Berkala Ilmiah Pendidikan Fisika
ISSN : 2337-604X (print)
ISSN : 2549-2764 (online)

Vol 8 No 1 2020
https://ppjp.ulm.ac.id/journal/index.php/bipf
page 40-49

Comic-Based Module Development Andro-Web to Improve Problem Solving Ability in Physics in High School Students

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DOI:10.20527/bipf.v8i1.7641

Received : 4 January 2020 Accepted : 29 February 2020 Published : 29 February 2020

Abstract

This research aims to determine the validity of comic-based module andro-web on the subject of an ideal gas and increased capacity problem-solving physics students after using comic-based module andro-web on the subject an ideal gas. The research uses the design nieveen model of development. In the assessment phase, the module then tried out on 30 grade XI science 2 Jenggawah Senior High School. The instruments of product quality are an instrument validation and instrument increased capacity problem solving of physics students about pre-test and post-test completed by using 5 indicators problem-solving. The average score validation comic-based module andro-web by validator 81,7 % with valid category. The score validation by user validator obtained score 93,3 % with a very valid category. Besides, increased capacity problem-solving physics students a score was obtained for 47,3 % in by test n-gain medium category. Thus, it was stated that comic-based module andro-web can be used in teaching material XI science class and will raise the ability problem-solving physics students on the subject of an ideal gas.

Keywords: comic andro-web, validity, problem solving

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How to cite: Annisa, S. A., Lesmono, A. D., & Yushardi, Y. (2020). Comic-Based Module Development *Andro-Web* to Improve Problem Solving Ability in Physics in High School Students. *Berkala Ilmiah Pendidikan Fisika*, 8 (1), 40-49.

INTRODUCTION

Physics is primarily fun and interesting lessons (Oktaviani, Gunawan, & Sutrio, 2017)(Widya Oktaviani, Gunawan, & Sutrio, 2017). Key importance in the process of teaching and learning physics is that the students should be able to associate the material studied with everyday life (Mulyono, 2012). Learning physics is an effort in the learning process between educators and learners in studying phenomena or symptoms that occur in nature as well as how the symptoms that occur with ease. So in the learning process of physics needed learning tools, such as teaching materials effectively and efficiently to facilitate the learning physics student learning and achieve the expected goals

One of the learning support that can be developed to make learning more interesting and easier for students to understand is to develop innovative teaching materials. The innovation efforts in developing several skills and

abilities to improve the quality of student learning, so that the subject matter presented in the classroom teacher can be easily understood by students. One is with the use of technology and information contained in this present era. The development of information technology and especially the Internet can be utilized in education as the means and infrastructure to support the quality of education.

However, based on the results of preliminary studies conducted in State Senior High School Jenggawah, obtained by the fact that the teaching of physics in schools only use the media that is offline as a PowerPoint or instructional videos. Though most of the students have had even adept at using the internet (smartphones, laptops, computers).

Physics would be more fun if it is packaged in the form of comics. This is according to research conducted by Hadi & Dwijananti (2015), which states that students are interested in using comics physics in the learning process and the students also stated that comics can help facilitate their understanding of physics. Comic physics developed in the form of an online application that easy to take anywhere, save paper, and can have more than one feature, such as the availability of online tests, animations, and materials (Hadi & Dwijananti, 2015). The use of comics as teaching materials can also help students to increase interest in learning, motivate and assist students in understanding physics learning with ease. This is consistent with previous studies, such as the development of teaching materials science-based comic able to increase motivation and student learning outcomes (Lestari, Wahyu, & Yushardi, 2016), development of teaching materials comics were able to foster interest in reading and learning outcomes of students (Wahab, Wasis, & Indana, 2016), as well as materials development comic teaching can improve learning motivation and students' understanding of concepts (Zain, Parmin, & Sumarni, 2013). Comic instructional materials help students to improve students' science literacy skills and can stimulate students to play an active role in the discussions during the learning process takes place (Tatalovic, 2009). As well as the development of teaching materials comics can improve learning motivation and students' understanding of concepts (Zain et al., 2013).

