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Research Article

Physics comics learning media based on *Engklek* traditional games on parabolic motion topics to improve creativity

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Abstract

In the 21st century science education starts to need innovation and is considered to bring about science, technology, engineering, mathematics (STEM) to provide the context learned in learning. Comic strips have been around for more than one hundred years. Comics become an interesting medium in the learning process as a global phenomenon. Comics are not only as a medium of entertainment but can be utilized in the field of education in schools. The aim of this study is to examine the effect of the use of comic media on the development of students' creativity in teaching the subject of parabolic movement in physics lesson. This research method is the R & D Educational Development (Educational Research and Development) with the 4-D model consists of 3 stages, i.e.: define, design, and develop. The physics teachers and peer reviewers are to assess and review the product from the theory feasibility and presentation of the media. The media accepts assessments and inputs for use as media improvements. The trial uses assessment tests (question test) and non-tests (questionnaire) to students. The result this research is physics comics learning media based on Engklek traditional games in the parabola motion topics to improve creativity can disseminate to students for physics learning process outside and inside the school.

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Introduction

The process of learning science is worthy of using literacy products such as comics (Aisyah, Zakiyah, Farida, & Ramdhani, 2017). Comics, animation, and games have great value and role in the entertainment media (Sheu & Chu, 2017). The story in the comic is a step to invite students who are lazy to read to like reading so useful (Negrete, 2013).

In the 21st century science education starts to need innovation and is considered to bring about science, technology, engineering, mathematics (STEM) to provide the context learned in learning (Michael, Hamilton, & Kootsookos, 2020). Comics are not only as a medium of entertainment but can be utilized in the field of education in schools (Widyastuti, Mardiyana, & Saputro, 2017). Comics include media that are often used in everyday life and as entertainment facilities (Sari, Ratnaningtyas, Wilujeng, Jumadi, & Kuswanto, 2019).

Comic strips have been around for more than one hundred years. Comics become an interesting medium in the learning process as a global phenomenon (Honarvar & Rahimi, 2011). Educators utilize comic media to engage creative and innovative students. Stories in comics require proper writing techniques and plots to convey the message accurately and clearly (Bitz & Emejulu, 2016). Making comics can be used to encourage all students who have a variety

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of potential, most students prefer picture books or comics (Lin & Lin, 2016). Comic books that have the features of humor, narration, and visual representation are considered potential media for science communication (Nikmah, Sari, Kuswanto, & Wardani, 2018).

Comics can be used as a fun and interesting learning medium for students at all levels of School (Fuccia, Witteck, Markic, & Eilks, 2012; Kim, Chung, Jang, & Chung, 2017). Comics are used by students at all levels to determine student interest in comics. Comics are expected to invite and encourage students to be curious in the learning process (Kim et al. 2017). Comics are modern learning strategies that are gaining popularity in science learning (Wiegerová & Navrátilová, 2017). Comics can be applied in learning activities for students and this media can be applied anywhere and anytime (Sari, Nikmah, Kuswanto, & Wardani, 2019).

Comics can be effective in creating awareness, educating, and supporting positive attitudes towards someone with a disability (Tekle-Haimanot et al. 2016). The main purpose of science education is to invite students to develop suitable concepts about science (Tsai, 2006). Strip comics and images as visual media, used to enhance students' creativity and understanding abilities (Listyani, 2019). The use of comic as a learning can tool enhances students' translation competences, cultural knowledge, and motivation (Furuhata-Turner, 2013). The effectiveness of the use of comic media on the storytelling skills of the students can increase (Lestari & Mustadi, 2020).

The need to maintain local wisdom values so that they remain characteristic of each region and exist in Indonesia (Fajarini, 2014). *Engklek* is a game that is found in various regions in Indonesia with various names such as Sundanese manda, ingkling, hoof, jlong jling, pecle, sondah, plate, or dampu. This traditional game was brought by the Dutch to Indonesia. The traditional *Engklek* game has problem solving values. This can be applied by organizing media and given to students in improving problem solving through traditional games *Engklek* (Iswinarti, 2017). Contextual learning is developed using science learning based on traditional game (Anwari, Nahdi, & Sulistyowati, 2016).
Students can make comics with their own creativity. Educators encourage the development of creativity and critical thinking of students (Ribeiro, 2016). The comics produced show the idea that educators can encourage and encourage students to learn. Relevant curriculum can inspire original and creative ideas (Bitz & Emejulu, 2016).

