

Development of Physics Comic 'History of Physics Series: The Development of Atom'

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Abstract

The quality of education can be improved by developing learning methods, curriculum development, and learning media development. One of them is learning media in the form of comics. This research aims to develop physics comics and analyze the validity of learning media of physics comics on the historical material of atomic development. The research was conducted using the R&D research model (*Research and Development*) with the *4-D model* (Define-Design-Develop-Disseminate). Based on the stages, obtained learning media products that were declared eligible after validation by two high school physics teachers and an expert lecturer gained the average validity in the media component of 90.0%, the display of 89.2%, the material by 90.7%, and the language by 95.4%. In general, the student's responses to the use of physical comic learning media include comic physics can increase motivation in learning (88.6%), students prefer that physics learning uses comic media (88.9%), through comic media, students are introduced to atomic inventors (88.9%), and physics comics can help to understand the historical material of atomic development (83.3%). Based on the study results, learning media of physics comics on the historical material of atomic development deserves to be used in physics. The implication of this study can help other researchers as a reference related to the development of comic physics learning media.

Keywords: Comic; Development of an atom; Physics Learning Media

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INTRODUCTION

Education is an essential factor in forming independent individuals through learning (Anesia et al., 2018). The quality of education can be improved by developing learning methods, curriculum development, and learning media development (Gunawan, 2014). Physics Learning is a process based on understanding and mathematical analysis

(Lesmono et al., 2012). Physics learning requires engaging supporting media to foster students' interest in learning (Ray et al., 2018). Comics are a learning media that presents simple illustrations and drawings with interesting stories associated with learning materials in the real world to support contextual learning (Wahyuni & Lia, 2020).

Research conducted by the uses (Haroky et al., 2019) of android-based physics comics is considered capable of understanding student concepts in Newton's Gravity material. He mentioned that the use of comic media in physics learning could increase students' learning motivation. Science-based comics can improve students' character and cognitive achievements (Nikmah et al., 2019; Yulianti et al., 2016).

Physics comics can be developed on various Physics materials taught in schools, one of which is the History of Atomic Development. The material is physics material that is taught both in the first and top schools. Although it has been taught at two levels, the material history of atomic development is not interesting enough. It is full of memorization ranging from the first theory of discovering atoms to the most recent atomic theory. Because of the directrices of the material, it is necessary to use a more exciting physics learning medium for students to learn about the History of Atomic Development material, one of which is The Physics Comic.

Physics comics have been created by many people and developed by previous researchers. Relevant research developed physics comics through *webtoon*, showing that Webtoon-based physics comics have advantages and disadvantages (Annisa et al., 2020). The advantages are attractive and easy to use but require additional applications and devices to access them. Another relevant research developed physics comic learning media used App called 'Paint Tool SAI' (Savila et al., 2018). The process of creating comics through this application requires devices such as laptops and tablet pens to draw. The advantages of using this application are that the resulting comic results are neater and interesting because it uses digital drawing techniques. However, a comic with a particular material to be used

appropriately as a learning medium needs to be developed first, which must go through the validity test stage. Therefore, the author conducted this study in which the purpose of this study is (1) to develop physics comics on atomic developmental history materials and (2) to analyze the feasibility of learning media of physics comics such as research purposes at number 1.

METHOD

The research was conducted in April–May 2021 using the R&D research model (Research and Development) with the 4-D model (*Define-Design-Develop-Disseminate*) developed by Thiagarajan, 1974. The scheme or flow of research conducted by the Author is outlined in Figure 1.

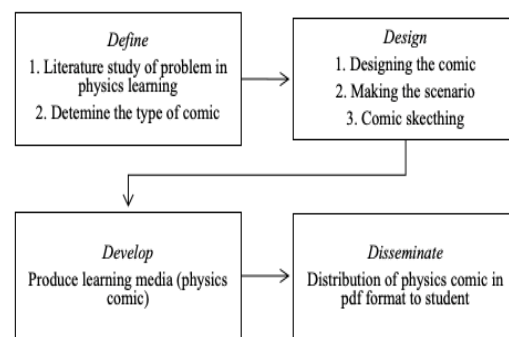


Figure 1 The 4-D model scheme that the authors conducted in this study

Define stages include analyzing problems in physics learning through literature studies and determining the limitations of physical material and the type of comics to be created. The design began by determining the initial design of the physics comic to be created, the creation of scenarios and sketches. The Develop stage was a revised comic production stage based on expert input. At this stage, the validation process was done by media experts and material experts (one lecturer and two high school physics teachers). Validation of learning media aims to assess and correct learning media before entering the trial stage. The

instrument in this study was a validation sheet containing aspects of assessment regarding the learning media of physics comics. The aspects listed included the media feasibility, learning materials, display, and use of language. The Disseminate stage was done on a limited basis to high school students in SMA Muhammadiyah 10 GKB, Gresik.

