Development of a Comic System For Human Digestive Education to Improve Critical Thinking Abilities

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Abstract: The use of technology-based learning media in stories and pictures has not been optimally used by teachers, which causes students' critical thinking skills to be low. This study aims to describe the development design and test the feasibility and effectiveness of Education Comic for the human digestive system to improve the critical thinking skills of SDN Patemon 02 Semarang grade V students. This type of research is research and development (R&D) with the ADDIE model. The stages of ADDIE are as follows: (1) Analyze, (2) Design, (3) Development, (4) Implementation, (5) Evaluation. Data collection techniques used were Test (pretest and post-test) and Non-test (interview, observation, questionnaire, and document data). The research subjects were 20 students in SDN Patemon 02 Semarang class V. The data analysis technique uses normality, t-tests, and N-gain tests. The study results show that (1) The development design of the educational comic uses the Adobe Photoshop CS3 application and Clip Studio Paint with components consisting of a cover, character introduction, reading instructions, materials, and evaluation. (2) The feasibility results of education comics from material experts with 90% of the category are very feasible, media experts are 90% of the category very feasible with the results of the questionnaire responses of students and teachers of 98.56%, 90.55%, and 96.67% respectively with the category of very feasible. (3) the effectiveness of the Education comic is shown from the t-test results obtained a significance value of 0.00, which means <0.05, then the hypothesis is accepted. The improvement in critical thinking skills is shown from the results of the N-gain test of 77.64% with the high category. The conclusion of this study shows that the Human Digestive System Education Comic has been successfully developed, feasible, and effective in improving the critical thinking skills of grade V students of SDN Patemon 02 Semarang.

Keywords: Critical Thinking Ability; Education Comic; Human Digestive System; IPAS.

Introduction

Education is one of the efforts in developing the potential of each individual. In this era of rapid development, increasing the implementation of formal and non-formal education worldwide is necessary. Formal education is education that is organized through school institutions [1]. Through education, a person can develop his potential, such as spiritual strength, religion, noble morals, and intelligence to face life in the future. This is to what is written in Government Regulation Number 57 of 2021 concerning National Education Standards Chapter 1 Article 1 Paragraph 1, which explains that Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious, spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation, and state [2].

The National Education Standards refer to the minimum criteria for the education system implemented in Indonesia. The primary purpose of national education standards is to ensure the quality of education that advances the nation's life and to form an identity and civilization based on the values of Pancasila and the 1945 Constitution. To achieve education goals, it is necessary to improve the quality of education [3]. One way to improve the quality of education is through formal education. With the existence

of formal education it is intended to develop the abilities or potentials possessed by students. In addition, formal education forms a pleasant learning experience for students and teachers by emphasizing the development of skills and character through the nation's values and policies taken and implemented by the government, namely by changing the Independent Curriculum in the Indonesian Education system.

The Independent Curriculum is an innovation in the world of Indonesian Education which has the goal of developing students' potential and learning interests optimally [4]. The Independent Curriculum allows educators to design high-quality learning that suits the needs of students and the learning environment. Based on specific themes identified by the government, projects will be developed to increase the realization of the Pancasila student profile. This is by Permendikbudristek No. 262/M/2022 concerning Guidelines for Implementing the Curriculum in the Context of Learning Recovery. It contains the Independent Curriculum structure, learning and assessment rules, the Pancasila Student Profile Strengthening Project, and teacher workloads. Where it explains related to intracurricular learning activities that are designed so that children can achieve the abilities that exist in the learning outcomes [5].

Learning Outcomes is an issue from the Ministry of Education and Culture used as a reference for implementing

learning in the independent curriculum. Learning outcomes are skills that students must master at each stage of learning [6]. The presence of Learning Outcomes assists teachers in formulating learning objectives that are based on students' individual needs. Learning objectives refer to the results of three aspects of competence that students will obtain through one or more learning activities, namely knowledge, skills, and attitudes. Learning objectives are developed with the opportunity to gather observable and measurable evidence through assessments to enable educators to monitor their progress toward learning objectives by the subjects.

