

Development of Digital Modules of Comic-based Static Electricity Material Assisted by MOOCs Platform for Class XII High School Students

Cahyani Diana Eka^{1,2}, Risdianto Eko¹ and Gunawan Bodi¹

¹Program Studi Pendidikan Fisika, Fakultas Keguruan dan Ilmu Pendidikan, Universitas Bengkulu

²E-mail: dianaekacahyani22@gmail.com

Received: 22 November 2025. Accepted: 18 January 2025. Published: 31 January 2025.

Abstract. This research is based on the unavailability of learning media that can increase students' interest and motivation to learn physics. This study aims to describe the feasibility and describe student responses to the digital module of comic-based static electricity material assisted by the MOOCs platform. This research is development research with reference to the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The research instruments used include expert validation questionnaires and student response questionnaires. The type of data used consists of quantitative data and qualitative data. This study obtained the results of the product feasibility validation assessment with an average percentage value of 89.36% which indicates that the comic-based digital module is very feasible to use. The increase in students concept understanding is included in the high category with an average percentage of 82.65% which shows that the use of comic-based digital modules assisted by the MOOCs platform is able to improve students concept understanding. The results of students' responses obtained an assessment with an average percentage of 89.57% with the category of student responses to the development of comic-based digital modules, namely very good, which means that comic-based digital modules assisted by the MOOCs platform have attractiveness and positive responses for students. Based on the overall results of research and discussion, it is concluded that the digital module of comic-based static electricity material assisted by the MOOCs platform is suitable for use in physics learning.

Keywords: Digital Modules, MOOCs, Digital Comics, Static Electricity.

1. Introduction

Education is an important component in the progress and development of a nation [1]. Education in a nation must adapt to the times and the rapid advancement of technology in the current era of globalization [2]. Adaptation of the education system to current technological advances can be realized through innovation in the application of multi-interactive learning media, namely the combination of two or more existing learning media to make classroom learning more interesting and dynamic [3].

To overcome these challenges, the Ministry of Education, Culture, Research and Technology continues to innovate education to improve the quality of education in Indonesia in order to compete globally [4]. One of the innovations is the change in the education curriculum from the 2013 curriculum to the independent curriculum, emphasizing the role of students as active participants in the learning process [5]. The change from the 2013 Curriculum to the Merdeka Curriculum changes learning from being more structured with clear guidelines according to a predetermined learning flow to being more flexible and providing space for teachers and schools to develop learning according to student characteristics [6]. In addition, the teacher, who initially acted as a teacher to convey subject matter, now acts as a facilitator and motivator in the classroom who guides students to learn actively [7].

Based on the results of interviews that have been conducted with students in 4 Senior High Schools (SMA) and 2 Madrasah Aliyah (MA), namely SMA Negeri 1 Bengkulu Utara, SMA Negeri 2 Bengkulu Utara, SMA Negeri 3 Bengkulu Tengah, SMA Negeri 11 Bengkulu City, MA Negeri 1 Bengkulu City, and MA Negeri 2 Bengkulu City. in Bengkulu Province in June 2024, it is known that teachers have used electronic learning media such as *PowerPoint* (PPT) in classroom learning activities, but the use of electronic learning media has not been used optimally so it needs to be improved again. The improvement can be done by adding variations of learning media that are in accordance with the subject matter. Students tend to get bored easily with monotonous learning activities so it is necessary to vary the use of more interesting learning media, such as the use of *Visual*, *Audio*, or *Audio-Visual* learning media that can create a meaningful learning environment and learning experience for students, so as to increase motivation and student learning outcomes.

One solution that can help teachers create a meaningful learning environment for students is to use learning media that is in line with technological developments [8]. Examples of technology-based learning media such as learning videos, simulations, animations, digital comics, posters, and educational games. Among these learning media, one of the learning media that can be used to increase student motivation and learning outcomes is the use of comics that are digitized and adapted to learning content [9]. Comics were chosen as the learning media developed because learning comics can increase student motivation and learning outcomes, besides that the integration of technology in it can train students' creative thinking skills, analytical thinking and ability to solve problems [10].

Comics are defined as a set of images arranged side by side to form a narrative and function as a means of conveying information to readers through a series of combined images [11]. The development of technology today, presents comics not only in printed form but also packaged in digital form [12]. Digital comics are a learning medium that is packaged to form a storyline using text, images, and dialogue in digital form that can be accessed on various electronic devices [13]. Comics that are packaged in digital form can make it easier for students to access them anytime and anywhere using a Smartphone or laptop [14]. Narestuti's research [15] shows that the use of digital comics as a learning media in class can be an alternative that can attract student interest and increase student learning motivation. Research conducted by Haroky [16] showed that students' concept understanding on android-based comic media was categorized as good in physics material. Karlimah [17] stated that the use of digital comics as classroom learning media is not only to increase student learning motivation and make learning more interesting, but also a form of digital technology adaptation, increase student digital literacy, and make it easier for students to understand learning materials. Based on this previous research, it can be concluded that the use of comics as learning media not only serves to attract students' attention and interest in learning but also can increase students' motivation and learning outcomes. To increase the value of efficiency and effectiveness of digital comic learning media can be combined with learning platforms available online [18].