The data analysis technique used in this study was the calculation of the average value of validation results. The average value obtained was then converted to a percentage to obtain the validity criteria of learning media. Each component that has been through the validation stage by physics teachers and expert lecturers was calculated using the formula in equations (1), whose validity criteria are grouped as in Table1

$$Validity = \frac{Score}{Score\ max} \times 100\% \quad (1)$$

Table 1 Validity Criteria

Percentage Interval	Interpretation Criteria
0 %- 20 %	Doesn't valid
21 % - 40 %	Less valid
41 % - 60 %	Valid enough
61 %- 80 %	Valid
81 % - 100 %	Very valid

(Ridwan & Akdon, 2013)

RESULT AND DISCUSSION

Results of Development of Physics Comic Learning Media

This research is in the form of physics comic development research which

produced a learning medium in the form of physics comics with the material of the history of physics: Atomic Development. Physics comic learning media developed by the Author was created with the help of a *comicker application*. The application makes it easy for writers to create comics according to the material they convey with various features.

The Physics Comic on the History of Atomic Development, as shown in Figure 2, explains the development of atoms put forward by several scientists ranging from Democritus to Niels Bohr then the orbital theory that was perfected from Bohr atomic theory. The comic did not start directly from the theory of atomic development but began with a prelude to two children talking about the "smallest object". The introduction is intended to attract students to be enthusiastic in reading the images and subsequent explanations in the comic.

After discussing the "smallest object", the next image in the comic discusses the theory of atomic development. Each atomic theory put forward by each character is briefly but clearly explained in the comic. For example, the atomic theory put forward by Ernest Rutherford is explained by the description: (1) how Rutherford invented his theory of experimentation; (2) the findings of experiments conducted; (3) Weakness of Rutherford's theory; (4) and the perfection of the theory undertaken by the next Inventor.

PHYSICS COMIC

Purpose:

1. The use of physics comics is intended to support physics learning in the history of atomic development.
2. To increase interest in learning physics includes learning motivation, introducing students to physics figures, especially about the development of atoms through comic visualization.

Instructions:

1. This comic is used as teaching material to accompany physics learning.
2. This comic can be used at the beginning of learning to increase students' learning motivation.

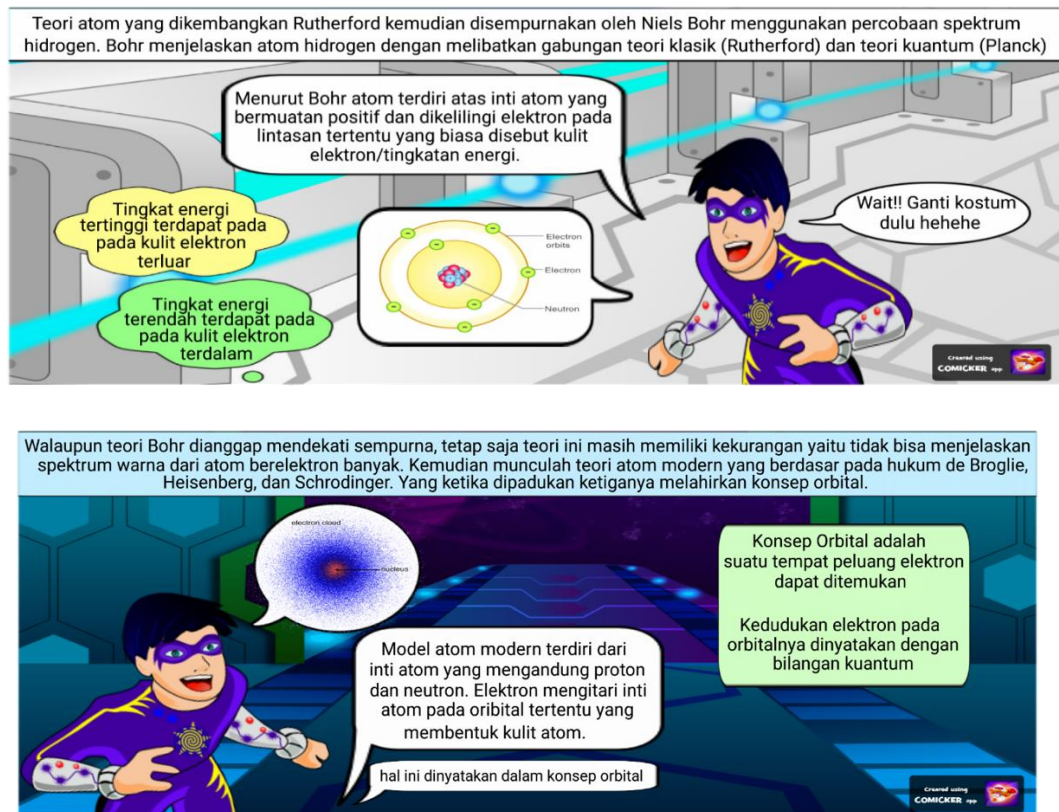


Figure 2 Comic Display

Feasibility of Physics Comic Learning Media

Physics comics that have been developed by the Author then in the feasibility test so that they can be used as a medium of learning atom development material. The feasibility test of the Physics comic was conducted with validity test by Physics teacher in senior high school and expert lecturers through validation sheet.