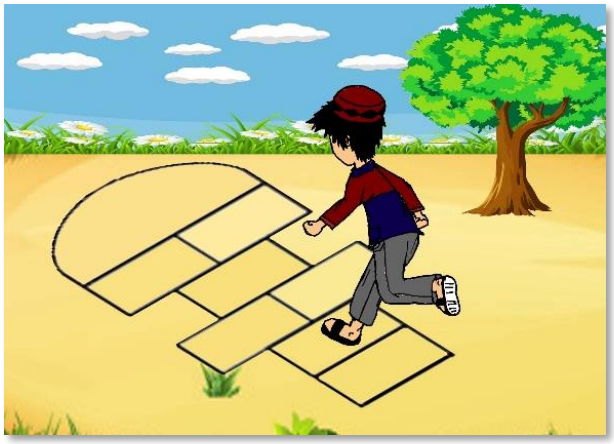


Figure 1.
Engklek Traditional Game

Researchers will apply research regarding the development of physics comics learning media based on the traditional game of the *Engklek* in the parabolic topics to improve creativity. This media can be applied in learning activities to improve creativity for students and can be applied anywhere and anytime.

Parabolic motion is a material that requires several pictures and real examples that exist in everyday life. Comic media is given so that students are able to imagine local wisdom of the traditional *Engklek* game related to parabolic motion material. students also have other imaginations that connect the motion of the parabola with things in the environment.

Parabolic motion is a material that requires several pictures and real examples that exist in everyday life. The researcher created a comic strip that links the parabolic movement chapter with local wisdom of the traditional game *Engklek*. Comic media is given so that students are able to imagine the local wisdom of the traditional *Engklek* game related to parabolic motion material. Students also have other imaginations that connect parabolic motion with other things in the environment. So that students can give real examples.

Sometimes students lack initiative if they are required to connect a physics material that exists in everyday life. They are still confused to understand the real concept of physics. So that researchers provide solutions to make media that is associated with local wisdom.

Students are very enthusiastic when researchers provide new media in the form of comics to be used in the learning process. Some students in the class were given comic media that had been imported into smartphones. So some use paper media and some use Android media. Comics in android are equipped with additional videos about parabolic motion material. The following week they exchanged media, so they could use both. Students make short videos in groups by demanding their own creativity.

Problem of Study

The problem of this research is,

- Does the use of comic media in teaching parabolic movement in physics lesson have an effect on the development of students' creativity?

Method

Research Model

This research is a case study of qualitative research techniques. In the case study, any phenomenon is described (Cresswell, 2016). The final media of this research is the physics learning comics media based on *Engklek* traditional game on parabolic motion topics to improve creativity. This research method is R & D (Educational Research and Development) with the 4-D development model. The procedure used 4-D in this study consisted of 3 stages, namely: defining, designing, and developing.

The initial step of product development (define and design) is to describe aspects of the theory of parabolic motion. Then make a plot, draw characters, storyboards, and combine all the ready-made images to be used as comics. Drawings are made using sketchbooks and pencils, images are scanned, the coloring process uses computer software. Then merge all images that have been completed and printed out.

Participants

Data was taken in class 10 science at Banjar State Islamic Senior High School on October 17-31, 2019. Sampling was carried out randomly and aims to reintroduce the traditional game *Engklek* that some students have known as a child. The making of comics based on local wisdom aims to invite students to learn the chapter of parabolic motion and preserve local culture. Utilization of existing media by preserving local wisdom.

