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Development of E-Comic Learning Media Assisted by Video in Science Learning on Human Blood Circulation Material

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Abstract: The lack of innovation in learning media at SDN Lumbungmas 01 impacts student learning outcomes. This research is of the RnD (Research and Development) type, referring to the Borg and Gall model. The purpose of this study is to test the feasibility, practicality, and effectiveness of developing e-comic media assisted by video. The population used consists of 12 students from class VB on a small scale and 22 students from class VA on a large scale at SDN Lumbangmas 01, totaling 34 students. Data collection techniques include tests and non-tests. The test technique involves pretests and posttests, while non-test techniques involve interviews, observations, questionnaires, and documentation data. The feasibility scores given by media, material, and language expert validators show that the development of e-comic media meets the criteria for being highly feasible with scores of 90% (very feasible), 90% (very feasible), and 70% (feasible), respectively, resulting in an average of 83.3% (very feasible). The practicality of media development, assessed through questionnaires, indicates it is highly practical. Based on pretest and posttest results, the e-comic media development meets the criteria for effectiveness. This is evident from the effectiveness analyzed through the t-test and N-gain test. The t-test shows that Sig. < 0.05, meaning there is a significant difference between learning outcomes before and after treatment. The N-gain test shows high criteria, with 0.6182 on a small scale and 0.7173 on a large scale. Based on these results, it can be concluded that the development of e-comic media assisted by video is feasible, practical, and effective for use in learning for fifth-grade students at SDN Lumbungmas 01.

Keywords: E-comic; Learning outcomes; Video

Introduction

Humans are the target of education (Laksana, 2021). Education helps humans to develop their human potential. This shows that education is a human need that is focused on providing knowledge, skills, and a certain expertise to develop their potential so they can adapt to the advancements in science and technology (López-Prados & Sáez-De-Adana, 2023). Advances and developments in the field of information and communication technology create a dynamic, competitive environment that requires active participation in global competition to keep up with or even compete with other nations (Arafik et al., 2021). In line with this, there is a need for human resources with the ability to think critically, logically, and creatively, balanced with the knowledge that can foster higher-order thinking skills (Abrori et al., 2023). One educational field that encompasses these abilities is Natural Sciences, which studies rational and scientific knowledge about the universe and everything in it (Bintoro et al., 2022). According to (Grahito Wicaksono, 2020) learning science can also help students realize the material in everyday life. Based on this, there is a need for learning that is adapted to the students' conditions and the developments of the 4.0 era (Aman & Wallner, 2022). This is reinforced by the use of a thematic curriculum that has an integrated concept across subjects. This curriculum emphasizes physical, mental, intellectual, and emotional student activity during

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learning to achieve optimal learning outcomes (Mustikasari et al., 2020). This concept is expected to provide a form of learning that sparks ideas, encourages imagination, and explores new things, accompanied by facilities for students as learning resources to enrich their knowledge and learning experiences (Tay et al., 2023).

However, in practice, there are still many obstacles in teaching science (Winangun, 2022). This is consistent with previous research which stated that there are still obstacles to the use of media as intermediaries for material from teachers to students (Palamar et al., 2023). Another study also mentioned that one of the factors causing the low level of understanding of science is the teachers' ability to innovate learning media, especially those based on technology (Sastrawan et al., 2021).

Observations and interviews conducted at SDN Lumbungmas 01 with the fifth-grade teacher also found several obstacles, namely monotonous learning resources that rely on government-supplied books. Moreover, the class teacher is not yet proficient in creating digital materials. Results from questionnaires distributed to fifth-grade students indicated that some students still have difficulty understanding science material. Students tend to have trouble understanding abstract material. Another problem is the lack of reading interest among students. This results in low learning outcomes in science subjects. Based on the number of students, which is 22 consisting of 10 girls and 12 boys, it was found that 17 students (77%) did not meet the minimum competency criteria (KKM) and 5 students (23%) did meet the KKM, with the established KKM being 70. A learning process can be considered successful if 75% or more of the total students participating in the learning activities have met the KKM set by the education unit. If this criterion is not met, it is considered unsuccessful and requires remedial actions.