Online learning platforms offer many benefits to their users. They are flexible and can be a platform for interaction between teachers and students in learning. Some online learning platforms are Massive Open Online Courses (MOOCs), Learning Management System (LMS), Moodle, Google Classroom, E-Learning, and many more. Each platform has its advantages and disadvantages. One of the most discussed online learning platforms nowadays and an innovation is Massive Open Online Courses (MOOCs). MOOCs is an online learning platform that contains courses on learning theory and pedagogy to fulfill students' learning needs [19].

The use of MOOCs has several advantages, such as MOOCs allows many people from all over the world to participate in it without being hindered by limitations of space, time and cost. MOOCs can be accessed using a Smartphone or laptop as well as a stable internet connection to access it, users can interact with each other in available courses, there are various disciplinary courses offered in MOOCs [20]. The use of MOOCs as a learning platform can increase student motivation and learning outcomes because by using MOOCs students can access learning materials anytime and anywhere. In addition, MOOCs can be a collaborative learning media between students and teachers in interacting online, and

in MOOCs usually available evaluation and feedback that can help students see progress and improve students' understanding of learning materials [21].

MOOCs was chosen as a platform for the dissemination of comic-based digital modules because MOOCs is a digital learning platform that is more inclined to learning videos. Learning using short videos is a phenomenon that is closely related to the preferences of modern society which tends to prefer listening to short explanations compared to reading them [22]. The trend of learning by using short videos is a learning innovation that is currently favored by students because most students like visual, audio, or audio-visual learning styles. Students tend to prefer watching short videos because in addition to using simple explanations, they are also presented with interesting, accessible, and interactive visual effects that make the learning process fun [23]. By using comics that are packaged into a learning video, it is hoped that it can make it easier for students to understand abstract physics learning material. Thus, the development of comics in the form of digital modules which are then disseminated through the MOOCs Platform is expected to provide great benefits to students and can increase student motivation and learning outcomes with the ease of learning through the Platform [24]. This research utilizes the MOOCs platform managed by Bengkulu University.

Comic-based learning media includes research that is still rarely researched. This can be seen based on bibliometric analysis conducted using the Scopus database from 2017 to 2024 which has evaluated the tendency of using comics as physics learning media. The results of the research analysis show that comics used as learning media not only function to increase students' interest in learning but also can improve students' understanding and learning outcomes. Comic-based learning media are also among the favored media by students. This can be seen from the responses shown in these studies, where students gave very positive responses to comic-based learning media.

This study aims to describe the feasibility and the student response to the digital module of comic-based static electricity material assisted by the MOOCs platform. Therefore, this study raises the title "Development of Digital Modules of Comic-based Static Electricity Material Assisted by MOOCs Platform for Class XII High School Students". Through this research, it is expected to contribute to the development of innovative and effective learning media in physics learning and provide a more enjoyable and meaningful learning experience for students.

2. Method

This type of research is research and development (R&D). Research and development is a research technique used to produce a particular product and then assess the effectiveness of the product [25]. By using the ADDIE model research design from the Branch [26]. This model consists of 5 stages of development, namely Analysis, Design, Development, Implementation, and Evaluation. These stages are presented in Figure 1 below.

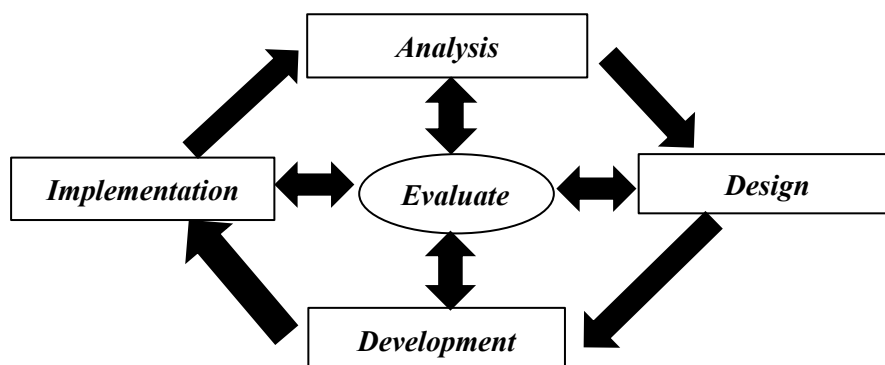


Figure 1. Stages of ADDIE development research [27].

The participants in this study were physics education lecturers, physics subject teachers, and grade XII students. Physics education lecturers and teachers became participants in becoming validators on comic-based digital modules through the MOOCs platform developed. Product trial subjects were 35 students of class XII at MA Negeri 2 Bengkulu City.