Data Collection Tools and Analysis

Product criteria that have been analyzed and assessed using Aiken V with information $s = r - I_0$, I_0 is lowest validity rating, r is number given by the assessor, c is highest validity rating, and n is number of assessors as shown in Table 2.

$$V = \sum \frac{s}{[n(c-1)]}$$

Figure 2.
Aiken V Formulation

Table 1.
V Aiken Product Valuation with Criteria

Score Range	Category
0,00 < V ≤ 0,25	Not good
0,25 < V ≤ 0,50	Pretty good
0,50 < V ≤ 0,75	Good
0,75 < V ≤ 1,00	Very good

The development process uses the stage of product assessment to experts. The media is assessed by peer reviewers and physics teachers. Peer reviewers and physics teachers assess and review products from theory and the media. The media accepts assessments and inputs for use as media improvements. Then the media is applied in the field using assessment tests (questions) and non-tests (questionnaires).

Procedure

Physics comics based on local wisdom of traditional games *Engklek* were made to increase student creativity in the physics learning process. Comics are provided with interesting pictures that invite students to understand the material given. Even though the material was provided with pictures, students were still enthusiastic about participating in

learning activities which they thought were new. Students are also invited to be creative after reading the comic. Students imagine by connecting parabolic motion with other local wisdom or with things in the student environment.

Figure 3.
The Learning Process in the Classroo

Several pictures were taken during the learning process using Physics comic media based on local wisdom of the traditional game *Engklek*.

Figure 4.
Students are Discussing

Figure 5.
One Example of a Student Video

The first step is defining, researchers find problems that exist in schools. The problem of not maximizing the use of media in these schools with certain characteristics. Researchers create media that are connected with local materials and wisdom. The physics material in the parabolic motion chapter is first analyzed based on aspects of local wisdom of the traditional game *Engklek*.

The second step is design, before making the story line the researcher determines the characters who will be involved in the comic. Then the material of parabolic motion that has been analyzed based on aspects of local wisdom of the traditional game *Engklek* is compiled with a storyline and compiled with a narrative. Then draw characters, place settings, and times according to the storyline and narrative that has been made. then the image is scanned and colored using the Photoshop application. All images are printed and organized into a comic.

The third step is development, where the finished comics are judged from the media and material aspects. The feasibility of material and media was assessed by material experts, media experts, physics teachers, and peer reviewers. After it was said that it was feasible to use, the physics comic based on local wisdom of the traditional game *Engklek* was tried out on students in grade 10 science at Banjar State Islamic Senior High School.

The process of making this media takes about three months, from July 2 to October 10, 2019 starting from define, design and develop. The maximum manufacturing process makes the manufacturing process fast.