Studying physics means to solve and discover why and how of events. So in physics learning takes their learning can make students practice the ability to troubleshoot and find the knowledge independently (Kurniawan, Rokhmat, & Ardhuha, 2015). The learning process of physics should be able to train the ability to solve physics students for solving the problem is the ability of science literacy of students or the ability fundamental to be possessed by students in science whatsoever (Lavin-Mera, Torrente, Moreno-Ger, Vallejo-Pinto, & Fernández-Manjon, 2009). Students will acquire a means of solving problems with the procedures carried out by scientists in obtaining a science to develop problem-solving abilities. Problem-solving is a technique that is considered effective for understanding the lesson. Because students are directly confronted with real-life problems and realities, what they have learned will be meaningful. This meaningful learning will not give difficulties and acceleration for students to understand the concepts and principles learned in their entirety. With the method of problem-solving, it can facilitate students in exploring new knowledge they have and can be responsible for the learning undertaken. Besides that, they are also able to encourage them to conduct their evaluations both for results and the learning process (Ahliha,

Mastuang, & Mahardika, 2017). Thus students can gain knowledge and new science (Sambada, 2012). However, the results of a preliminary study conducted in the state senior high school Jenggawah that subject teachers are admitted less practice physics problem-solving skills so that students' problem-solving skills are less measurable. This is the background of the researcher to develop a comic book-based teaching materials andro-web to enhance the problem-solving physics students.

Some researchers have developed a teaching material in the form of comics, but in print as research conducted by Tyas, Wahyu, & Yushardi (2015) and Widyawati & Prodjosantoso (2015). Some researchers have also developed teaching materials crate comics android based on research conducted by Hadi & Dwijananti (2015) and Irwandani & Juariyah (2016), but they develop instructional materials that can only operate and available in the Android system only. Therefore, researchers developed a comic instructional materials that not only can be operated via the android device but also using the website. Development of teaching materials based comic andro-web accessible to everyone regardless of age, background, culture or social status. Other than that, andro-web comics can be used for student learning without the restrictions of time and place. The learning process can be done anywhere and anytime. Development of teaching materials based andro-web comics have been developed previously by Lesmono, Bachtiar, Maryani, & Muzdalifah (2018), but using the topic of effort and energy. The development of teaching materials based on andro-web comics can increase motivation, interest, and attention of students (Lesmono et al., 2018). Researchers are interested in conducting a study to develop teaching materials in the form of comics based modules andro-web to enhance the problem-solving physics students on the subject of the Ideal Gas..

Based on these descriptions formulated a problem that the validity and improvement of students' physics problem-solving abilities after using andro-based modules web comic on the subject of the ideal gas. The purpose of this study was to determine the validity of the comic-based modules andro-web and determine the increase physics problem solving ability of students after using andro-based modules web comic on the subject of the ideal gas.

METHOD

The research design proposed by Nieveen, McKenney, & Akker (2006). The subjects were 30 students of class XI IPA 2 State Senior High School Jenggawah second semester of the academic year 2018/2019. The stages of research and development by Nieveen et al (2006), include: the preliminary study (preliminary research), the design phase (prototype phase), and the stage of assessment (assessment phase).

In the first stage of the preliminary study (preliminary research) performed to obtain a preliminary picture of the implementation of the research include the information and data collected about the implementation of learning in school. At this stage, the analysis of the problems and needs in learning through the provision of a questionnaire to students. Furthermore, the study of literature by collecting existing theory study of the relevant research data earlier.

The second stage of the design stage (prototype phase). At this stage, the first draft in the form of product design, learning support devices such as syllabi, lesson plans, and product quality assessment instruments. Assessment of quality products developed undertaken to fulfill the validity of the instrument and physics problem-solving ability of students. The validity of the instrument

in the form of expert and user validation, while the instrument could physics problem-solving ability of students in the form of a matter of pre-test and post-test.