Natural and Social Sciences (IPAS) is one of the subjects implemented in the Independent curriculum at the elementary school level. IPAS integrates science and social studies subjects. Hopefully, it can deepen the concept and improve students' skills according to the independent curriculum's learning goals. According to information from the Ministry of Education and Culture, The merger of Science (Natural Sciences) and Social Sciences (Social Sciences) in the Independent Curriculum aims to make education more holistic, involving various disciplines, and relevant to the context. By combining these two subjects, students are expected to understand the relationship between natural and social aspects of daily life. Science and technology learning requires media to visualize something abstract into concrete because elementary school-age children still in the concrete operational stage need a real example to understand what the teacher conveys. So, there is a need for exciting learning media to increase students' interest and thinking ability towards material that they consider problematic [7].

Learning media helps students receive and process the learning materials from teachers. Learning media provides students with many benefits, including making it easier to achieve learning goals [8]. This is especially important in online learning, where students often have difficulty understanding the material well. The use of media in communication and learning has the following impacts: (1) Learning becomes more standardized, (2) Learning becomes more interesting, (3) Learning becomes more interactive, (4) Learning time can be shortened, (5) The quality of learning outcomes can be improved, (6) Learning can be delivered at any time according to demand or needs, (7) Students develop a positive attitude towards the material they learn, and (8) The role of educators can change to a more positive direction [9]. The media plays a vital role in learning, supporting teachers' expansion of student knowledge. Teachers can use various types of learning media as a source of knowledge for students in the learning process to realize educational and learning goals that expect students to develop critical thinking skills.

The ability to think critically is a skill that must be present in students. In the era of rapid development of the times, we are entering an increasingly advanced era marked by the rapid changes occurring in various aspects of life. Therefore, it is necessary to instil critical thinking skills in students to filter the existing information. His writing in a journal entitled Critical Thinking Skill: Concepts and Assessment Indicators said that a person is said to be able to think critically if the person can think logically and systematically. However, the fact is that the critical thinking skills of students in Indonesia are still relatively low. This is known based on research [10]Trend In International Mathematics and Science Study (TIMSS) in 20, which revealed factual, procedural, and conceptual knowledge among Indonesian students. In general, the purpose of TIMSS is to monitor the outcomes of the education system regarding student learning achievement in Mathematics and Science. It was concluded that Indonesia ranked 44th out of 49 countries [11]. Trend In International Mathematics and Science Study (TIMSS) also showed that 54% of Indonesian students have relatively low science and cognitive skills, which include comprehension, application, and reasoning.

Based on the results of the pre-research that has been carried out through observation and document data obtained through grade V teachers of SDN Patemon 02 Semarang City in class V, which amounted to 20 students, several main problems were found, including (1) Teachers are not optimal in implementing technology-based learning media. Teachers only apply learning media in whiteboards and textbooks; no technology inserts exist. This affects learning because students get bored quickly and do not create interactive, practical, and fun learning. (2) Students' critical thinking skills are still low. During the learning process, the teacher tries to provide questions in the form of analysis to stimulate students to think critically. Regarding teachers' questions, only 25% of students can give critical answers. In contrast, other students tend to be silent and do not give feedback regarding the questions provided. At the time of evaluation, students were given questions with a C4 (Analysis) level. Still, the results showed that only 35% of students could answer correctly, and the rest, namely 65%, were inaccurate in answering all the evaluation questions. With this, the class teacher also argued that the critical thinking ability of class V students was still low. (3) Students are less able to understand the learning materials delivered by teachers, especially in science and science subjects, with materials on the human digestive system.

The results of the interviews obtained by students still showed misconceptions when mentioning the names of the organs and diseases of the human digestive system. The results showed that 86.4% of students needed media with attractive presentations, visuals, and colours to support existing textbooks. Furthermore, when researchers asked questions about books that students liked, as many as 90.8% of students were interested in reading books with many pictures. Elementary school students aged 6 to 12 are at the concrete operational stage. The ability that emerges at this stage is applying logical rules to the thought process, but is still associated with concrete objects. Therefore, the researcher is interested in developing learning media in the form of comics because this media is based on the characteristics of elementary school students still in the concrete implementation stage.