Table 2.
Local Wisdom Physics Concepts: Engklek Traditional game

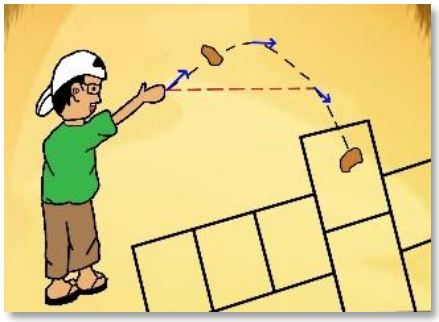
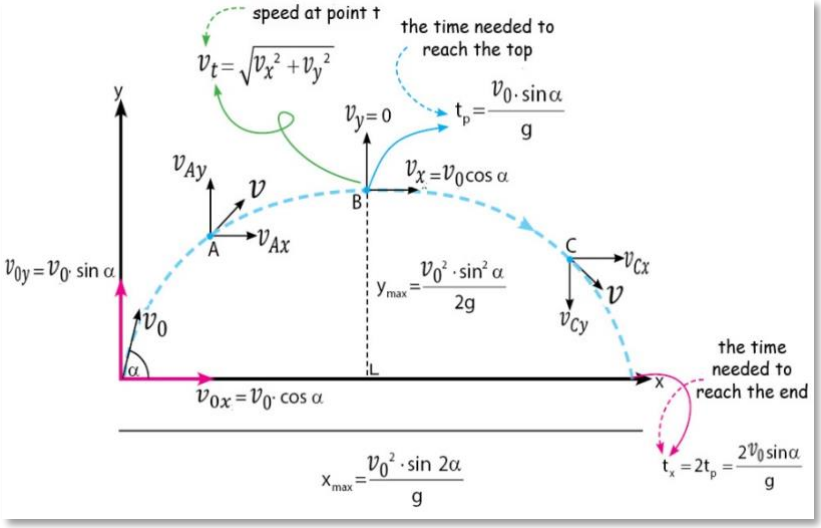
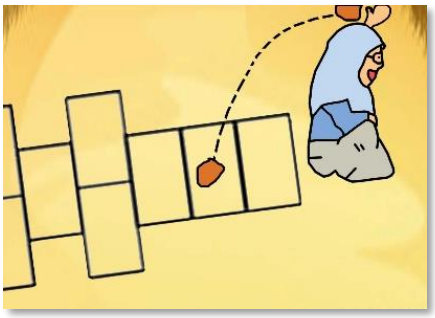
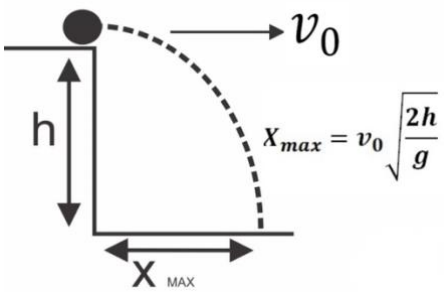
Activities	Theory
 **Figure 7.** *When Gaco is Thrown into the Game Plot and Forms a Semicircle or Parabolic Motion*	Parabolic motion is a two-dimensional motion of objects that forms an elevation angle on the y axis and x axis. The y-axis (vertical) is Irregularly Straight Motion and the x-axis (horizontal) is Irregular Straight Motion. There is no link between the movements of the two objects, they only form a parabolic motion. The x-axis is a component of Regular Straight Movement. Movement produces velocity on a horizontal axis at a fixed point or position. The initial component is a symbol of the initial speed. The difference between the x axis and the y axis is the displacement symbol / distance on the x axis which is indicated by X, whereas on the y axis it is indicated by Y.  **Figure 8.** *Parabolic Motion Track*
 **Figure 7.** *When Gaco is Thrown into a Game Plot and Forms a Quarter Circle or Half Parabolic Motion*	 **Figure 9.** *Half Parabolic Motion Track*

Figure 10.
Drawings are Made Using Sketchbooks and Pencils

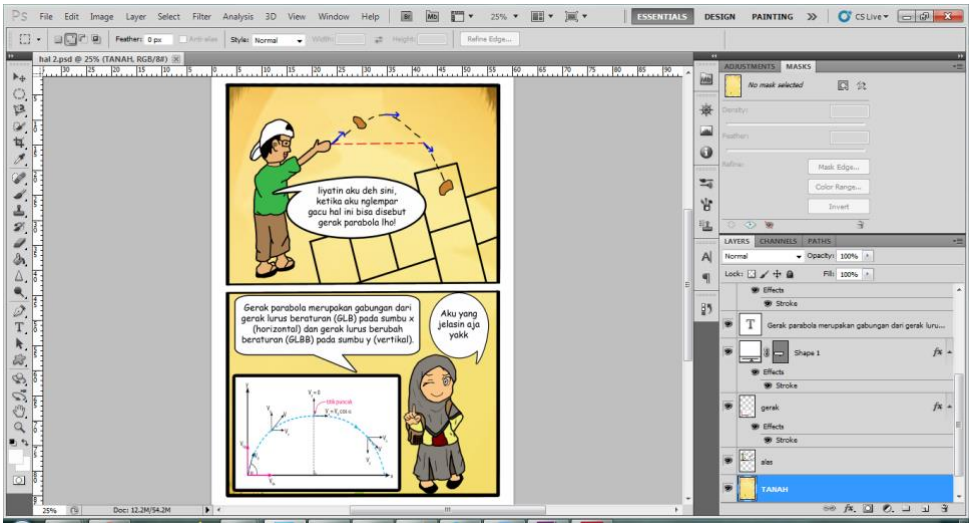


Figure 11.
The Coloring Process uses Adobe Photoshop Software

Figure 12.
Final Product Physics Comic Learning Media

Results

The product trial in the research is the development stage, namely the assessment by peer reviewers, physics teachers, and use test questions and questionnaires. The purpose of this assessment is to produce a decent product. The data consisted of the results of peer reviewers, physics teachers, question test and questionnaire from student response results.