Furthermore, the first draft that has been generated, evaluated the validity of the assessment by experts and users. Expert validation test conducted by two professors of Physical Education Guidance and Counseling University of Jember and user validation is done by a high school physics teacher Jenggawah State. Validation value referred to at the interval level of validity determination module instrument-web-based comic andro to enhance the problem-solving physics students on the subject of ideal gas as shown in Table 1 the validity of the following criteria.

Table 1 Criteria Value Validity

No.	Criterion Validity	Validity Level
1.	85.01% - 100.00%	Very valid or can be used without revision
2.	70.01% - 85.00%	Valid, or can be used but need minor revision
3.	50.01% - 70.00%	Less valid. It is advisable not used because it needs major revision
4.	01.00% - 50.00%	Invalid, or may not be used

The third stage is the stage of assessment (assessment phase). At this stage the first draft of the revised produce the second draft, the draft was subsequently tested in the field to find out how much improvement students' problem-solving abilities. Increasing students' problem-solving physics problems measured using pre-test and post-test in the form of an essay. Solving the problem is analyzed using five indicators, namely: Useful Description, Physics Approach, Specific Application of Physics, Mathematical Procedures, and Logical Progression (Jennifer L. Docktor, (Docktor,Dornfeld, Frodermann, Heller, Hsu, Jackson, & Yang, 2016).

Data analysis techniques used to process the value of the pre-test and post-test are to use the N-gain test score. Criteria for improvement of physics problem-solving ability of students can be seen by looking at the Table 2 N-gain test criteria below.

Table 2 Determination of Levels Comprehension

Score	Criteria
Score ≥ 70%	High
30% ≤ Score <70%	Moderate
Score <30%	Low

Data analysis techniques used to process the value of the pre-test and post-test is to use the N-gain test score. Criteria for improvement of physics problem solving ability of students can be seen by looking at the Table 3 N-gain test criteria below.

Table 3 Test Criteria N-gain

Classification N-gain value	Criteria
Ng ≥ 70%	High
Ng ≤ 30% <70%	Moderate
Ng <30%	Low

RESULTS AND DISCUSSION

Product development generated in this study are based modules andro-web comic on the subject of the Ideal Gas. Andro-based modules webcomics can only be accessed online via smartphone/android or laptop / PC. Applications and websites that use are webtoon titled "Invisible but Ideal". Andro-based modules webcomic consists of 9 episodes explaining ideal gas material and its relationship to the problems of everyday life with the URL:

https://www.webtoons.com/id/challenge/tak-terlihat-tapi-ideal/list?title_no=230744,

Here's a comic-based display module andro-web version of the smartphone/android and laptop/PC, can be seen in Figures 1 and Figure 2.