The solution to address these issues is to develop creative and innovative media based on technology (Fitria et al., 2023; Swandi et al., 2020). This learning media is expected to improve learning outcomes (Arafik et al., 2021). This aligns with the opinion of Mioramalala et al. (2021) who stated that media suited to students' conditions would facilitate learning. One type of media that can be used as technology-based learning media is e-comic (Mansur et al., 2023; Rutta et al., 2020). E-comic is a learning medium connected to the internet, with an output in the form of a link that can be accessed using digital media with a single click (Swandi et al., 2020). It can be understood from this that digital media has advantages in terms of easy access (Harisman et al., 2023; Schille & Støckert, 2024). E-comic learning media essentially shares the same principles as printed comics, consisting of images, colors, and dialogues, but its presentation will be more complete, engaging, and efficient (Apostolou & Linardatos, 2023; Castro et al., 2023; Trisiana et al., 2020). The developed e-comic media will be packaged in the form of dialogues without eliminating the material coverage, and videos will be embedded to enhance students' understanding of the presented material. Videos also provide a new impression for students towards the learning media. This is in line with the opinions of Ichihashi et al. (2023) and Shofi (2020), who stated that audiovisual media like videos can offer something new, enjoyable, and capture students' attention.

Previous research by Marini et al. (2023) also revealed successful learning using e-comic. E-comic media also provides good understanding for students as information receivers and teachers as material providers and also serves as motivation in creating technology-based learning media (Endiawan et al., 2021; Lima et al., 2022; Nur'aeni et al., 2023). Based on this, the researcher conducted a study with the aim of testing the feasibility, practicality, and effectiveness of e-comic learning media assisted by video on the learning outcomes of students in science learning on the topic of human blood circulation.

Metode

The type of research used in this study is Research & Development. This research will produce e-comic media assisted by video to improve science learning outcomes on the topic of blood circulation for fifth-grade students at SDN Lumbungmas 01. The development carried out by the researcher refers to the procedure developed by Sugiyono (2019), which consists of 10 steps. However, due to time and cost constraints, only the first eight steps were applied, namely: (1) potential and problems; (2) data collection; (3) product design; (4) design validation; (5) design revision; (6) product trial; (7) product revision; (8) trial usage. The research outline can be seen in Figure 1.

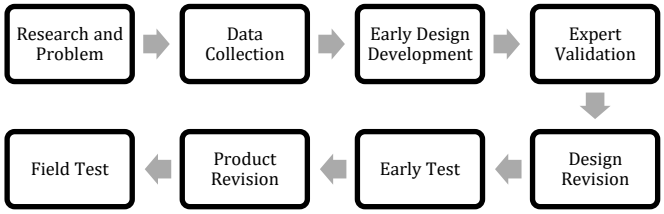

Figure 1. Modified Model from Borg & Gall

The potential and problem identification stage is conducted to ascertain the potential and issues present at the school. This stage is carried out by conducting interviews, observations, and data documentation in the form of learning outcomes of fifth-grade students at SDN Lumbungmas 01. The next stage involves

collecting data and information to plan the product to be developed according to the problems found, by distributing questionnaires to determine the needs of teachers and students. After analyzing the data from the need's questionnaires, the researcher designs several product aspects regarding design, materials, and language. The product design aligns with the basic competence, which is 3.4 "Explaining the circulatory organs and their functions in animals and humans, and ways to maintain the health of human circulatory organs."

The next step is validating the product design made by competent expert validators in media, content, and language. Data collection is conducted by filling out validation sheets prepared by the researcher in the form of a Likert scale.

The following step is the design revision. The design is revised based on feedback provided by expert validators so that the product can proceed to the testing phase. After revising the product, it is then tested on a small scale with 12 students from class VB, selected using purposive sampling based on different levels of cognitive ability. The product is tested in learning as an e-comic medium aided by video. After the learning session, both teachers and students are asked to fill out response questionnaires, which are then analyzed, and any suggestions or feedback are used for further product revisions.

The final stage is the large-scale product trial with 22 students from class VA for the 2023/2024 academic year. This trial aims to determine the effectiveness of the developed product based on students' learning outcomes.

The data types used in this research are primary data, obtained directly during the research, comprising qualitative and quantitative data. Qualitative data are collected through interviews, observations, and questionnaires, while quantitative data are collected from the learning outcomes of fifth-grade students at SDN Lumbungmas 01 in the form of pretests and posttests.