Table 3.
Product Evaluation of Theory Aspects

No	Aspect	*Aiken V*	Category
1	Display	0.81	Very Good
2	Theoretical coverage	0.87	Very Good

Table 4.
Product Evaluation of Media Aspects

No	Rated Aspect	*Aiken V*	Information
1	Visual Quality	0.91	Very Good
2	Content	0.80	Very Good
3	Comic Design	0.86	Very Good
4	Readability and Language	0.79	Very Good

Table 5.
Product Evaluation of Ease Aspects

No	Rated Aspect	*Aiken V*	Information
1	Perceived ease	0.83	Very Good
2	Use of real products	0.86	Very Good
3	Effectiveness	0.87	Very Good
4	Understanding	0.80	Very Good

Product evaluation of theory and media aspects by peer reviewers and physics teachers. The three tables above shows the product evaluation of theory, media, and practical aspects that stated in very good categories.

Media applied in the field is used to see and know openness of reading, effectiveness, usefulness, and clarity of parabolic motion topics in its application. The media is also used to improve student creativity.

Table 6.
Overall Assessment Results with The Media

Media	Theory	Mean
4.52	3.81	4.17
Very Good	Good	Good

Assessment of the feasibility of physics comics learning media based on *Engklek* traditional games to improve creativity, produce on average of 4.17 in the good category. Physics comics learning media based on *Engklek* traditional games to improve creativity is feasible to be used and continued in the disseminate to students. Figure 12 to display about physics comics learning media based on *Engklek* traditional games.

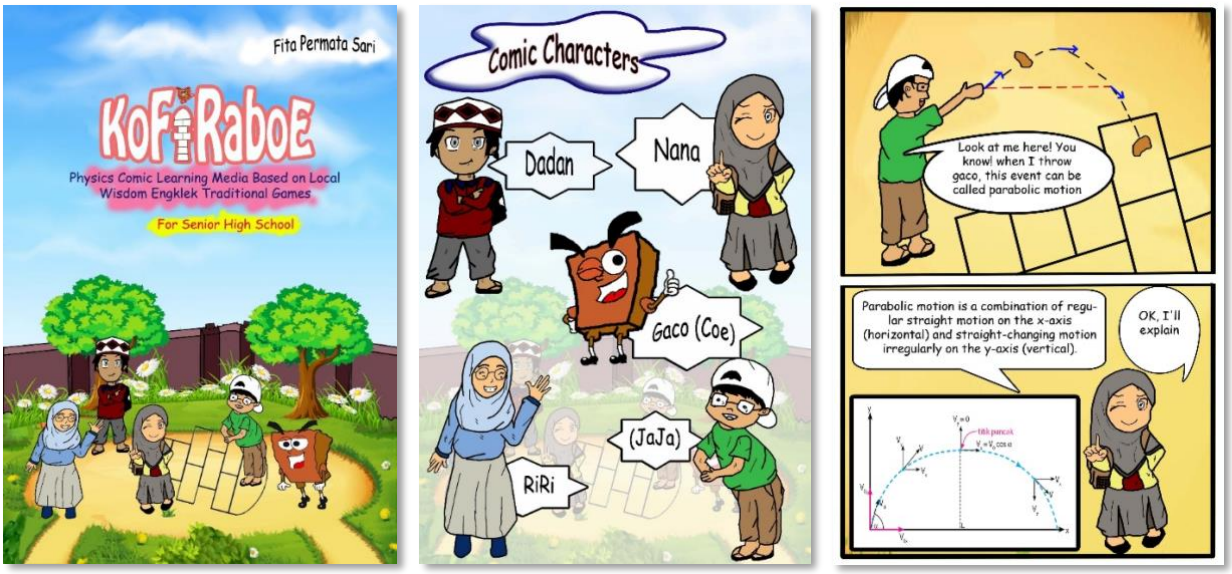


Figure 12.
Final Product Physics Comic Learning Media Based on Engklek Traditional Games