The comic was first launched in 1896 by Richard Felton Outclaut under "The Yellow Kid". Comics are a print medium designed to express ideas through images, often combined with text and other visual information. Comics are currently popular among children and teenagers, and the comics themselves can be designed according to the characteristics of students, so comics themselves can also be a forum to solve problems related to students' interest in reading and learning outcomes [12]. The characteristics of the Education Comic are unique and

exciting, and its creation is flexible according to the child's characteristics. It is easy to insert problems that invite students to think critically. The research carried out by the study entitled "Development of digital-based comic media on students' critical thinking skills in metamorphosis materials in high grades" states that there is a significant influence on students' critical thinking skills. Increased student learning outcomes from the pretest and post-test characterize it. Thus, learning media can be applied to learning because it is an excellent alternative to improving students' critical thinking skills [13].

Based on the relevant problems and sources of study, the researcher has the goal of "describing the design of development, testing the feasibility and effectiveness of the Education Comic of the human digestive system to improve the critical thinking skills of grade V students of SDN Patemon 02 Semarang.

Research Methods

Main This research is a type of research and development (R&D). Research and development (R&D) theory is research used to produce products. Borg and Gall stated: "Educational research and development is the process of development and validation of educational products," meaning development research is the process that leads to the development and validation of products and the use of development products. The product development in this study is Education Comic, which was developed using Adobe Photoshop CS3 and Clip Studio Paint applications [14].

The research subjects were 20 students in grade V of SDN Patemon 02 Semarang. This development research aims to describe the development design and test the feasibility and effectiveness of the Education Comic of the human digestive system to improve the critical thinking skills of SDN Patemon 02 Semarang grade V students.

The research design model used in this study is the ADDIE research and development model with the following stages: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. Developed by Dick and Carey to design a learning system. [15]
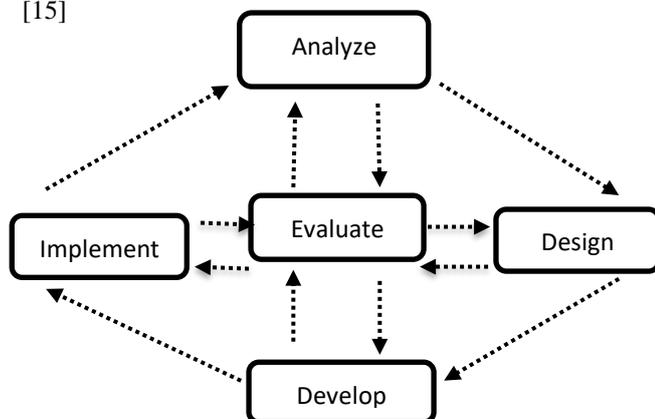

Figure 1. Stages of the ADDIE Model

The data collection techniques used are tests in the form of pretest and post-test questions and non-tests in the form of observations, interviews, and document data. The data analysis techniques used to determine the feasibility of the product are expert validation sheets and teacher and student questionnaire sheets. Meanwhile, the product's effectiveness is determined by a normality test using the Shapiro-Wilk test, a t-test with paired samples, and an N-gain test.

Results and Discussion

Development of Education Comic for the Human Digestive System

The research entitled "Development of Human Digestive System Education Comic to Improve Critical Thinking Skills of Social Science Class V Elementary School" uses the ADDIE development model, namely Analyze, (2) Design, (3) Development, (4) Implementation, (5) Evaluation. The following are the steps to develop the Human Digestive System Education Comic that the ADDIE model has carried out:

The analysis stage involves several processes, including needs assessment and task analysis. This study's analysis began with preliminary data collected at SDN 02 Patemon Semarang City through observation and interviews with class V teachers. The study subjects were 20 students in class V and teachers of class V. Some information was obtained about the process of teaching and learning activities (KBM) and the availability and use of social science learning media in schools. The researcher can analyze the learning content and its needs based on the interview results. The results of the analysis phase are:

a. Needs Assessment
Based on the results of the interviews that have been conducted, it is known that students need learning media on the human digestive system material so that students have a spirit of learning and interest in thinking during learning and liven up the learning atmosphere in the classroom so that it becomes exciting and fun learning.

b. Task Analysis
Task Analysis is carried out to identify critical tasks that students must carry out. Task analysis includes understanding Learning Outcomes and Objectives related to the learning materials prepared through the learning media being developed.