Data collection was done by interview method, questionnaire method, and test method. Interviews were used to identify problems, obstacles, difficulties, and potentials that need to be researched in the physics learning process at school. Questionnaires used in this development research are expert validation questionnaires and student response questionnaires. In this study, the questionnaire was given to validators to assess the development of learning media made. Analysis of questionnaire data begins with grouping data, tabulating data, and giving scores to respondents' answers. The assessment score contained in the expert validation questionnaire uses a Likert scale with a score range of 1-4, where a value of 1 indicates very unworthy, 2 indicates unworthy, 3 indicates worthy, and 4 indicates very worthy. The percentage results obtained from media validation will be grouped according to the Likert scale feasibility interpretation criteria so that conclusions about the feasibility of the media will be obtained as in Table 1.

Table 1. Learning media feasibility categories [28].

Percentage	Interpretation
0% - 25 %	Very Unfeasible
26 % - 50 %	Not Feasible
51% - 75 %	Feasible
76% - 100 %	Very Feasible

The student response questionnaire was used to determine student responses to the digital module of static electricity material assisted by the MOOCs platform that had been developed. The assessment score contained in the student response questionnaire uses a Likert scale with a score range of 1-4, where the value of 1 indicates very bad, 2 indicates not good, 3 indicates good, and 4 indicates very good [29]. The percentage results obtained based on student responses will be grouped according to the Likert scale feasibility interpretation criteria so that conclusions will be obtained on student responses as in Table 2.

Table 2. Category of student response questionnaire [30].

Percentage	Interpretation
0% - 25%	Very Bad
26% - 50%	Not Good
51% - 75%	Good
76% - 100%	Very Good

Tests were conducted to measure students' cognitive understanding before and after using comic-based digital modules on static electricity class XII material. Analysis of the increase in students' cognitive understanding was carried out with the N-Gain normality test, with the category of increasing students' understanding of concepts in static electricity material presented in Table 3.

Table 3. Categories of improvement in students' cognitive understanding [31].

Average	Criteria
$g > 0.7$	High
$0,3 \leq g \leq 0.7$	Medium
$0 < g < 0.3$	Low
$g \leq 0$	Fail

Product validation questionnaire data assessment scores and student response questionnaires can be analyzed using the formula [32] in equation 1 below:

$$Percentage = \frac{\text{total score achieved}}{\text{maximum score}} \times 100\% \quad (1)$$

3. Results and Discussion

3.1. Result

This research was conducted in the odd semester of 2024/2025. This section will describe the process and results of the research obtained along with a discussion based on the research that has been done. The main result in this study is the final product of the digital module of comic-based static electricity material assisted by the MOOCs platform which is feasible to use and gets a good response from students. The data stating that the digital module of comic-based static electricity material assisted by the MOOCs platform is feasible to use is based on the results of the validity test conducted by a team of experts consisting of two lecturers and one physics teacher, as well as student response tests conducted by 35 students of class XII I MA Negeri 2 Bengkulu City. This product is produced in accordance with the following research and development steps.

3.1.1. Analysis Stage

The analysis stage is carried out by collecting initial information through interviews with students and literature studies in accordance with the products developed. Student interviews were conducted to find out how students' opinions on physics learning, learning media commonly used in physics learning, and how students' interest in comic-based physics learning media. Interviews were conducted in a structured and open manner in June 2024 to representatives of SMA/MA students in Bengkulu, namely SMA Negeri 1 Bengkulu Utara, SMA Negeri 2 Bengkulu Utara, SMA Negeri 3 Bengkulu Tengah, SMA Negeri 11 Bengkulu City, MA Negeri 1 Bengkulu City, and MA Negeri 2 Bengkulu City. The results of interviews that have been conducted are that the internet network in schools is quite good, the learning methods used are still conventional methods, teachers have used electronic learning media such as PowerPoint (PPT) in class learning activities, therefore the development of digital modules is needed at this time because of the demands of the curriculum which requires teachers as facilitators in learning activities and create a learning atmosphere that can make students to be able to play an active role during the learning process.

In addition, a literature study was also conducted with bibliometric analysis on the use of comic learning media in physics learning. The results of the bibliometric analysis showed that the increasing trend of article publications on the use of comics as physics learning media shows the increasing research interest in exploring the potential of effective learning media. By continuing to develop comic-based learning media, it is expected to be an alternative in the learning process, and can improve overall student learning outcomes.

The results of the analysis of interviews with students and the results of bibliometric analysis obtained then evaluated the results obtained. Evaluation is carried out to explore and identify problems obtained based on the results of interviews and bibliometric analysis in order to design the right solution, and minimize errors that may occur at a later stage. After the evaluation at this analysis stage, the results obtained will be used as the basis for the development of a digital module of comic-based static electricity material assisted by the MOOCs platform.

3.1.2. Design stage

This stage is carried out by determining the elements needed in making comic-based digital modules, such as:

1. Selecting media and learning materials

Before determining the learning material that will be raised, an analysis is carried out first about which material can be visualized into a story with an interesting plot using language that is easy to understand and can be associated with phenomena in everyday life. After filtering from some physics subject matter, it was found that the material suitable for visualization into a comic is material about static electricity. Static electricity material was chosen because this material is a basic material about electricity where the concept of this material is often encountered in everyday life, such as the phenomenon of hair standing up when brought close to a balloon that has been rubbed with a woolen cloth. The phenomenon of standing hair is an interesting phenomenon if developed into a comic

storyline. In addition, the phenomenon of static electricity can be simulated simply by using Phet Simulation, so that it can make the comics developed more interesting and easy to remember.

