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To cite this article: Faruq Haroky *et al* 2019 *J. Phys.: Conf. Ser.* **1233** 012045

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Android-Assisted Physics Comic Learning to Train Students' Conceptual Understanding of Newton's Gravity

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Abstract. This aims of the research to determine students' conceptual understanding of Newton's gravitation concept by producing comic physics media. This research was conducted in May 2018 for high school students of grade 10 science, using one class of rumbel with 10 students. Researchers used the ADDIE development model. Data was obtained through class discussion and assessment tests. The results showed that students' understanding of concepts when treated using comic-assisted android media can be categorized as good.

Keywords: Android; Physics; Comic; Newton's gravity.

1. Introduction

It is important for teachers to know students' thinking about the concept of physics. Because improper understanding of concepts can lead to difficulties and hinder understanding of physical material correctly. With good conceptual understanding, it can create a sensation of coherence in course which means that isolated knowledge can be connected with other course [1], and make the concept of abstract lessons according to students more concrete [2].

To produce a better conceptual understanding, students should be actively involved in classroom learning interactions [3]. To create good interaction can be done using interactive learning such as practicum in physical laboratories or virtual laboratories [4], or media-based learning so students are challenged to think more deeply [5]. One of the media that can be developed to create interactive learning is Comics. Comics are one of the superior educational media compared to other media that are good for increasing students' knowledge [6].

The key to success in physics learning is shown in the media of educational technology used, because physics is a course that contributes a lot to the scientific and technological development of society [7]. Learning needs to be combined by utilizing technology. Learning to use Android can provide wider opportunities in the use of mobile technology so that it can improve students' learning abilities, high order thinking skills, motivation, and allowing learner-centered learning processes [8].

This paper will discuss about the development of comic media which includes video lesson and integrated question exercises in applications on android, to train students' conceptual understanding in the concept of Newton's Gravity.

The rest of this paper is organized as follow: Section 2 presents literature review. Section 3 describes the proposed research method. Section 4 presents the obtained results and following by discussion. Finally Section 5 concludes this work.



2. Related Works

This section presents a short review on existing literatures.

2.1. Characteristics of Physics Instruction

Physics is a branch of natural science, and is a science that was born and developed through observation steps, formulation of the problem, hypothesis formulation, testing hypotheses through experiments, conclusion, and theoretical and concept discoveries. [9] The nature of physics is the study of natural phenomena. Through a series of scientific processes that are built on the basis of scientific attitudes and the results are realized as scientific products composed of the three most important components; concepts, principles and theories that apply universally.

Many of the several research found the lack of conceptual understanding of students in the lessons indicated by the difficulty of students understanding the concept of physics [10]. Conceptual understanding is the ability of students to understand the meaning of learning and can apply it in everyday life which is the learning outcomes of students in the cognitive domain [11] and can apply the concept of problem solving to understand fundamental concepts [12]. To find out how far the conceptual understanding of students can be done by using comic media that are tried using a conceptual approach compared to traditional approaches. Fun physics learning can occur if the tools and learning media used can improve students 'conceptual understanding, attract students' learning interests and motivate students to learn.

2.2 Comics in Intuitions

According to the Educational Technology Competency Standards for Teachers, teaching staff should master the basic skills of general learning media selection and development methods [13]. Hence it is important for a teacher to apply media in learning. The use of media in learning activities will be more interesting and fun when packaged in the form of comic media. Comic books are a good educational tool to increase students' knowledge [14]. This is because comics are not like textbooks, stories and comics allow many perspectives, visually and verbally, and apply the beginning, ending, climax moment and focal point, as well as the complexity of complex stories, and virtual reality simulations [15]. Learning using comics includes illustrations and written content which are effective interventions to increase knowledge in achieving learning goals [16]. Comics consist of simple and concise illustrations, and are superior learning media compared to other learning tools. Clarity in comics helps convey an imprinted message, especially with a strong story [6]. When a teacher chooses comics with strong social messages, the effect may be as strong [17]. Comics are often used in everyday life. This media is already familiar to the general public [18]. Comics are widely used as entertainment facilities.

Along with the development of knowledge today, comics do not only function as entertainment devices, but also are used in education. Many people from all cultures and all ages like to read comics which is one of the most common humour carriers. In newspapers, magazines and the internet, a large number of comics are available [19]. Thus, the comic can be used for learning purposes that can increase students' motivation and interest in learning. From the increasing motivation and interest in learning of students, it is expected to be able to train students' conceptual understanding of the concept of physics.

With several theories that have been submitted, the comics are not only used as entertainment facilities, but can also be used in the field of education. As an instructional media, comics must be able to introduce information through interesting plot and narrative stories. In the learning process, comic books have aspects that support and facilitate learning. That is by paying attention to visual and verbal aspects, with the groove that applies the starting point, the end, the climax moment and the focal point.

3. Methodology

The type of research developed is the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). This research is only limited to the Implementation stage. The study was conducted on April 19 2018 in Yogyakarta. The subject of the study consisted of 18 students of the X grade high school.