Discussion and Conclusion

The product manufacturing phase starts from define, design, and develop. The first step is define starts from found a problem, give a solution with a good idea, developing product design and research, and describe the physics aspects of *Engklek*. Second step is design starts from draw characters, storyboards, designing grooves, combining images with stories that have been made, comics are completed and arranged according to the story. The technique of writing clearly and accurately in comics needs good plot and strong character (Bitz & Emejulu, 2016). Comics are drawn manually using pencil and paper, scanned images, the process of coloring and editing using Adobe Photoshop software in computer. The final stage of the image arranged and printed as needed.

Physics comics learning media based on *Engklek* traditional games in the parabola motion topics to improve creativity has been said to be feasible after though an assessment processes from peer reviewers and physics teachers. The result of *Aiken V* from the media aspect includes visual quality, design, content, readability, and language; material aspects include display and theoretical coverage; and easy aspects include perceived ease, use of real products, effectiveness, and understanding. All three aspects get very good categories. Media is said to be in the right category to be used in physics learning activities and can be applied anywhere, anytime (Sari, Nikmah, Kuswanto, & Wardani, 2019).

Products that have been revised from the validation assessment are continued to trials given to students. Physics comics learning media based on *Engklek* traditional games in the parabola motion topics is said to be feasible after being tested on students. The product assessment from theory and media in the field trial were 4.17 get a very good category and said feasible for applied to students. Science comics can be an appropriate educational tool used in the world of education (Kim et al. 2017). Physics comics learning media can be applied to physics learning for students and categorized as good for all students (Sari, Ratnaningtyas, et al. 2019). Physics teachers can minimize students' concerns when facing the final assessment of physics by conveying concepts that are clear and easy to understand (Putranta & Jumadi, 2019).

Comics can be used as a fun and interesting learning medium for students at all levels of Education (Fuccia et al. 2012; Kim et al. 2017). Science literacy that students have has an important role in developing thinking skills in solving problems in everyday life (Putranta & Supahar, 2019). The process of learning science is worthy of using literacy products such as comics (Aisyah et al. 2017). The language in comics can turn complex science into easy science so that it is easy for students to understand (Lin, Lin, Lee, & Yore, 2015). The local wisdom based physics comic media: android-assisted hopscotch game can improve creative thinking abilities of high school students and products are categorized as suitable for use in the physics learning process (Sari, Nikmah, & Kuswanto, 2020). Physics comics learning media based on *Engklek* traditional games in the parabola motion topics to improve creativity can disseminate to students for physics learning process outside and inside the classroom.

Local cultural values are important in Indonesia, educators must preserve the learning of physics based on local culture such as the *Engklek* traditional game. The initial step of product development is to describe aspects of the theory of parabolic motion. Then make a plot, draw characters, storyboards, and combine all the ready-made images to be used as comics. science comics become an appropriate educational tool used in education and students's science literacy have an important role. Physics comics learning media based on *Engklek* traditional games in the parabola motion topics to improve creativity can disseminate to students for physics learning process outside and inside the school.

Recommendations

The authors provide suggestions for further research that can apply comic learning media to examine other thinking skills. Comic media must be adapted to the skills that will be developed. For physics teachers, this development research can be used to improve students' understanding of concepts in parabolic motion material. As a follow up, the teacher can develop similar android based or paper modules with different Basic Competencies. Utilization of products in learning can be synergized with learning approaches based on student centered learning, HOTS oriented learning models, and enjoyable learning methods. Students can take advantage of various new media provided. Students can also have more experience if the physics teacher provides various models and varied learning media so that they are not boring.

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