                        | Very good      |

The components contained in the instructional feasibility instrument of learning media obtained 89% of the results with "very good" interpretations. This value is obtained based on the basic competencies to be achieved, indicators of achievement of basic competencies following basic competencies and learning objectives following indicators of competency achievement. The value obtained is also based on the appropriate material and content enrichment component.

The Required Component in the graphic feasibility test instrument obtained 88.4% with "very good" interpretation. This value is obtained according to the suitability of the size of the book used with the thickness of the comic book made and with the contents of the book. This value is also obtained based on the skin design, the layout of the contents of the book and typography of the contents of the book starting from the layout does not cover the face and back, layout composition, color used and the letters (size and type) used. The evaluation is also based on the layout of the comic panels and balloons.

Table 2. Results of Validation Test by Learning Media Experts

| No. | Aspect                                         | Percentage of Achievements | Interpretation |
|-----|-----------------------------------------------|----------------------------|----------------|
| 1.  | Components of indicators and objectives learning | 83%                        | Very good      |
| 2.  | Components of material enrichment             | 85%                        | Very good      |
| 3.  | Content compatibility                         | 100%                       | Very good      |
|     | Average of all aspects                         | 89%                        | Very good      |

Table 3. Validation test results by Graphic Experts

| No. | Aspect                                    | Percentage of Achievements | Interpretation |
|-----|-------------------------------------------|----------------------------|----------------|
| 1.  | Book size                                 | 100%                       | Very good      |
| 2.  | Book leather design                       | 73%                        | Good           |
| 3.  | The layout of the contents of the book    | 93%                        | Very good      |
| 4.  | The typography of book content            | 87.5%                      | Very good      |
|     | Average of all aspects                    | 88.4%                      | Very good      |

The components contained in the language feasibility test instrument obtained 81% with "very good" interpretation. This value is obtained based on the contents of the comic, characterizations in the comics (harmony of the characters between one another), the presentation and sentences used in the comics are by Enhanced Spelling.
Table 4. Validation Test Results by Literary Experts

| No. | Aspect                        | Percentage of Achievements | Interpretation |
|-----|-------------------------------|-----------------------------|----------------|
| 1.  | Fill in the comic             | 100%                        | Very good      |
| 2.  | Characterization in comics    | 75%                         | Good           |
| 3.  | Presentation                  | 75%                         | Good           |
| 4.  | Sentences in comics           | 75%                         | Good           |
|     | Average of all aspects        | 81.25%                      | Very good      |

After researching formative evaluation and development, the comics developed in the form of physics comics on temperature and heat material are already good and materially feasible, learning media, language, and graphic design.

4. Summary

After researching formative evaluation and development, the comics developed in the form of physics comics on temperature and heat material have passed the feasibility test by experts. The results of the feasibility test by material experts obtained 86% results; learning media obtained a value of 89%, language with a score of 88.4%, and graphic design with results of 81.25%. The validation show that the comics developed for temperature and heat material deserve to be used as one of the students' independent learning media.

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