Table 2 shows that the average score given by validators is more than 75% in media, display, material, and language components. Table 2 also informs that the learning media developed by the Author in the form of physics comics about the History of Physics: Development of Atom worth using and very valid following the criteria in Table 1.

Table 2 The Validation Results Conducted by Two High School Physics Teachers and Lecturers Include Media, Display, Material, and Language Components

Component	High School Physics teacher		Expert Lecturer	Average	Criteria
	1	2			
Media	95.0 %	80.0 %	95.0 %	90.0 %	Very valid
Display	92.5 %	77.5 %	97.5 %	89.2 %	Very valid
Material	100 %	77.7 %	94.4 %	90.7 %	Very valid
Language	100 %	94.4 %	91.7 %	95.4%	Very valid

Physics comics are worth using because they meet the validity following Table 2, but validators give some suggestions from high school physics teachers and expert lecturers. High School Physics Teacher (1) advised on media components that state that:

"Need to add comic instructions."

Not so far from those suggestions. Lecturer experts (1) revealed that:

"The media has been good; it is better when going to explain a concept beginning with an introduction first, so it does not seem that the comic contains a full concept of material."

In addition, the High School Physics Teacher (2) also provides advice in the form of:

"It has been good, a little revision for the writing system to make it more

interesting. Recheck the writing so that nothing is wrong".

Student's response to the use of physics comic learning media

The next stage is a limited trial conducted on 35 high school students. The trials were conducted to analyze students' responses to the use of physics comic learning media.

Physics learning requires media to help the learning process, foster students' learning interests, and improve cognitive abilities (Purwanti & Subang, 2020). Learning media can improve the quality of education through the regulation of teacher and student activities to be more targeted (Agustin et al., 2018).

Table 3 Student responses towards physics comic learning media

Statement	Percentage of answers
Comic content can encourage me to learn physics	88,6 %
The existence of examples in real life can provide an understanding of the material development of atoms.	86,7%
Learning physics through comics can add to the spirit of learning	89,3%
This comic supported me in mastering physics lessons, particularly atomic development materials.	81,2%
I would instead learn physics using comic media.	88,9%
The material in comics helped me to understand the history of atomic development.	83,3%
The material in comics introduced me to the physics figures of atomic inventors.	88,9%
This comic helped me to visualize the process of atomic discovery carried out by physics figures.	82,2%

Previous research results showed that the use of physics comics can foster students' reading interest and literacy in physics learning. The use of physics comics accompanied by student worksheets can train the skills of (Putri et al., 2018) the scientific process in students (Susanti et al., 2016). Comic learning media can improve learning outcomes and is practically used as

teaching materials. Based on the study results (Jumini et al., 2020; Septiana et al., 2019), physics comics influenced students' creativity shown by the questionnaire data. One of the learning skills of the 21st century is the use of technology. Physics comics assisted by social media (Instagram) can be used as an alternative to learning because it is

flexible and can train the skills of the 21st century.

Some researchers also say that comics are a light, informative media that is entertaining and easy to understand, suitable for use as independent learning material (Hanson et al., 2017; Yulianti et al., 2016). The same research was also conducted by (Siswoyo et al., 2020) that the comics developed for temperature and heat material deserve to be used as one of the students' independent learning media.

The presence of picture illustrations in comic books can provide more accessible science communication. Learning media in the form of comics has been researched in various researches and considered effective in education (Lin & Lin, 2016) because it has many benefits (Kim et al., 2017). One of them is that the comic storyline is more interesting than the student worksheet, so it is effective in preventing student boredom (Widyastuti et al., 2017)

CONCLUSION

From the analysis of research data discussed above, it can be concluded that the author has developed a learning medium in the form of Physics comics discussing the History of Atomic Development material. The developed Physics Comics were created with the help of the *Comicker* App. The physics comic on The History of Atomic Development has been through the stage of feasibility test (validity) by two high school physics teachers and an expert lecturer. The average validity result obtained on the media component was 90.0%, the display was 89.2%, the material was 90.7%, and the language was 95.4%. In general, the student's responses to the use of physical comic learning media includes comic physics can increase motivation in learning (88.6%), students prefer that physics learning uses comic media (88.9%), through comic media, students are

introduced to atomic inventors (88.9%), and physics comics can help to understand the historical material of atomic development (83.3%).

The results of this study can help other researchers as a reference related to the development of comic physics learning media. The advice for further research is to develop a learning medium of physics comics with android applications to make it more practical. In addition, the creation of physics comics can be integrated with local culture and wisdom to increase the love of the homeland.

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