



Development of E-Comic Media on the Human Digestive System to Improve Learning Outcomes of Grade V Primary School Students

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ABSTRAK

Perkembangan teknologi pada dunia pendidikan masa kini terhitung cepat dan berinovasi, begitu juga dengan penggunaan media pembelajaran yang digunakan oleh para pendidik pada pengembangan pendidikan di era digital. Penelitian ini bertujuan untuk mengembangkan media e-comic materi sistem pencernaan manusia untuk meningkatkan hasil belajar siswa kelas V SD. Penelitian ini menggunakan metode Research and Development (R&D) dengan model ADDIE: Analyze, Design, Develop, Implement, Evaluate. Subjek penelitian ini melibatkan ahli materi, ahli media, serta 22 siswa kelas lima, Sekolah Dasar. Pengumpulan data menggunakan kuesioner analisis dan wawancara guru kelas V SD. Analisis data menggunakan teknik kualitatif dan kuantitatif. Hasil penelitian menunjukkan, 1) pengembangan media e-comic materi sistem pencernaan manusia kelas V SD dilakukan dengan mengikuti tahapan ADDIE: Analyze, Design, Develop, Implement, Evaluate. 2) Kualitas media e-comic dengan penilaian ahli materi, ahli media dan guru kelas V dengan keterangan sangat baik dan layak untuk diuji cobakan sesuai saran para ahli. Penerapan media pembelajaran e-comic berpengaruh pada hasil belajar siswa dengan peningkatan, dari nilai pretest menjadi nilai posttest terdapat kenaikan hasil belajar pada kenaikan persentase sebesar 54%. Dengan demikian, hal ini menyimpulkan bahwa media e-comic materi sistem pencernaan manusia kelas V SD, dapat meningkatkan hasil belajar dan layak digunakan untuk pembelajaran berkelanjutan.

ABSTRACT

Technological developments in today's world of education are rapid and innovative, as is the use of learning media by educators in the development of education in the digital age. This study aims to develop e-comic media on the human digestive system to improve the learning outcomes of fifth-grade primary school students. This study uses the Research and Development (R&D) method with the ADDIE model: Analyze, Design, Develop, Implement, Evaluate. The subjects of this study involved subject matter experts, media experts, two fifth-grade teachers, and 22 fifth-grade students State Elementary School. Data collection was conducted using analysis questionnaires and interviews with fifth-grade teachers. Data analysis was performed using qualitative and quantitative techniques. The results showed that 1) the development of e-comic media for fifth-grade elementary school students on the human digestive system was carried out by following the ADDIE stages: Analyze, Design, Develop, Implement, Evaluate. 2) The quality of the e-comic media was assessed by subject matter experts, media experts, and fifth-grade teachers as very good and suitable for testing according to the experts' suggestions. The application of e-comic learning media had an effect on student learning outcomes, with an increase from pretest scores to posttest scores, representing a 54% increase in learning outcomes. Thus, it can be concluded that e-comic media for fifth-grade elementary school students on the human digestive system can improve learning outcomes and is suitable for use in continuous learning.

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1. INTRODUCTION

Education plays an important role in building students' knowledge and insight. Education has an influence in the learning process, such as the scope of learning, which is limited to the classroom and books in this century, where learning has moved into the digital realm (Hara et al., 2021; Mahesa et al., 2022). Good education is education that is capable and suitable for students in achieving maximum learning outcomes. Through current technology, many methods of delivering the learning process have been designed as digital learning media tools, such as e-learning, e-books, e-comics, and interactive games (Bessette, 2020; Lim et al., 2020). In 21st-century education, students are considered more modern with technology-based education because it suits the needs of students who have difficulty learning and understanding abstract concepts, with technology being more flexible and relevant to the needs and characteristics of students. The goal of education in the 21st century is for students to master skills and be more responsive to change by mastering these four elements, which form the basis for students to develop and adapt. It is hoped that students will become outstanding individuals who are able to solve problems in society. The application of the 4C concept (critical thinking, creativity, communication, and collaboration) is a supporting factor in education today. This 4C concept is applied in primary schools to help students solve problems (Erdoğan, 2019; Taufiqurrahman, 2023).