The feasibility of the media to be used in learning is analysed from the category of media quality. The media is considered feasible if they get a minimum of categories with good quality. The media quality category is obtained from the media validation data by the validator. Media quality assessment data in the form of quantitative data with a scale of 1-5. Data were analysed using percentage of success. The measurement of students' conceptual understanding variables is done in 2 ways, with assessment and discussion tests. Data from the concept understanding are obtained based on student tests. While the results of the discussion data, in the form of a score based on indicators of students' concept understanding. Furthermore, the data were analyzed using the percentage of success.

$$P = \frac{f}{N} 100\% \quad (1)$$

Information:

P : Percentage

f : Number of subjects in certain categories

N : Frequency of total or total number of subjects

Furthermore, determined the length of the interval class in each category consisting of five categories, the grouping of values in each category is presented in Table 1.

Table 1. Assessment criteria

No	Interval %	Category
1	$80,01 \geq x \leq 100$	Very good/feasible
2	$60,01 \geq x \leq 80,00$	Good/feasible
3	$40,01 \geq x \leq 60,00$	Enough
4	$00,00 \geq x \leq 40,00$	Less

The type of data produced in this research is quantitative data. The instrument used in this study is an expert validation sheet, tests and discussion of students. Data from the media assessment results in the form of scores, then the score is converted into a scale of 5 according to the Likert scale. While the data from the assessment of students' conceptual understanding in the form of scores from the results of the analysis using the instrument test sheet.

The product developed in the form of physics comic media equipped with videos on Newton's Gravity lessons. The comic can be read through the Himawari Rider application on a smartphone or Android. The appearance of android comics can be seen in Figure 1.



(a)



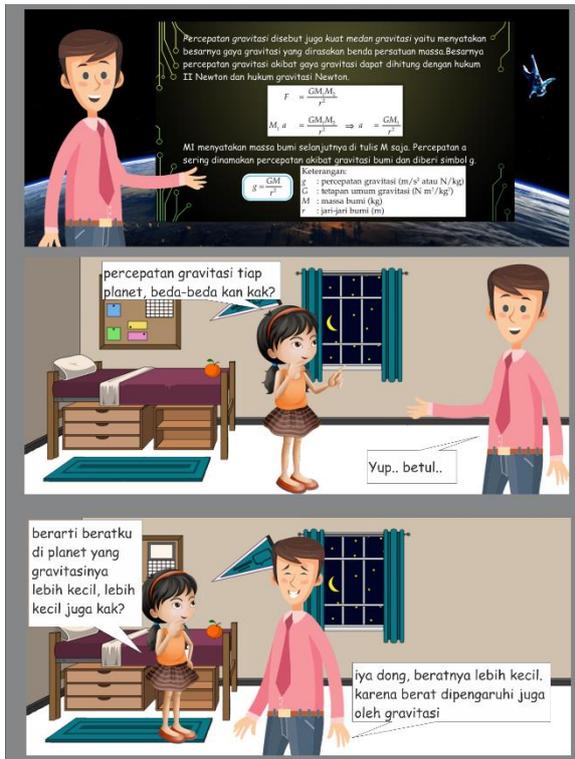
(b)



(c)



(d)



(e)



(f)

Figure 1. Comic media on page (a) 1; (b) 2; (c) 3; (d) 4; (e) 5; (f) 6.

4. Result and Discussion

This section presents the obtained results and following by discussion.

4.1. Result

4.1.1. Media Validation

Media validity test by experts is done to determine the feasibility of the product before being used in learning. Aspects assessed at the media validation stage consist of aspects of content, language and comic presentation. The assessment results of this aspect can be seen in Table 2.

Table 2. Media Validation

Rated aspect	Presentation of content	Language	Comic android
Total	32	23	15
Score max	35	25	15
Percentage (%)	91.42	92	100
Category	Very good	Very good	Very good

The value of validation calculation by the expert is obtained with the content presentation aspect of 91.42%; language 92%; and 100% android comics. In accordance with the validity criteria in Table 3, it can be concluded that the media developed is very valid and can be used in the learning process.

Table 3. Validity Criteria

Validity criteria (%)	Level of validity
81,26 - 100,00	Very valid
62,51 - 81,25	Valid
43,76 - 62,50	Invalid
25,00 - 43,73	Very invalid

4.1.2. Conceptual Understanding

Assessment of concept understanding is carried out in two ways, namely discussion and tests.

4.1.2.1. Student Discussion

The learning process is carried out by group discussion and class discussion. Students conduct discussions based on student worksheets that have been integrated in android comic media. Conceptual understanding of students is taken from practice questions on android comic media that students must complete in groups. Hence, understanding the concept of students based on the results of the discussion is presented in Table 4.

Table 4. Understanding Concepts of Students Based on Discussion Results

Indicator	Interpret	Compare	Conclude	Apply
Percentage	100	100	87.5	59.37

Table 4 explains that conceptual understanding of students in discussion groups. On each indicator, the results are the majority that are very good. In the interpreting indicator getting a percentage of 100% is very good, the indicator compares also get a percentage of 100% is very good, the indicator concludes the percentage of 87.5% also means having very good criteria. However, the indicator applied only gets a percentage of understanding the concept of 59.37% with sufficient criteria. This is because the indicator applying students gets difficulty in applying the concept of Newton's gravity into mathematical equations.