2. Initial design

This digital module of comic-based static electricity material assisted by the MOOCs *platform* is designed as an alternative learning media that can be used by students to learn anywhere and anytime. The initial steps taken in the development of this digital module of comic-based static electricity material assisted by the MOOCs *platform* are:

- a. Planning the storyline, the story is made with simple language then associated with the phenomenon of everyday life and associated with static electricity material in accordance with the learning objectives and learning outcomes that have been determined.
- b. Comic framework, the comic framework is made in Word based on the storyline that has been made before. The comic framework contains a synopsis of the story, the characters contained in the comic, and the storyline.
- c. Choosing applications for making comics, there are many applications or AI that can be used to create comics such as Canva, Adobe Photoshop, Storytribeapp, and Clip Studio Paint. Of these tools, Storytribeapp is easier to use and is equipped with tools that support making comics. Storytribeapp was chosen as a tool to develop comics in this study because by using Storytribeapp we can be creative by using the tools and elements available in it.

At this design stage, evaluation is also carried out. Evaluation at the design stage is carried out to ensure that the design made is in accordance with the objectives of the product to be developed, identify and correct the shortcomings of the design made before entering the development stage and then disseminated.

3.1.3. Development stage

a. Initial product

The initial product of this research is produced based on the initial design design that has been made at the design stage. Below are presented the parts of the initial product that have been produced.

1. Main Page

On the main page there is a module title, namely Static Electricity, then there is a description of the subjects taught, requirements for attending classes, target students, and author profiles that can be accessed by students. In addition, menus such as curriculum contain learning materials, practice questions, and material summaries, and there is a materials menu that contains digital comic links. The appearance of the main page on the digital module of comic-based static electricity material assisted by the MOOCs platform can be seen in Figure 2.

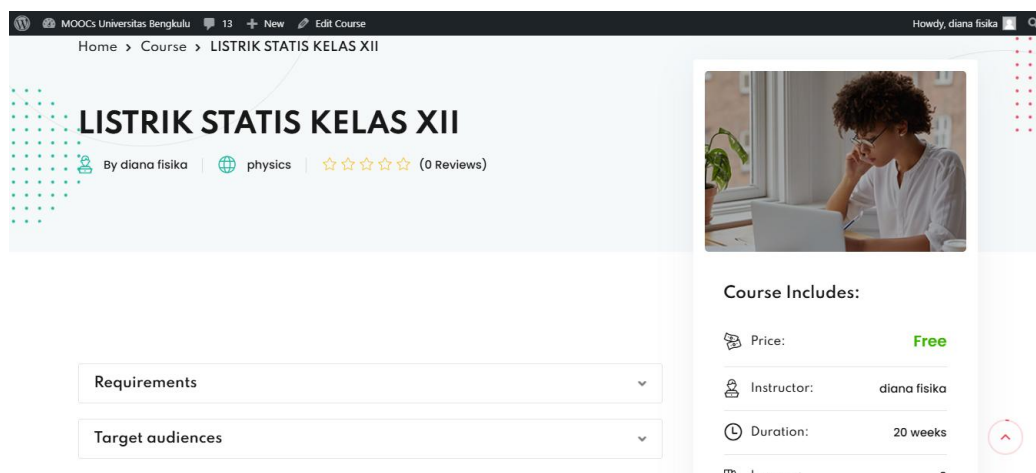


Figure 2. Main page display.

2. Overview

The preface to this comic-based digital module of static electricity material assisted by the MOOCs platform contains an expression of the author's gratitude, background, an overview of comic-based digital modules, and the author's objectives for comic-based digital modules. This preface is divided into three parts, namely opening, content, and closing. In this MOOCs platform, the preface is in the overview section. The display of the preface page can be seen in Figure 3.

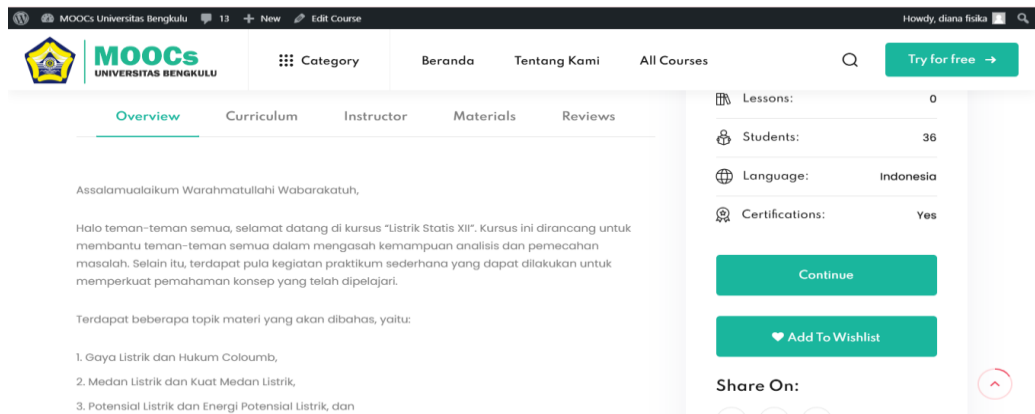


Figure 3. Display of preface page.