The design stage is known as the process of preparing learning media products. The design at this stage is based on the results of the student needs questionnaire, so it is still simple and will then be the basis for the following development process. The second stage is to prepare a design for the material developed in the Educational comic learning media. The material developed is on the human digestive system in class V. Comics developed in the form of educational comics with the help of the Adobe Photoshop application. The title "Education Comic of the Human Digestive System" is written on the cover as a theme that covers the entire storyline. The next stage is to develop the concept of an Education comic, consisting of several stages, as follows:

a. Determining the Theme
This educational comic's theme is the human digestive process, starting from part 1 of the introduction of

the names of organs and their role in the digestive process. Then, part 2 talks about how humans can experience digestive system disorders.

b. Determining the character according to the Theme

The characters in this Education comic are illustrations of pictures of each name of the digestive organ and the name of the disease of the digestive system. So the existing characters play the role of the mouth, oesophagus, stomach, small intestine, large intestine, and anus. Meanwhile, the part of the disease management in the digestive system of the characters who play a role is the teacher, Pipo, and Bolbol. The three characters will tell how digestive system disorders occur by being illustrated with characters with a storyline in the form of a conversation between a pipe and a ball.

c. Planning process

After creating the Education comic script, the next step is to create an Education comic, which is made using Adobe Photoshop CS3 and Clip Studio Paint applications. The two applications used have different roles in creating this Education comic; Adobe Photoshop CS3 only creates panel pages and speech bubbles related to writing pages and sentences, while Clip Studio Paint is used to draw and color the characters and objects contained in the Education Comic. An educational comic design focuses on the material of the human digestive system in which there is a problem-oriented insert at the beginning, which will be an initial problem for students and try to find a solution to the problem. In the compiled material's storyline, there are also foreign terms that spur students to think critically. At the end of the story, an evaluation aims to test how far the students can absorb the material of the human digestive system designed in Education Comic.

This development stage is an activity stage in product plan implementation. This phase transforms the conceptual framework into a product ready to be implemented. The development stage includes several steps, including:

a. Developing an Education comic design

The product produced in this study is an education comic, which is designed with a different picture using the Adobe Photoshop CS3 application. It includes a cover, reading instructions, a character introduction, and a storyline. Education Comic media developed by the material in the learning of IPAS Chapter 5 (How we live and grow) Topic B (Why we need to eat and drink) focuses on the material of the human digestive system. The media developed consists of the following components:

1. The first page has a cover page that displays the title of the Education comic and the author's name.
2. A preface that contains the purpose of making a comic
3. Table of contents
4. Introduction page of characters who play a role in the story of the Education comic
5. The content of the Education comic is in the form of material on the introduction of organs in the human digestive system and disorders of the human digestive system with problem-

oriented inserts to improve critical thinking skills.
6. Evaluation at the end of the Education comic to train students' memory in the application of the Education comic.
   b. Author Biography
   c. Bibliography

The display of the results of the development of the Education Comic Human Digestive System is as follows:
1. Display of cover development and introduction of Education comic characters.

Figure 2. Cover and introduction of Education comic characters

2. Display of the development of Education comic reading instructions

Figure 3. Education comic reading guide

3. Display of the development of educational comic material for the human digestive system

Figure 4. Education comic material on the human digestive system

4. Evaluation Display

Figure 5. Evaluation of Education comics

Once the media is developed, the next step is validation to ensure a fit. Validation is carried out by several experts, including media experts and material experts, to assess the feasibility of the media.

Feasibility of the media Education comic of the human digestive system

The development of media designed in advance is then tested with material and media experts to obtain suggestions for improving the development of educational comic media. During the activity, media and material experts provided notes for enhancing the development of the Human Digestive System Education comic. The suggestion is to add one more page to the Education comic to bring up the orientation of the initial problem that students must solve. It is necessary to adjust the material on the mouth and oesophagus for the Education comic material. Finally, it is essential to eliminate excessive character images.