In the teacher's account revealed in interviews and observations on 22 March 2025, teachers still use teaching methods such as conventional media, books, lectures, and discussions, although sometimes teachers also use digital methods in the form of PowerPoint presentations. This has led to a lack of interest in learning among students, resulting in suboptimal learning outcomes that do not meet standards. This condition is reflected in the learning practices carried out in schools regarding the use of learning media by teachers. Therefore, the role of teachers in the media development process is very important for the success of student learning outcomes (Latifah & Utami, 2019; Prodjosantoso & Hertina, 2019). Teachers are professional educators and must have expertise and proficiency in designing learning tools for the learning process to take place. Teachers must have professional qualities so that students can grow and develop optimally in the digital era by updating learning methods in line with the times through modern learning media and applying appropriate science and technology (Byukusenge et al., 2022; Priantini & Manu, 2020). Professional teachers can develop innovative, creative, and interesting learning methods for primary school students.

Comics are books that feature cartoons with various types of characters and tell stories through illustrated narratives designed to entertain readers. Meanwhile, research development using digital comics presented in digital file form can make it easier for teachers to deliver material, as it presents text and images arranged in the form of a storyline. These digital comics are included in interesting and innovative teaching materials and contain colourful images in the form of animated stories (Murti et al., 2020; Swandi et al., 2020). E-comic media is also very relevant when combined with IPAS lesson material on the human digestive system for fifth-grade primary school students, because e-comic media helps students understand digestive system material so that they can imagine how the digestive process occurs in humans (Anggareni et al., 2013; Laksmi & Suniasih, 2021). This research also offers novelty in the form of integrating e-comic media by using storytelling that combines narration, attractive illustrations, and interactive questions in one platform. This will provide a more interactive learning experience, unlike learning materials that have so far relied more on textbooks or learning media that are less appealing to students. To support learning media for Generation Alpha, known as a generation that is proficient in digital technology updates and prefers a visual and interactive world (Cole & Feng, 2015; Wijaya et al., 2022). Generation Alpha is more interested in digital services such as e-books, e-comics, and learning. A learning style that provides broader information can increase interest in reading to understand abstract concepts.

This study developed e-comic media that offers several advantages: it is able to present interesting stories virtually, improve readers' vocabulary, convey difficult material in a concise and easy-to-understand manner, and visualise expressions in e-comics that can build emotional engagement with readers (Jang et al., 2021; Prodjosantoso & Hertina, 2019). This e-comic media is designed for fifth-grade primary school students who are focused on learning about the human digestive system, so this study serves to examine the improvement in fifth-grade students' learning outcomes after using e-comic media in IPAS learning, which shows that students who use e-comics have a better understanding than those who use conventional media because it can improve student learning outcomes (Hempel et al., 2020; Lestari et al., 2021).

The main objective of this study is to develop and determine the quality of e-comic products about the human digestive system in fifth grade elementary school according to media experts, teachers, and students, as well as to determine the improvement in student learning outcomes after using e-comic media on the human digestive system for fifth grade elementary school students. Pedagogically, it is

beneficial for students during the learning process, as they will read the material through e-comics and be able to increase their literacy interest and understanding of the fifth-grade human digestive system material. For teachers, the development of these e-comics can be an alternative and interesting learning medium when delivering material that requires a realistic visual style. For researchers, it is useful for creating something new and improving learning outcomes in the subject of Science and Technology (IPAS) on the human digestive system for fifth-grade students, using e-comics as a learning medium, and then using the quality of the e-comic learning medium created to facilitate the learning process.

2. METHOD

This research method uses a Research and Development (R&D) approach with reference to the ADDIE model, which consists of five stages for creating an innovation product that is suitable for use. The ADDIE data collection method has five stages: Analysis, Design, Development, Implementation, and Evaluation (Sugiyono, 2019). The ADDIE model is shown in Figure 1.