3. Material

This section is the most important part contained in the digital module of comic-based static electricity material assisted by the MOOCs platform because it contains exposure to learning material in the form of comic-based learning videos that explain static electricity learning material. There are four main topics in static electricity material in this digital module, namely the first electric force material and Coloumb's law, second electric field material and electric field strength, third electric potential energy material and strong electric potential energy, and fourth capacitor material and its application. The display of the comic-based static electricity digital module material assisted by the MOOCs platform in the material section can be seen in Figure 4.

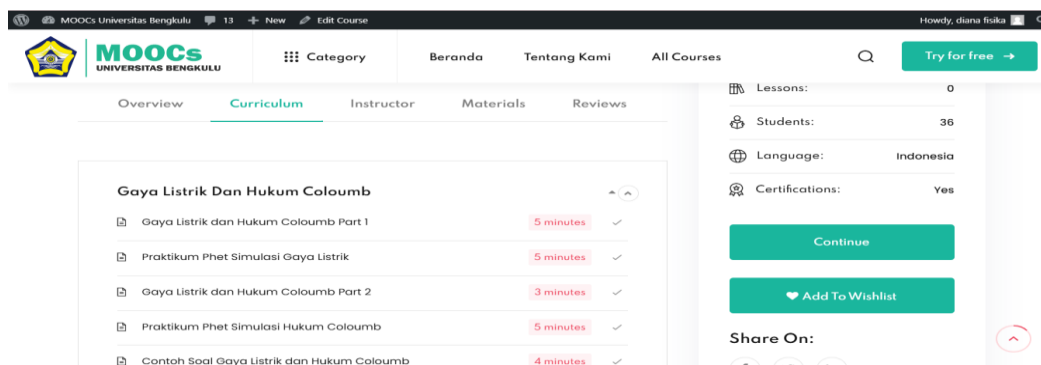


Figure 4. Material page display.

Each material contained in the digital module of comic-based static electricity material assisted by the MOOCs platform is presented in the form of a learning video. Where, the comics that have been made are then put together in the form of presentations and then used as learning videos using the Apowerec application. The learning videos that have been made are then uploaded to Youtube and linked to the MOOCs platform. The display of learning videos that have been linked to the MOOCs platform can be seen in Figure 5.

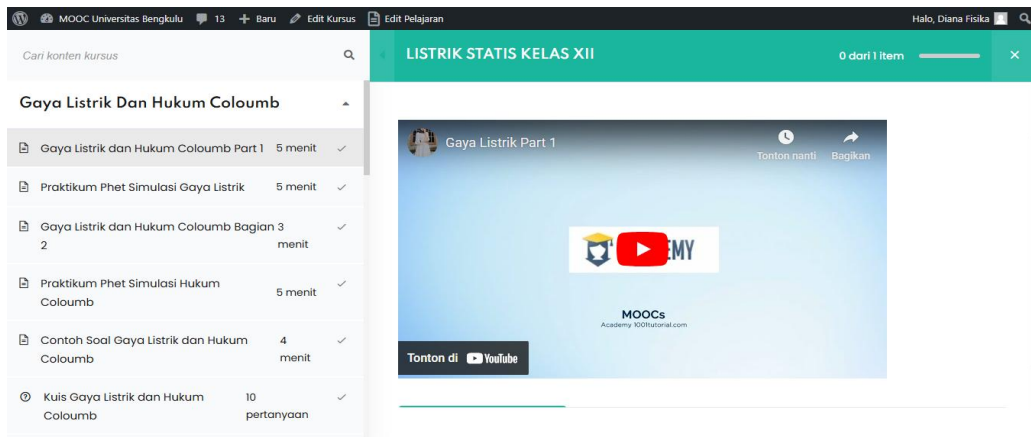


Figure 5. Learning video in MOOCs.

4. Questions

The exercise questions contained at the end of each subject matter contained in this module are in the form of multiple choices. These questions are used to measure the level of student understanding of the material contained in the digital module. The display of exercise questions contained in this module can be seen in Figure 6.