After the revision was carried out, to find out whether or not the Education comic learning media was feasible was obtained from the assessment scores of several material experts and media experts. The following are the results of the validation recapitulation from the experts:

Table 1. Recapitulation of Validation Results

No.	Expert	Presented	Criterion
1.	Material	90%	Very worthy
2.	Media	90%	Highly Worthy

Media validation is carried out to assess the media developed with the aspects assessed, namely media design, language, and ease of use of media. Based on the percentage, the results of media validation were obtained by 90%. The table shows that learning media is considered very feasible to use in learning. This is based on the percentage of eligibility criteria of 86%-100%. Material validation was carried out to assess the feasibility of the learning media developed by the science and technology subject matter, namely about the human digestive system, by determining the suitability of learning tools in the form of teaching modules with aspects assessed in the form of the relevance of materials and questions to CP and ATP. Based on the percentage, the results of material validation were obtained by 90%. Learning media is considered very feasible to be applied in learning. The score obtained is based on the range of media eligibility criteria, which is 86%-100%. In addition, the results of another study, namely a study entitled "Development of E-Comic Media based on Problem-Based Learning", obtained the result that e-comic media is feasible to be developed based on the results of validation by experts. The assessment results from learning content experts reached 97% with the very good category, learning design experts also reached 97% with the very good category, learning media experts obtained 100% with the very good category, and individual test subjects obtained 90% with the very good category. Media Education Comic is good because it has exciting and relevant animated character images and students' characteristics. Through it, elementary school-age children can solve problems and think systematically about concrete objects so that children can solve problems in daily life. [16].

Implementation is the stage where the product is tested in learning. In addition, the feasibility test of a media can also be seen from the results of the teacher and student responses questionnaire. The activity was carried out twice, starting with a small group trial of 5 children To find out that the products developed could be categorized as feasible before being applied in learning and a large group trial of 20 children. The two activities were carried out on grade V students of SDN Patemon 02 Semarang City with the overall results of the questionnaire that had been filled out as follows:

Table 2. Recapitulation of teacher and student responses

No.	Questionnaire	Presentase (%)	Criterion
1.	Small group trials	98.56%	Very worthy
2.	Large group trials	90.55%	Highly Worthy
3.	Class V teacher	96.67%	Highly Worthy

Refer to Table 2. Based on the data of student respondents to the educational comic media in small and large group trials and teacher responses, the average results were 98.56%, 90.55%, and 96.67%. So it can be stated that the Education Comic media of the human digestive system is included in the criteria that are very suitable for learning. It is said to be very feasible, as the theory that learning media is possible and can be applied in learning if the percentage obtained is >75% [17].

The effectiveness of the educational comic on the human digestive system

This research focuses on the science and technology curriculum for grade V students, which discusses the Human Digestive System. The product being developed requires an assessment to determine whether the educational comic media created effectively improves critical thinking skills while learning. Experts in the field carry out material validation, while media validation is carried out by media experts. To test the effectiveness of the media in improving participants' critical thinking skills, a field trial was carried out by collecting data on the results of the pre-test and post-test conducted by students during the learning process, as well as a test in a large group. The results of the data obtained will be analyzed using the Normality test, T-test, and N-Gain Score test to determine the effectiveness of the media in improving critical thinking skills.

Normality Test

The normality test is a procedure to check that the tested data comes from a normally distributed population. The normality test is used to evaluate whether or not an independent variable, a dependent variable, or both in a regression model has a distribution similar to the normal distribution. The purpose of this normality test is to determine whether the data has a distribution that corresponds to normal circumstances or not. [18]
The following are the Normality test results using the Shapiro-Wilk Test processed using the SPSS application.

Table 3. Normality Test Results

		Test of Normality Shapiro-wilk	
	Class	Say.	Category
Results	Pretest	0.752	Normal
Critical thinking skills	Postest	0.067	Normal

Based on the table above, the results show that the signification values of 0.752 and 0.067 are more significant than 0.05, so it can be concluded that the tested data is usually distributed.

Uji t-test

A one-sample t-test, also known as a one-sample t-test, is a method used to assess whether the mean of a sample is significantly different from a specific value or constant. This test is one of the hypothesis techniques that helps decision-making related to descriptive hypotheses. A one-sample t-test is carried out on data scaled in ratio or interval and with a normal distribution. [19]

Table 4. Hasil Uji Paired Samples Statistic

Paired Samples Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Pretest	20	54.2000	12.47988	2.7905
Postest	20	79.0000	7.26926	1.6254

Based on the statistical output table above, students' average learning outcomes before and after treatment are 54,2000 and 79,0000, respectively. There is a difference in the average learning outcomes of students before and after being given treatment. Furthermore, to find out if the difference is significant, the results of the "Paired Samples Test" are interpreted as follows:

Table 5. Hasil Uji Paired Samples T-test

Paired Samples Test				
	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Pretest-Postest	-24.80000	9.54546	2.13443	.000

Referring to the table above, a significance value of 0.00 was obtained, which means <0.05, and then the hypothesis of the test results was accepted.