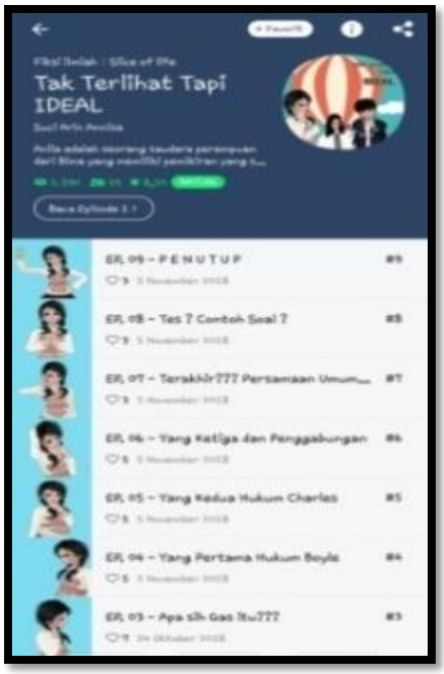

Figure 1 Version of the smartphone / android

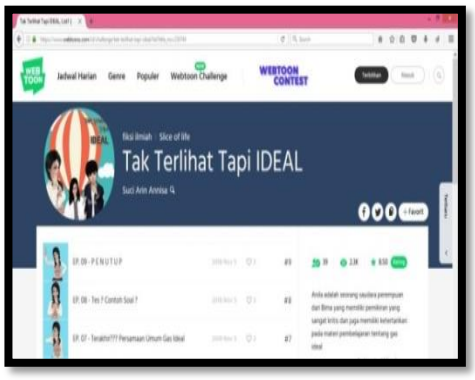

Figure 2 Version of the laptop / PC

Here is one snippet of the content modules that give rise to an element of problem-solving physics students, can be seen in Figure 3.

Figure 3 Trailer troubleshooting

Validation module andro-web-based comic conducted by two experts, namely professors validator FKIP Jember University of Physical Education and a validator that users physics teacher state senior high school Jenggawah. The indicators used in the validation between validator experts and different users. Experts Validator more emphasis on validation of comic content in the form of language, letters, pictures, symbols, and materials, while the user validation more emphasis on ability and efficiency in the learning module. The scores given in this study consisted of a scale of 1 to 4 include (1) poor, (2) bad, (3) adequate, and (4) exellent. The results of expert and user validation module andro-web-

based comics are shown in the Table 4 the following.

Table 4 Results Validation Expert and User Module Web-Based Comic-Andro

Validation	Score	Category
Expert 1	81.7%	Valid
Expert 2	81.7%	Valid
Average Expert	81.7%	Valid
Users	93.3%	Very Valid

Scores validity of andro-based modules webcomic by expert validator 1 and 2 experts obtained the same score is 81.7% with a valid category. Besides, scores of validity by the validator obtained a score of 93.3% to the category of very valid. Thus it can be said that the comic-based modules andro-web to enhance the problem-solving physics students can use in the classroom on the subject of the Ideal Gas.

Andro-based modules webcomics that have valid criteria tested to class XI IPA 2 State Senior High School Jenggawah. The data obtained is the pre-test and post-test. The value of the results of the pre-test and post-test were analyzed on each indicator to determine the level of students' understanding. The results of the analysis of the level of understanding shown in the Table 5 below.

Table 5 Comprehension Level

Indicator	Pre-test		Post-test	
Useful Description	1.83	Moderate	3.15	High
Physics Approach	0	Low	1.71	moderate
Specific Application of Physics	2.53	Moderate	3.17	High
Mathematical Prosedures	2,59	Moderate	4.52	High
logical Progression	0	Low	0.63	Low
Total	6.95		13.19	
Criteria	Moderate		moderate	

The results of the analysis of determining the level of understanding of 30 students of class XI IPA 2 State Senior High School Jenggawah showed an increase in scores of pre-test and post-test on every indicator. But in the total score of the pre-test and post-test gain the same criteria that were the total amount despite increased.

Description Useful indicator obtained scores of pre-test and post-test is 1.83 to 3.15 with the criteria being the high criteria. In the Physics Approach indicator, obtained scores of pre-test and post-test with low criteria is 0 to 1.71 with the criteria being. On Application-Specific indicators of Physics, obtained scores of pre-test and post-test are 2.53 to 3.17 with the criteria being the high criteria. In Procedures Mathematical indicators, obtained scores of pre-test and post-test that is becoming a criterion of 2.59 to 4.52 with high criteria. Logical Progression indicator obtained scores of pre-test and post-test is 0 to 0.63 with the same criteria, namely low. Also, the total value of the pre-test of the overall indicator score obtained 6.95, while the total value obtained a post-test score of 13, 19. Increasing the range of 6.95 to 13.19 were thus classified criteria based modules andro-web comics can enhance students' understanding of each indicator solving physics students. This is according to research conducted by Keogh, Naylor,

& Wilson (1998), that the comic offers an easier way to maintain students' interest, especially when students have difficulty at the time of learning. Students may be very interested in learning to use comics physics and students also find it helpful to learn how to use comics to comic physics can enhance students' understanding of the physics of matter (Hadi & Dwijananti, 2015). 19 belong criterion being that comic-based modules andro-web can enhance students' understanding of each indicator solving physics students. This is according to research conducted by (Keogh et al., 1998), that the comic offers an easier way to maintain students' interest, especially when students have difficulty at the time of learning.