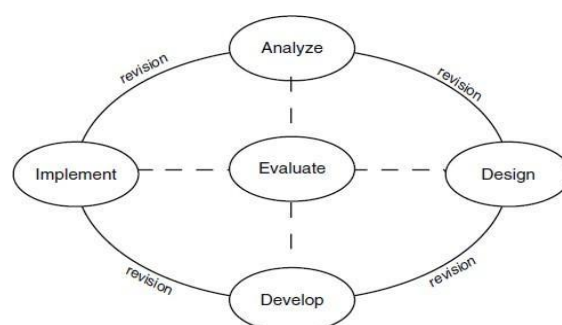


Figure 1. The ADDIE Method

In the Analysis stage, the researcher focused on interviews and questionnaires for fifth-grade students, and the researcher conducted observations focused on identifying problems in the field. In the Design stage, the researcher developed a prototype using a storyboard with e-comic illustrations, narratives, and interactive quizzes. The Development stage involved the development of the e-comic prototype using formative evaluation involving expert lecturers and two fifth-grade teachers. Summative evaluation was conducted using pre-test and post-test techniques involving 22 students from Kentungan State Elementary School. The application stage was carried out at Kentungan State Elementary School with 22 students. The evaluation stage assessed effectiveness through summative pre-test and post-test results and a questionnaire on responses to the e-comic learning media. The instrument use are shown in Table 1, Table 2, Table 3, Table 4, and Table 5.

Table 1. Expert Instrument

No	Aspect	Indicators	No Questions
1	Material Suitability	CP and TP Suitability	1
2	Content	Materials are appropriate for the children's cognitive level	3
		Depth of Material on the Human Digestive System	4,5,6
3	Language	Language used in accordance with the rules	7,8
	Benefits of	Accurate information in line with the System material Human	9,10,11,12,13,14
4	Learning	Digestion	

Table 2. Expert Instrument

No	Aspect	Indicators	No Questions
1	Appearance	Design consistency in e-comics	1,2,3,4,5
2	Content	Material appropriate to the students' level of development and free from misconceptions	6,7,8,9,10
3	Language	Communicative language	11
4	Benefits of Learning	E-comic helps students in learning the concept of the human digestive system	13,14

Table 3. Fifth Grade Teacher Instrument

No	Aspect	Indicators	No Questions
1	Teaching	Design consistency in e-comics, layout, ease of teaching	1,2,3,4,5,6,7
	Material Display	materials	
2	Content	Learning media can increase student motivation among students	11,14
3	Material	Material related to the theme of the human digestive	12,13,15,16,18,19,20,21
4	Instructions for use of media	Instructions for use	17,18
5	Language	Language appropriate to the students' level of development	22,23,24,25,26

Table 4. Test Instruments

No	Aspect	Indicators	No Questions
1	Display of Teaching Materials	Explaining Objectives and Definitions	1,2
2	Content Process	Identifying the sequence of the digestive system in humans	3,4,11
3	Material	Explaining the functions of the human digestive organs	12,13,15,16,18,19,20
4	Instructions for use of media	Explaining the function of enzymes	17,18

Table 5. Student Response Questionnaire

No	Aspect	Indicators	No Questions
1	Appearance	An attractive e-comic display with illustrations that supporting	1,2,3,4,5
2	Content	The story is consistent with the material on the human and helps to understand the concepts	6,7,8,9
3	Material	E-comic help to understand and make it easier when completing test/quiz	10,13,14
4	Instructions for use of media	Explaining the function of enzymes	
5	Language	Easy to understand language	11,12
6	Motivation	Can increase motivation to learn science	15

Data using qualitative analysis techniques and descriptive quantitative data. The data obtained through the needs analysis process was used by researchers to interpret suggestions from validators regarding science learning media based on e-comic learning media. Meanwhile, quantitative data was obtained from expert validation.