The research design used is pre-experimental with a one-group pretest-posttest model, where a pretest is conducted before the treatment and a posttest after the treatment. This aims to compare the results before and after the treatment using e-comic media aided by video. Data collection techniques include tests and non-tests. The test type consists of 30 multiple-choice questions, while the non-test type includes interviews, observations, questionnaires, and document data. To determine the feasibility of the developed product, analysis is conducted through the evaluation results from media, content, and language validators using a Likert scale. To assess the practicality of the product, questionnaires are distributed to students and teachers after the treatment using a Likert scale. The product's effectiveness is then evaluated using the n-gain test on the pretest and posttest scores of students in the large-scale trial.

Results and Discussion

Potential and Problems

Based on the interviews and observations conducted at SDN Lumbungmas 01, several issues related to the learning process were identified. It started with complaints about the implementation of the 2013 curriculum, which was considered unsuitable as it required a significant amount of time to complete the material topics. The primary goal of the 2013 curriculum is for students to be active and capable of independently finding information. Additionally, the use of media was not maximized. Observations in the classroom revealed that only 2-dimensional media such as images were used. This indicates a lack of innovation in media for each learning session. This is quite imbalanced compared to the available facilities, such as LCDs, Wifi, and gadgets owned by each student. Referring to the student's grade records, it was found that science learning outcomes were still relatively low. Among the 22 fifth-grade students (10 girls and 12 boys), 17 students (77%) had not yet met the minimum passing criteria (KKM), and 5 students (23%) had met the KKM, where the KKM for science is 70. Learning is considered successful if 75% or more of the total students achieve the established KKM. If this criterion is not met, the learning is considered unsuccessful, and remedial actions are needed.

Data Collection

Data collection was carried out by distributing questionnaires to teachers and students regarding the necessary needs for learning. Based on the data collected, it was found that the student and teacher books often felt ineffective because they required repetition of the material. Considering the minimal state of the media, teachers needed innovative learning media that could keep up with the times. Students required reading materials that not only contained text but also included colored images. Based on the obtained data, it was concluded that there was a need to develop learning tools in the form of engaging learning media that followed technological advancements, used images and colors, but still considered the material coverage.

Based on this, the researcher proposed a technology-based comic media utilizing mobile media, namely e-comic with videos, allowing the researcher to innovate in the form of video-assisted e-comics. The content of the material in this media was adjusted to the basic competencies (KD), indicators, the students'

environment, and language appropriate to the student's development. This media concept received positive responses and approval from both students and class teachers.

Product Design

The video-assisted e-comic media was designed by the basic competencies, indicators, and learning objectives. The e-comic was developed with a concept involving character dialogues, animated pictures, color combinations, and videos tailored to the student's development to make it easier to understand. The e-comic was designed using the Canva application by inserting several relevant items to form a continuous story about human blood circulation. Besides dialogues, this media also included videos to support the predetermined material. The size used for creating this e-comic was 25 x 20 cm, making it very suitable for display on mobile media screens, whether on phones or laptops. The final result of this media was in the form of an electronic book, so the design needed to be extracted using an additional application, Heyzine, to convert the design sheets into a unified digital comic book. The steps in creating this media involved inserting videos into pre-prepared sections. The final product would be shared via a link, requiring an internet connection to access it. The e-comic consisted of the following parts:

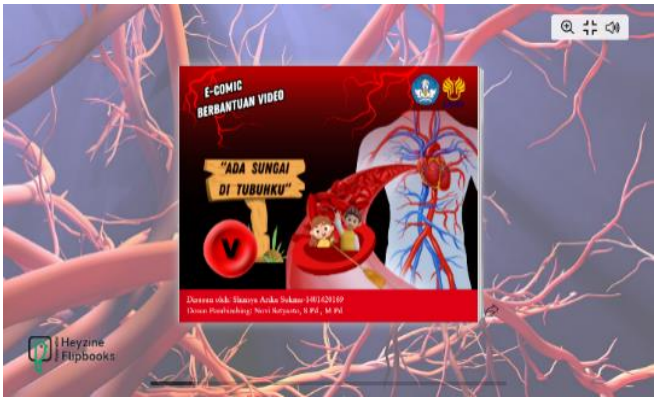

Figure 2. Front cover

Figure 3. Foreword, KD, Indicators, and Learning Objectives

Figure 4. Instructions for the use and introduction of female characters

Figure 5. Introduction of male characters

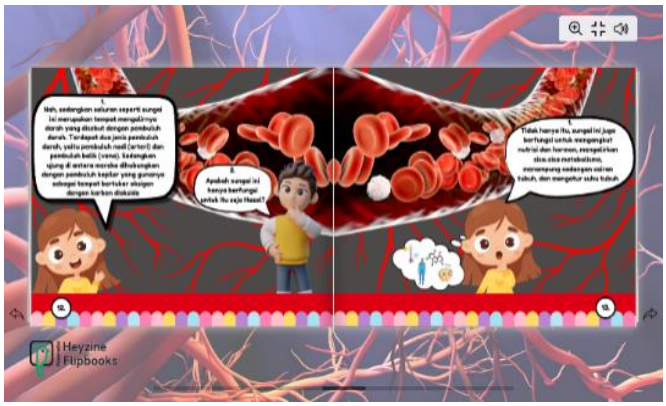

Figure 6. Presentation of material in the form of conversation

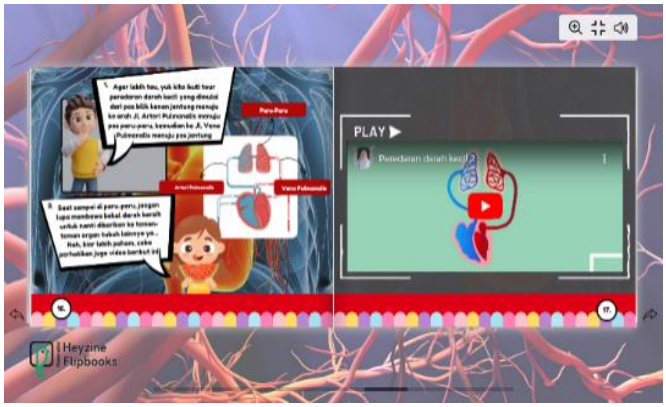

Figure 7. Presentation of material in the form of video

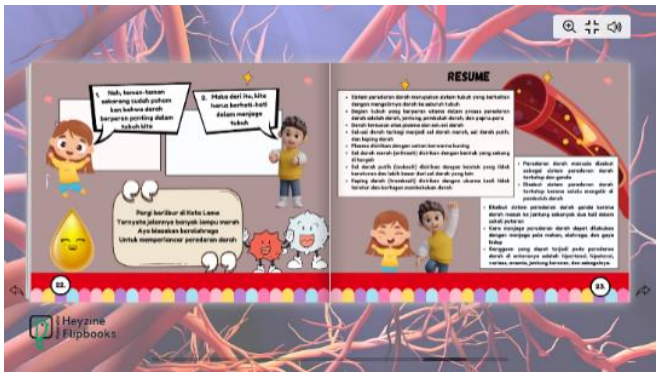

Figure 8. Summary

Figure 9. Glossary and bibliography

Figure 10. Back cover

Steps to Design the Media: 1) Prepare the concept 2) Design the product content according to the learning material on Canva 3) Extract the Canva design into Heyzine.

Feasibility of Video-Assisted E-comic Media: Design Validation

At this stage, the researcher conducted a feasibility test by validating the media with expert validators in media, material, and language who were competent in their fields. Media validation was carried out by lecturers in the elementary school teacher education study program, material validation by lecturers in the same program, and language validation by lecturers in the Indonesian language study program. The assessment was conducted using a Likert scale and included a notes column for feedback, allowing the researcher to revise the developed product.

Table 1. Results of Expert Validators' Assessment of Video-Assisted E-comic

Aspect Feasibility	Validation Index (%)	Description
Media expert	90 %	Very decent
Material expert	90%	Very decent
Language expert	70%	Worthy

Table 1 shows that the validation results given by the media expert validators were 90%, which means it can be categorized as feasible because it is more than 80%. The material validation also categorized the e-comic media as feasible at 90%. The language validation resulted in 70.5%, also categorizing it as feasible. The average score obtained from these data is 83.3%, indicating a very feasible rating. This aligns with the research conducted by Mustikasari et al. (2020), which stated that e-comic media received a material expert rating of 3.51 (good category) and a media expert rating of 4.01 (good category). Another study by Safitri et al. (2023) also stated that learning using the developed e-comic media was feasible with minor revisions, scoring 81.4%. Meanwhile, research conducted by Endiawan et al. (2021) stated that learning using the developed e-comic media obtained scores of 52, 27, 21, and 51 from four validators, with valid criteria. Based on this, it can be said that video-assisted e-comic media can be categorized as good and feasible for testing, provided revisions are made.