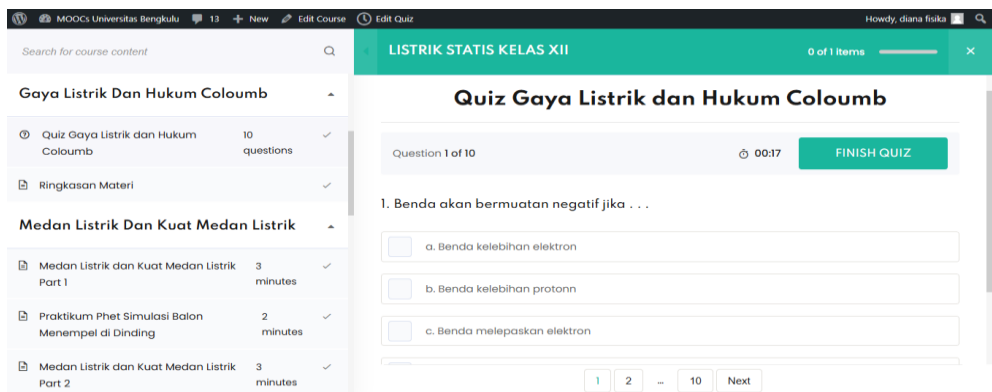


Figure 6. Exercise question.

5. Summary

The learning material that has been explained in this comic-based learning video is summarized in the summary section. This section is made to make it easier for students who want to repeat the learning material briefly and easily remembered by students. The display of the summary section can be seen in Figure 7.

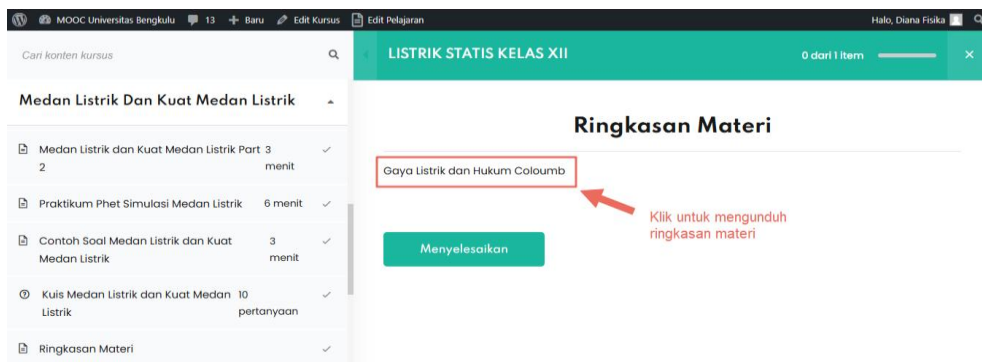


Figure 7. Material summary.

6. Digital Comics

Besides being presented in the form of learning videos, comics about static electricity material are also packaged in the form of Flipbooks. This digital comic is presented as an alternative learning for students who want to read the static electricity material contained in the digital comic themselves. This digital comic of static electricity material can be seen in the materials section on the MOOCs platform. The digital comic display of static electricity material is presented in Figure 8.



Figure 8. Digital comics of static electricity material.

b. Product Validation

At this stage of development, validation of the digital module of comic-based static electricity material assisted by the MOOCs platform is also carried out. Product validation is carried out to determine the validity of the product developed. The validity test was carried out by 3 experts, namely 2 Bengkulu University Physics Education lecturers and 1 physics teacher MA Negeri 2 Bengkulu City. This validation was also carried out to determine the feasibility of the product developed before being tested on students. Data from expert validation assessment results, where the average percentage of product feasibility assessment is 89.36% with a very feasible category. The results of the product validation that has been carried out can be seen in Table 4.

Table 4. Feasibility results of comic-based digital module of static electricity material assisted by MOOCs platform.

Assessment Aspect	Response	
	Score	Qualitative Category
Content Feasibility	87.5%	Very Feasible
Presentation Feasibility	89.58%	Very Feasible
Language Feasibility	87.5%	Very Feasible
Media Feasibility	90.74%	Very Feasible
Concept understanding	91.6%	Very Feasible

c. Product Revision

This stage is carried out by making product revisions based on suggestions and input from validators. This stage is also an evaluation phase at the development stage. Where, based on the results of the validation of the feasibility of this comic-based digital module assisted by the MOOCs platform, several suggestions were obtained from the validator, namely:

1. Enlarge the font size contained in the digital comic.



Figure 9. Display before the font size is enlarged.



Figure 10. Display after the font size is enlarged.

2. Fixing unclear images on digital comics.

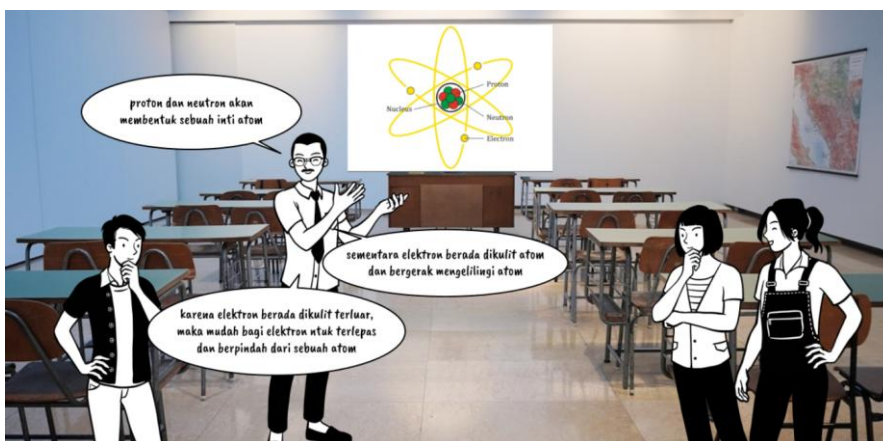


Figure 11. Display before the image is fixed.