3. RESULT AND DISCUSSION

Result

The researchers applied the five stages of ADDIE: analysis, design, development, implementation, and evaluation. In the analysis stage, the researchers identified obstacles in the school by distributing questionnaires to fifth-grade students, conducting observations, and interviewing fifth-grade teachers at Kentungan Public Elementary School. The results of the student questionnaire analysis showed that students were more interested in digital media than conventional media. This was supported by the results of interviews with fifth-grade teachers at Kentungan Public Elementary School, which showed that teachers still used lecture, discussion, and conventional media methods and had never used e-comic learning media in the learning process. This was due to the lack of e-comic learning media that was in line with the curriculum. Teachers' limitations in creating e-comic media are one of the obstacles in the teaching and learning process. In practice, teachers use conventional learning media, although they sometimes use digital media such as PowerPoint, which is adapted to the material to be presented, especially in IPAS subjects.

The design stage of the e-comic media to be developed based on the problem. The design stage was formed as a prototype using a storyboard, which is a rough outline with a structured plot. The design process was tailored to the needs of the fifth-grade human digestive system curriculum, as the e-comic media was developed based on the learning outcomes and learning objectives of the fifth-grade science

curriculum. Therefore, storyboards are used by researchers as a guide in the development of e-comic media, which includes objectives, narratives and sketches, supplemented by quizzes to evaluate students after using the e-comic media. The e-comic media was designed with a storytelling approach that presented stories through child characters related to the daily lives of students, adapted to the material on the human digestive system. Storyboard is show in Figure 2.

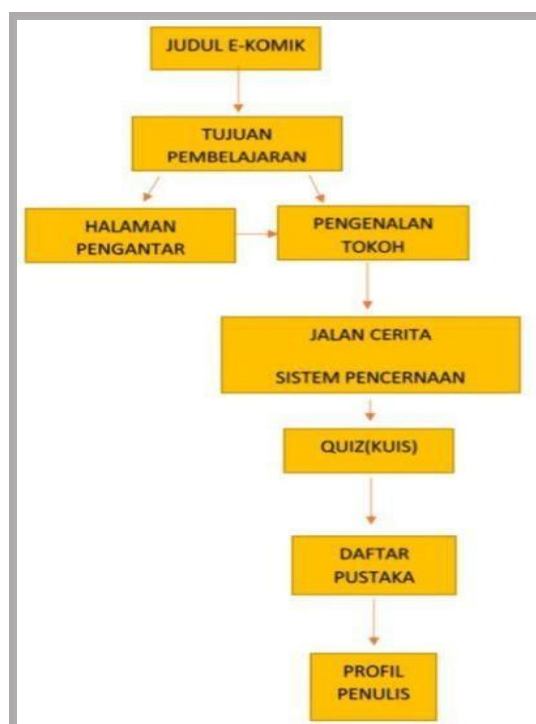


Figure 2. Storyboard

During the development stage, researchers developed an e-comic media product on the human digestive system for fifth-grade elementary school students. After completing the design of the e-comic media, the researchers validated the product to determine its suitability as a learning medium. The product was declared suitable and valid for testing on students. The development stage was validated by one subject matter expert, one media expert, and two fifth-grade primary school teachers. The validators assessed the e-comic media based on learning outcomes and learning objectives in accordance with the curriculum and IPAS aspects. This stage was to refine the learning media before the implementation stage with suggestions for improvement and comments from the validators as show in Table 6, and Table 7.

Table 6. Validation Assessment

No	Validator	Result Category	Average
1	Material expert	Fair	2.14
2	Media expert	Good	2.62
3	Teacher Class five (1)	Very Good	3.48
4	Teacher Class five (2)	Very Good	3.48

Table 7. Question Validation

No	Validator	Pretest	Posttest	Category
1	Teacher Class Five (1)	98.33	97.5	
2	Teacher Class Five (2)	96.67	97.5	
Average		97.5%	97.5%	Suitable Used

Based on Table 6 and Table 7 the results of the validity validation of the e-comic learning media about the human digestive system for Grade V elementary school, the media is considered 'suitable for testing with revisions as suggested'. This was proven through an assessment conducted by validators, which showed that the e-comic was in line with the pedagogical approach to education, making it a

suitable e-comic learning medium for educational purposes. Therefore, the researchers made revisions to improve the medium before entering the implementation stage, as shown in [Table 8](#).