Design Revisions

The researcher revised the learning media design according to the directions, criticisms, and suggestions from the media, material, and language experts. Suggestions from the media experts included color usage, font size, and font type consistency. Suggestions from the material experts included adjustments to the lesson plan, learning objectives, punctuation, and questions. Suggestions from the language experts included spelling adjustments, using APA style for bibliography compilation, and using oral language varieties.

Figure 11. Cover before revision Figure

Figure 12. Cover after revision

Figure 13. Foreword, KD, indicators and objectives before revision

Figure 14. Foreword, KD, indicators and objectives after revision

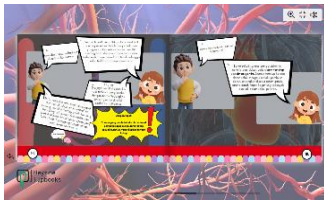

Figure 13. Presentation of material before revision

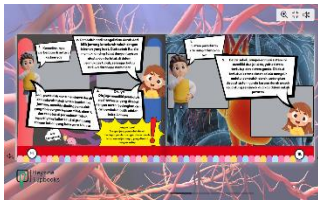

Figure 14. Presentation of material after revision

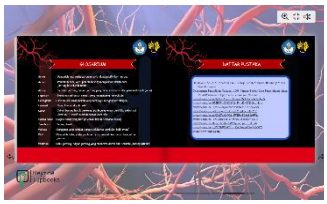

Figure 15. Bibliography list before revision

Figure 16. Bibliography list after revision

The Practicality of Video-Assisted E-Comic Media

The first media practicality test was carried out on a small scale in the VB class with a total of 12 students consisting of 4 students who got high scores, 4 students who got medium scores, and 4 students who got low scores. The test results were taken using a Likert scale with a total of 18 questions. The Likert scale is adjusted to the situation of students and teachers after using video-assisted e-comic media. The assessment criteria are based on the following tables and calculations

Table 3. The Assessment Criteria

Percentage	Criteria
81.26% - 100%	Very practical
62.51% - 81.25%	Practical
43% - 62%	Quite practical
25% - 43.75%	Not practical

$$\text{Percent Value} = \frac{Number\ of\ scores\ obtained}{Maximum\ score} \times 100\% \quad (1)$$

The questionnaire sheet for testing the practicality of teachers and students using video-assisted e-comic media contains three aspects, namely 1) presentation of material content, 2) technical quality and presentation of material, and 3) language and readability of material. The questionnaire sheet on the aspect of presenting material content consists of six indicators, namely 1) suitability of material with basic competencies, 2) suitability of indicator material, 3) suitability of material with learning objectives, 4) suitability with students' level of thinking, 5) completeness of material, and 6) delivery of material. Aspects of technical quality and material presentation consist of five indicators, namely 1) media appearance, 2) appearance of writing, images, videos, and colors, 3) instructions for use, 4) dialogue presentation, and 5) media operations. The linguistic aspect and readability of material consist of one indicator, namely the use of appropriate language in the media.

Table 2. Results of data processing of student and teacher responses on a small scale

Respondent	Precentage	Information
Teacher	95%	Very practical
Student	95.7%	Very practical

Table 2 explains that the results of teacher and student responses to video-assisted e-comic media obtained very practical results, with responses of 95% from teachers and 95.7% from students. Based on these results, video-assisted e-comic media can be used practically in learning activities.

Table 3. Results of data processing of student and teacher responses on a large scale

Respondent	Precentage	Information
Teacher	100%	Very practical
Student	98.2%	Very practical

Table 3 explains that the results of teacher and student responses to video-assisted e-comic media obtained very practical results, with a response of 100% from teachers and 98.2% from students. This is in line with previous research conducted by (Safitri et al., 2023) which stated that in small-scale trials a score of 79.3% was obtained with very practical criteria. Based on these results, video-assisted e-comic media can be used practically in learning activities. Other research also revealed that the use of the e-comic media that was developed received a positive response from teachers and students, respectively, namely 93.33% and 95% of the minimum criteria of 75.01%.

Effectiveness of Video-Assisted E-comic Media in Usage Trials

The effectiveness of video-assisted e-comic media on human blood circulation is based on student learning outcomes. The design used is a pre-experimental design with a one group pretest-posttest model. This model uses steps in the form of giving a pretest before being given treatment in the form of learning to use e-comic media with the help of video and carrying out a posttest after giving treatment.