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Most students get low scores on indicators Useful Description, Physics Approach and Logical Progression in the pre-test. Description Useful indicator, students write only known information and asked out of the problems given. However, students are still difficulties in differentiating the equations of the problem. One example is the "ideal gas are in a closed room with volume V, pressure p and temperature T. If the volume has been changed into ½ times the original and the temperature was raised to four times the original .....". Most students write the equation is known of the problems is "V1 V2 = ½". An error writing the equation will have an impact on the next stage of completion.

In Physics indicator Approach, students have not been able to explain the concepts used to solve a given, so that students get a score of 0. This is because most of the students still can not distinguish the equations prevailing at the material ideal gas. Logical Progression indicator, most students only solve the problems until the calculation phase without reassuring the calculation, whether it is correct or not so that the score obtained is still low.

At the time of the post-test, the students' ability in resolving problems of physics to get better and according to indicators of physics problem-solving abilities. However, some students still do not meet the minimum completeness criteria physics lesson. There are 18 of the 30 students who received a score below 75, which means that the student has not met the minimum completeness criteria, while 12 students already meet the completeness criteria. When the post-test students get low scores on indicators of Logical Progression. Most students still write the conclusion of completion of the calculation results without convincing results of the calculations are great or not. Besides, the value of the pre-test and post-test were analyzed using the N-gain test. The test results of N-gain of the data pre-test

and post-test are shown in Table 6 below.

Table 6 Results Test Analysis of Ngain

Component	Pre-test	Post-test	Difference	N-gain	Category
Total students	30	30			
Top scores	66	96		47.3%	moderate
Lowest score	09	31			
Average	34.9	65.7	30.8		

The results of the analysis of the physics problem-solving abilities increase 30 class XI IPA 2 State Senior High School Jenggawah shows that the average value of the pre-test and post-test of 34.5 and 65.7 to 30.8 margin. Data were analyzed using the N-gain test to see an increase in the physics problem-solving ability of students grade XI 2. N-gain test results showed that the increase in physics problem-solving ability of students obtained a score of 47.3% in the medium category. Thus, it is stated that the comic-based modules andro-web can enhance the problem-solving physics students on the subject of the ideal gas.

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However, interviews have been conducted on students after learning module using andro-web-based comic admitted students are not accustomed to resolving problems by writing a note, asked and answered using equations and calculations, even sometimes students just write mathematical equations and calculation procedures only. Most students find it too complicated and too long if you have to write down the information on the matter especially if you have to analyze the problem. Also, students claimed to have never been taught how to resolve the problem by the 5 indicators physics students' problem-solving abilities.

According to some opinions of students, the learning-based module using andro-web comics give a sense of interest in the study of physics. Moreover, the module web-based comic andro can raise the curiosity of the later stories in each episode as it presents illustrations and materials that are easy to understand and be understood. Andro-web comic design interesting and the plot is not confusing. While the advice given by students and teachers is better if the module is printed comic that learning can be more flexible and does not require android devices and the Internet.

CONCLUSION

Andro-based modules webcomic based on the results of expert validation obtained an average score of 81.7% with a valid category, while the results obtained user validation score 93.3% with a very valid category that can be

implemented at the test site development. Andro-based modules webcomic can enhance the problem-solving physics class XI IPA 2 State Senior High School Jenggawah. This research can be referenced for other researchers to improve learning media in the classroom. For furthermore research, the webcomic can be constructed for other learning material beside the ideal gas.

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