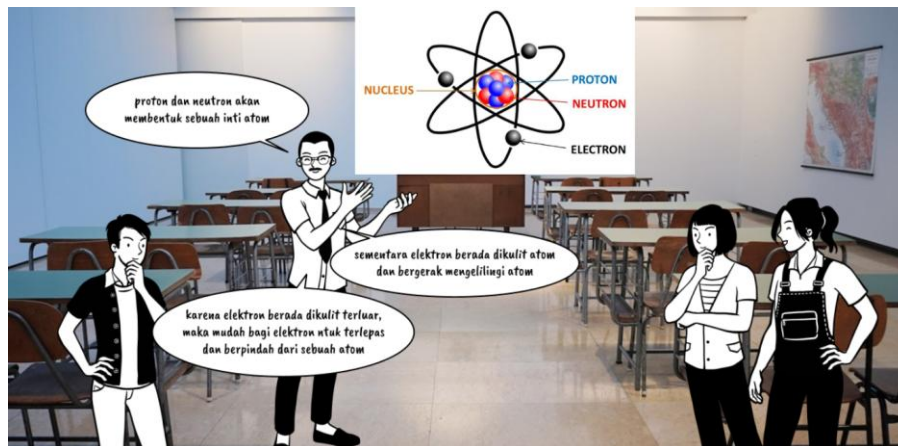


Figure 12. Display after image fixed.

3.1.4 Implementation Stage

The Implementation stage or the dissemination stage is the fourth stage in development research, where at this stage the product that has been developed and has been revised after expert validation is then tested on XII I MA Negeri 2 Bengkulu City class students totaling 35 students. The implementation of the research was carried out by giving a Pretest and Posttest to see the increase in students' concept understanding and distributing student response questionnaires to the digital module of comic-based static electricity material assisted by the MOOCs platform developed. The Pretest was conducted at the beginning of the meeting before students were introduced and used the comic-based digital module assisted by the MOOCs platform to learn, while the Posttest was conducted at the end of the meeting after students learned with the comic-based digital module assisted by the MOOCs platform. Based on the Pretest and Posttest scores, the effectiveness data is 0.82 and the N-Gain percentage of increasing students' concept understanding is 82.65%. The effectiveness category of increasing students' understanding of concepts is high. Then, students were asked to respond to the digital module of comic-based static electricity material assisted by the MOOCs platform, the results of which can be seen in Table 5.

Table 5. Results of student responses to the digital module of comic-based static electricity material assisted by the MOOCs platform.

Assessment Aspect	Response	
	Score	Qualitative Category
Effectiveness of Digital Module	90.95%	Very Good
Learning Motivation	89.82%	Very Good
student learning activity	88.57%	Very Good

The results of student responses shown in Table 5 have an average percentage score of 89.78% with the category of student responses to the development of comic-based digital modules, which is very good, which means that comic-based digital modules assisted by the MOOCs platform have attractiveness and positive responses for students.

3.1.5 Evaluate stage

Evaluation is carried out at each stage of research and development. The evaluation stage is carried out to evaluate the comic-based digital module developed based on input obtained from expert validation and based on the implementation stage that has been carried out. Based on input from validators and implementation that has been done, revisions are made based on aspects that may be revised. The results of the revision of this evaluation stage are comic-based digital module products of static electricity material assisted by the MOOCs platform that are suitable for use. The product developed is a digital

module of comic-based static electricity material assisted by the MOOCs platform for XII grade high school students. This is indicated by a high N-Gain score of 0.82 and a student response of 89.57%. Therefore, the product developed, namely the digital module of comic-based static electricity material assisted by the MOOCs platform for class XII high school students, is very feasible and good to develop after getting very feasible validation results from all validators and getting excellent student responses to the media.

3.2 Discussion

3.2.1. Needs analysis of comic-based module development assisted by MOOCs platform

The needs analysis was conducted through interviews with representatives of SMA/MA students in Bengkulu, namely SMA Negeri 1 Bengkulu Utara, SMA Negeri 2 Bengkulu Utara, SMA Negeri 3 Bengkulu Tengah, SMA Negeri 11 Bengkulu City, MA Negeri 1 Bengkulu City, and MA Negeri 2 Bengkulu City. The results of interviews that have been conducted are that the internet network in schools is quite good, the learning methods used are still conventional methods and teachers have used electronic learning media such as PowerPoint (PPT) in class learning activities, therefore the development of digital modules is needed at this time because of the demands of the curriculum which requires teachers as facilitators in learning activities and create a learning atmosphere that can make students to be able to play an active role during the learning process. The solution that teachers can use to overcome these problems is to use interesting and interactive learning media to be able to attract attention and increase student learning motivation, and can improve students' cognitive understanding.