Table 8. Suggestions and Revisions

No	Comment Suggestion	Before Revision	After Revision
1.	Complete the instructions for use	No instructions for use	 The method and barcode have been added
2.	Adding child characters	 Previously, there was only one character	 After revision, characters have been to the story
3.	Changing the setting the opening story	 Previously, there was too imaginative	 The setting has been changed to reflect the habits of students without imagination
4.	Character misattribution	 Previously, there were errors in naming characters and dialogue flow	 It has been improved with the correct organ names and more contextual dialogue
5.	Evaluating questions	 Before the evaluation questions were turned into an interactive	 After revision it was turned into an interactive game

Base on [Table 8](#), the product revision stage was carried out in accordance with the suggestions and comments from subject matter experts, media experts, and fifth-grade teachers, with improvements made to the visual design to suit the daily lives of students, the characteristics of e-comic media, and the presentation of material to match the educational characteristics and cognitive comprehension levels of fifth-grade primary school students. The e-comic learning media is expected to be more engaging and capable of improving student learning outcomes, focusing on human digestive system material for fifth-grade primary school students.



Figure 3. Final Results of the E-comic Learning Media on the Human Digestive System

Figure 3 shows the revised results of the e-comic material on the human digestive system, which has been revised in accordance with the validator's suggestions. The improvements include the suitability of the visual design, characters, and presentation of the material to match the educational characteristics and cognitive comprehension level of primary school students, especially fifth-grade primary school students. The e-comic media is expected to be more appealing and capable of improving the learning outcomes of students who focus on human digestive system material for fifth-grade primary school students.

The implementation stage was carried out to determine the improvement in learning outcomes after using e-comic media. The implementation stage was carried out at Kentungan State Elementary School on 22 October 2025 with a limited test subject of 22 fifth-grade students. The implementation was carried out by applying the learning media developed by the researcher to determine the improvement in learning outcomes using formative (pre-test) and summative (post-test) assessments. The use of e-comic media showed an improvement in student learning outcomes, as indicated by an increase in the formative score (pre-test) with an average score of 57.72 and a summative assessment score (post-test) of 85, representing an increase of 27.27%, equivalent to 54%, as shown in Figure 4.

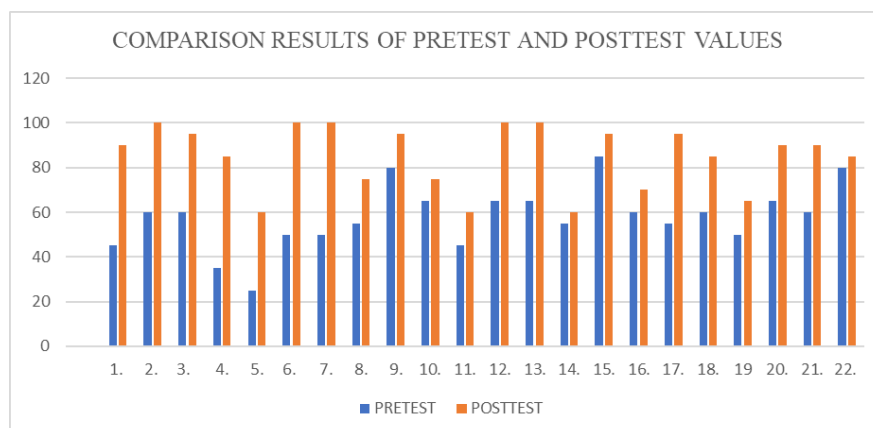


Figure 4. Graph of Learning Outcome Improvement

This improvement in learning outcomes shows that e-comics can help students better understand the concepts of the human digestive system. This is in line with learning theory, which states that visual and narrative media such as comics can improve conceptual understanding because they present material in a concrete, interesting, and appropriate way for primary school students. Student response scores were assessed using a scale of 1 to 4 for e-comic learning media about the human digestive system. This assessment was carried out by fifth-grade students at Kentungan State Elementary School, who obtained an average score of 3.53, which falls into the excellent category.