4.1.2.2. Test

The effectiveness of physics comics is viewed from the understanding of the concept of learning achievement of students based on test results. The question of concept comprehension tests was given to 18 students in science X class. Following are the results of students' conceptual understanding based on the test results presented in Figure 2.

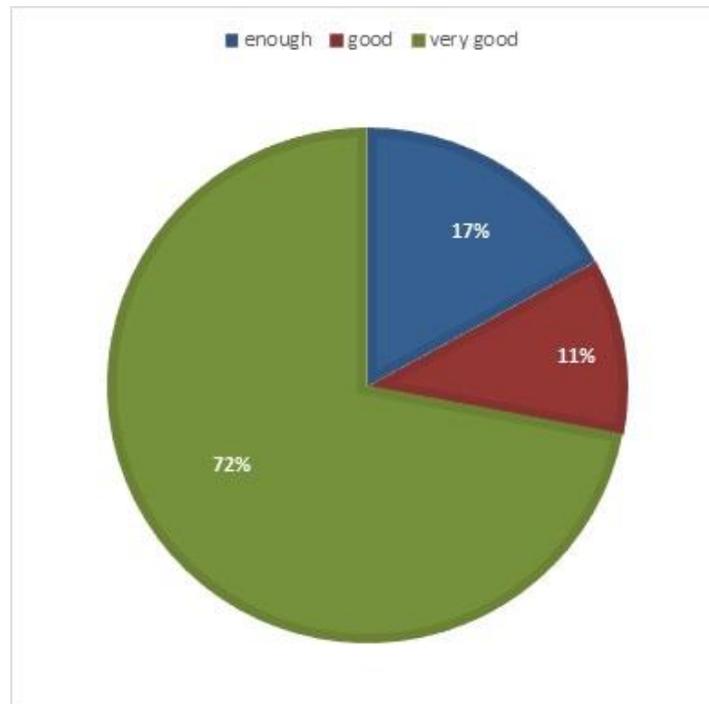


Figure 2. Student Conceptual Understanding Based on Test Results

Figure 2 explains that the percentage of students' conceptual understanding based on the results of the Newton Gravity test results were very good at 72%. Students who get good category by 11%. Whereas students who get the concept comprehension criteria are enough percentage of 17%.

Pemahaman konsep peserta didik berdasarkan indikator soal pemahaman konsep pada materi Gaya gravitasi Newton ditunjukkan pada Table 5.

Table 5. Students' Conceptual Understanding Test based on Understanding Indicators of Newton's Gravity Concept

Indicator	Determine the relationship between the radius and the force of gravity	Determine the relationship between altitude and gravitational acceleration
Percentage	92.78	94.44
Category	Very good	Very good

Table 5 shows the understanding of students who were tested with test questions. Understanding the concept of students on indicators determines the relationship between the radius and force of gravity to get a percentage of 92.78% with very good categories. While the conceptual understanding of students on indicators determines the relationship between altitude and gravitational acceleration shows a percentage of 94.44% with very good categories. This shows that using android-assisted comic media can train students' understanding of physics concepts, especially in Newton's Gravity lessons.

4.2. Discussion

The subject of physics in high schools often contains abstract concepts. Abstract concepts can be overcome by using images, images are developed in the form of comics to create a more pleasant and interesting learning atmosphere [20]. With a good and fun learning atmosphere, it will be easier for

students to understand the concepts of physics being studied. In addition, the use of conventional media has made physics learning less attractive and even tends to reduce students' motivation. The rapid development of information technology has provided a great opportunity for the production of learning media that is more interactive and interesting in an easy and low cost way [21]

This research develops Android-based physics learning media that serves to improve students' understanding of concepts developed using the Sigil computer program. The media is in the form of physics comics equipped with videos. Learning media products produced in the form of epub files. Files in epub format can be opened via the Himawari reader application on Android devices. Android-based physics learning media products have several characteristics, namely: (1) the product is a file that can be read using an Android device; (2) products support high school physics learning in Newton Gravity lessons; (3) products can be used inside or outside physics learning at school; and (4) the product presents an explanation of the lesson, and exercises the questions presented in an interesting and interactive manner.

The results of product validation and implementation show that the media is suitable for use in high school physics learning in Newton Gravity lessons. The implementation results show that the android comic learning media can train students' conceptual understanding. This is because learning using comic-assisted media in Android, students are not only faced with mathematical concepts but also from the story scenarios so that students can conclude their own concepts from the subject matter learned. In line with Budiarti [22] who explained in his paper that, after applying comic media assisted learning to the increase in the pretest to the posttest score, learning motivation and reading comprehension skills between the control class and the experimental class. The entire test and the results of the research show that comic media have a positive and significant effect on learning outcomes and students' understanding. Hence, the physics-based Android comic application is worthy of being used as a learning medium on the subject of Newton's Gravity for high school.

5. Conclusion

This paper has presented android-assisted physics comic learning to train students' conceptual understanding of newton's gravity. The conclusion of this study is that by using Android-based physics learning, media can train students' concept understanding in the learning process.

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