To supported the interview data obtained, a bibliometric analysis literature study on the trend of using comic-based learning media in physics learning was also conducted. The results of the bibliometric analysis show that the development of comic-based learning media needs to be continuously developed because it has great potential in increasing student interest and learning outcomes, especially in subjects that are considered difficult such as physics. Previous research by Febrianti [33] showed that the use of comics as learning media can enrich students' learning experience, making learning materials more interesting and easy to understand. In addition, the increasing trend of article publications on the use of comics as physics learning media shows the growing research interest in exploring the potential of effective learning media [34]. By continually developing comic-based learning media, it is hoped that it can be an alternative in the learning process, and can improve student learning outcomes.

3.2.2. Feasibility of Comic-Based Digital Module Assisted by MOOCs Platform

Based on the results of expert validation in Table 6, it states that the content feasibility aspect is 87.5%, the presentation feasibility aspect is 89.58%, the language feasibility aspect is 87.58%, the media feasibility aspect is 90.74%, and the motivation and learning outcomes aspect is 91.6% which has an average percentage of feasibility from the three validators is 89.36% with the category "Very Feasible". Based on the criteria for the validity of a media developed according to Savitri [28], it states that a media is said to be valid if the percentage results of the feasibility assessment obtained are more than > 61%. These results indicate that the digital module of comic-based static electricity material assisted by the MOOCs platform is successfully developed and suitable for use. In addition, according to Puspananda [35] comic-based learning media can be used to convey subject matter more interestingly so that it can attract student attention and increase student learning motivation, and can increase student understanding. This statement is supported by research [36] which states that learning comics compiled from a series of images and words to form a comic to convey learning information can help students to understand learning material more easily with stories that are relevant to students' daily lives.

3.2.3. Effectiveness of comic-based digital module assisted by MOOCs platform to improve students' concept understanding

The N-Gain percentage obtained reached 82.65% with the effective category. So that from the pretest and posttest values it can be concluded that the digital module of comic-based static electricity material assisted by the MOOCs platform is effectively used to improve student learning outcomes, especially in

static electricity material. The results of this study are in line with Ratnaningtyas' research [37] which states that digital comics are an effective and efficient medium used in learning because they can improve students' concept understanding. The delivery of subject matter packaged into a story related to everyday life is a special attraction for students to learn. Karlimah [17] stated that the use of digital comics as a learning media in class is not only to increase student learning motivation and make learning more interesting, but also a form of digital technology adaptation, increase students' digital literacy, and make it easier for students to understand the subject matter. In addition, combining comic-based learning media with learning platforms available online such as MOOCs can increase the efficiency and effectiveness of the learning media [18]. The use of MOOCs as a learning platform can increase student motivation and learning outcomes because by using MOOCs students can access learning materials anytime and anywhere, MOOCs can be a collaborative learning medium between students and teachers in interacting online, in MOOCs there is also evaluation and feedback that can help students see progress and improve student understanding of the subject matter [21].

3.2.4. Student response to comic-based digital modules assisted by the MOOCs platform

The digital module of comic-based static electricity material assisted by the MOOCs platform as a whole received a positive response from students with a percentage of 89.57% and the category "Very Good". This positive response is based on students' interest in comics that are used as learning media, thus triggering interest and motivating students to learn physics. This is also supported because the comics are assembled with a combination of images and writing arranged in such a way as to form an interesting storyline related to daily life events and packaged in simple language so that it can make it easier for students to understand the material in it. These results are in line with research [38] which states that the use of comics as physics learning media gets a good response from students because the packaging of abstract physics material into a comic with a combination of interesting images makes learning activities in class more interesting. Ratnaningtyas [37] in her research also stated that the use of comics as a physics learning media can be one of the innovations that can increase student interest in learning and get a good response from students. So, the digital module of comic-based static electricity material assisted by the MOOCs platform gets a positive response from students.

4. Conclusion

The final result of this research is a digital module of comic-based static electricity material assisted by the MOOCs platform which has been validated by experts starting from the content aspect, presentation aspect, language aspect, media aspect, motivation aspect and learning outcomes. With the results of expert validation, it shows that the digital module of comic-based static electricity material assisted by the MOOCs platform is suitable for use as learning media. The digital module of comic-based static electricity material assisted by the MOOCs platform has been tested to increase student understanding, the results show that the digital module of comic-based static electricity material assisted by the MOOCs platform is effective for improving student understanding. Students gave a good and positive response to the digital module of comic-based static electricity material assisted by the MOOCs platform So it can be concluded that the digital module of comic-based static electricity material assisted by the MOOCs platform that has been developed is suitable for students to use as an independent learning resource that can be accessed anywhere and anytime so that it can improve students' understanding of concepts in static electricity material. The suggestion for further research is to improve the quality of comics even better by working with experts in the field of design and communication.

Acknowledgment

The researcher is grateful to the physics education study program, Bengkulu University, which has given permission to researchers to participate in the Merdeka Belajar Kampus Mengajar (MBKM) Research activity, where one of the outputs is this article. The researcher would also like to thank the extended family of MA Negeri 2 Bengkulu City for giving permission and helping the implementation of this research.

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