Table 3. Results of students' pretest and posttest trials on a small scale

Test Type	Average	Average Difference
Pretest	51.91	30.84
Posttest	82.75	

Table 4. Results of students' pretest and posttest trials on a large scale

Test Type	Average	Average difference
Pretest	53.54	32.96
Posttest	86.50	

Based on Table 4, it can be seen that there was an average increase of 32.96 in large-scale media trials. These data show that there are differences in student learning outcomes regarding understanding blood circulation material in the VA class at SDN Lumbungmas 01 before and after the use of video-assisted e-comic media. The next effectiveness test was carried out using the t-test and N-gain test. The thing that must be done before the t-test and N-gain test is the normality test.

Table 5. Normality test in small groups

Situation	Sig.	Criteria
Before being given treatment	0.280	Normally distributed
After being given treatment	0.358	Normally distributed

Table 6. Normality test in large groups

Situation	Sig.	Criteria
Before being given treatment	0.228	Normally distributed
After being given treatment	0.138	Normally distributed

Analysis of normality test results using the Shapiro-Wilk type. This is because the number of respondents is less than 30. Data is said to have a normal distribution if Sig. > 0.05. Based on the small-scale normality test table, the pretest and posttest normality test results were obtained respectively, namely 0.280 and 0.358. So, it can be seen that the learning outcome data is normally distributed. Based on the large-scale normality test table, the pretest and posttest normality test results were obtained sequentially, namely 0.228 and 0.138. So, it can be seen that the learning outcome data is normally distributed.

The next step is a test to determine significant differences between before treatment and after treatment. The test results on small and large scales show significant differences because Sig. < 0.05 or t count < t table. The results obtained from the small and large scales are both 0.000, which means less than 0.05. Based on this, it can be seen that there is a significant difference between before treatment and after treatment.

Table 7. Small scale t-test

Average Difference	Sig. (2 tailed)	Criteria
-30.83333	0.000	Significant differences

Table 8. Large scale test

Average Difference	Sig. (2 tailed)	Kriteria
-32.95455	0.000	Significant differences

The next step to find out the criteria for the average difference that has been obtained is to use N-gain analysis, namely comparing the differences between the SMI (Social Movement Institute) and the pretest.

Table 9. Average small scale N-gain Results

Average Difference	N-Gain	Criteria
30,84	0.6182	High

Tabel 10. Rata-rata hasil N-gain Skala Besar

Average difference	N-Gain	Criteria
32,96	0.7173	High

Based on Tables 9 and 10, the average difference in student learning outcomes on a small scale was 30.84 with an N-gain of 0.6182, categorized as high. On a larger scale, the average was 32.96 with an N-gain of 0.7173, also categorized as high. This data indicates that the video-assisted e-comic learning media for the human circulatory system subject in grade V at SDN Lumbungmas 01 is effective in improving student learning outcomes. This aligns with previous research by Safitri et al. (2023), which stated that the development of the media received a score of 68.9% with a medium criterion. Another study also stated that e-comic media could improve critical thinking skills with a score of 4.03 in the medium category (Widyawati et al., 2024). Another study revealed that digital comic media could enhance learning outcomes, with results in cycle I at 61% and an increase in cycle II to 93% (Narestuti et al., 2021). The effectiveness of comic media in improving students' thinking skills is also supported by previous research by Setyowati et al. (2023), which stated that the N-gain test results showed the critical thinking skills of the treatment group at 61.8% (medium) and the control group at 38.2% (low).

Conclusion

Based on the results of the conducted research, it can be concluded that the development of video-assisted e-comic learning media can improve the learning of the human circulatory system in science subjects. This can be analyzed from the average product validation score of 83.3%, which falls into the very feasible category. The analysis of pretest and posttest scores showed an increase with a difference of 32.96 and an N-Gain of 0.71, categorized as high. Based on this data, it can be proven that the development of video-assisted e-comic learning media is feasible, practical, and effective in improving the learning outcomes of grade V students in the science subject of the human circulatory system.

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Author Contributions
Shinsya Arika Sukma contributed to conducting the research, developing the product, analyzing data, and writing the article. Novi Setyasto acted as a supervisor during the research activities and the writing of the article.

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Conflict of Interest
The authors declare no conflict of interest.

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