Uji N-Gain

The last analysis in this study is by N-Gain testing. N-gain is a formula used to determine the influence of the use of learning media on students' critical thinking skills based on the level of effectiveness. To find out the improvement that occurred on the average results of students' critical thinking skills in the material of the human digestive system using Education Comic. So, what will be observed is whether there is an increase in pretest and post-test scores. The following are the results of the N-Gain test using the SPSS application [20].

Table 6. N-Gain Test Results

Descriptive Statistics				
	Min	Max	Mean	Criterion
N-gain	69.21	89.88	77.6405	Tall

Based on Table 6, the minimum score of students was 69.21 while the maximum score was 89.88, and the average result was students' critical thinking skills in the material of the human digestive system using Education Comic. It was observed from the results of the test using SPSS that there was an increase in pretest and post-test. With a mean result or an average value of 77.64%, with high criteria because the result was > 0.70 from the N-Gain test effectiveness criteria table. The Education Comic media is said to be effectively used and can improve students' critical thinking skills during the learning process because it is seen from the components of the Education comic, which consists of problem orientation and inserting material with foreign terms to the evaluation of the final part of the Education comic which spurs students to think critically and systematically.

The factors that affect the average improvement results get a high category, namely (1) the readiness of teachers and students before learning. Teachers' readiness is that they have designed media and developed meaningful learning strategies so that students have a good level of preparedness during learning. Learner readiness refers to the overall condition of a person that allows him to respond

or act according to the situation he is facing. It includes physical and mental conditions that affect each other, which are necessary for the individual to achieve optimal readiness in the learning process [21]. (2) Students' learning styles. In addition to learning readiness, students also apply learning styles. Learning style is a way of absorbing and understanding information that is used as an indicator to act and relate to the learning environment [22]. One of them is the visual learning style. What is meant to be learned by obtaining information from looking at pictures, diagrams, maps, posters, and so on [23]. So when the "Education Comic" media is presented in learning, the response given by students is excellent, and they look enthusiastic in following illustrations, reading instructions, observing pictures, observing problems directly, and solving existing problems quite well. (3) Comfortable learning environment. The existence of a safe and comfortable learning environment improves learning conditions and provocative interactions and presents challenges for students to be actively involved in the learning process. This situation makes it easier for students to accept the material taught by the teacher and helps them deepen their understanding.

Evaluation is the last stage in development research using the ADDIE model. This research has only reached the trial stage of product application in learning. For this reason, evaluation is obtained from development and implementation activities. The evaluation results were obtained from media and material validators by getting suggestions and input from the media used. The evaluation from media experts does not add anything to the media used because the selected media is appropriate and suitable for the characteristics of grade V elementary school students.

Meanwhile, the evaluation from material experts is to add incomplete material and eliminate excessive images. Media Education Comic also received a response from teachers, assessing that the learning media is very effective and efficient and meets practical criteria because the application of Education Comic media can be done offline (Print books) and online (Link Gdrive) so that the media can be accessed and scanned by everyone and more efficiently.

Conclusion

The results of the research on the development of Education Comic media using the ADDIE model with human digestive system materials to improve the critical thinking skills of grade V elementary school students were developed using the Adobe Photoshop CS3 application and Clip Studio Paint with components consisting of covers, character recognition, reading instructions, materials, and evaluations. They are showing promising results and meeting the feasibility and effective category in helping to improve students' critical thinking skills in learning. The feasibility of the Education comic is based on the validation results obtained from material experts and media experts of 90% and 90%, respectively, with the category of very feasible. The results of the teacher response questionnaire of 96.67% of the category are very feasible. The response of students to the media in the small and large group tests was 98.56% and 90.55%, respectively, with the category of very feasible. Media Education Comic can also improve

critical thinking skills, as seen from the effectiveness of the N-gain test results with an average percentage of 77.64% High criteria.

This study concludes that Media Education Comic for the human digestive system has been successfully developed, and it is very feasible and effective in improving the critical thinking skills of SDN Patemon 02 Semarang grade V students.

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