This stage is designed to facilitate researchers in assessing the feasibility of each process. the process evaluation stage is a stage of the ADDIE application: analysis, design, development, implementation, and evaluation, then the product evaluation stage to assess the feasibility of the e-comic media being developed, validated by experts with assessments in Table 6 and Table 7, evaluation of learning outcomes in the form of formative and summative assessments and the results of student response questionnaires after using e-comic media -comic media. If there is an increase in the percentage

of formative and summative results, then the e-comic media with an average of 27.27, equivalent to 54%, as shown in [Figure 4](#), indicates that e-comic media is capable of improving the learning outcomes of fifth-grade elementary school students with a student response questionnaire result of 3.53 with the description "Very Good".

Discussion

Development of e-comic media on the human digestive system for fifth grade elementary school students using the ADDIE model: analysis, design, development, implementation, and evaluation. The researcher developed this e-comic media based on findings of problems in the school environment, namely that teachers still use lecture, discussion, and conventional media methods and have never used e-comic learning media in the learning process, even though students are more interested in digital media. It was from this problem that the researcher began to develop e-comic media. Because e-comics are considered more attractive than other digital media, e-comics are digital versions of comics that are easily accessible, more flexible, and entertaining ([Rina et al., 2020](#); [Widyawati et al., 2024](#)). The development of narrative and illustration e-comic media is developed in accordance with the achievements and objectives of IPAS learning, which can help students improve their learning outcomes in fifth grade. E-comics have emerged as a digital pedagogical tool and are capable of improving the learning outcomes of fifth-grade primary school students, especially in the subject of the human digestive system ([Antari et al., 2023](#); [Sari Hutami et al., 2023](#)).

This is relevant to the cognitive development of students according to Piaget, who states that children aged 7-12 enter the concrete operational stage. This study used fifth-grade elementary school students as subjects. Children aged 10-11 years old can be said to be capable of logical thinking, although still limited, and already understand cause and effect. As stated in the study show that KOMIKA is able to increase students' interest in science literacy with very practical assessment criteria ([Kusumaningrum & Masruro, 2022](#)). This is effective in student learning outcome tests, with an achievement of 91%, which is classified as very effective. The study had the same objective, namely to develop e-comic learning media on the subject of area and perimeter of flat shapes in Grade IV primary school and to improve mathematical problem-solving skills using the Four-D model, whereas in this study, the researchers used the ADDIE model ([Iqbal et al., 2020](#)). Based on the results of the study, e-comic media on the human digestive system improved the learning outcomes of fifth-grade primary school students.

There was a noticeable improvement from the formative assessment (pre-test) with an average of 57.72 to the summative assessment (post-test) with an average of 85, showing an increase of 27.27 or equivalent to 54% after the use of e-comic media. The results of this study imply that e-comic media can be used as an alternative innovative learning media in elementary school science education, because e-comic media also helps teachers convey information that requires visual style, and e-comic media is considered more attractive in improving student learning outcomes ([Rokhaniyah & Virgantara Putra, 2021](#); [Susilowati & Hartoyo, 2023](#)). However, the development of e-comic media still has limitations. This study only measures students' cognitive level, so the results do not provide an assessment of the affective and psychomotor domains. The trial was conducted on a limited scale with 22 fifth-grade elementary school students, so the results cannot be applied to other schools in general. Development is still focused on only one subject, so the effectiveness of the media on IPAS material is not yet known ([Haka et al., 2020](#); [Novianita et al., 2020](#)).

Researchers were unable to measure the practical value of implementation due to limitations in students' mobile phones. Unstable internet connections caused disruptions during the trial period, so further research is recommended. For future research, it is hoped that a more comprehensive assessment of cognitive, psychomotor, and affective aspects can be conducted to gain a detailed understanding of student comprehension. For further research, it is recommended to use a broader or larger and more diverse sample so that the results can describe the overall effectiveness of the media. Future researchers are expected to develop e-comic media for IPAS material more broadly so that the scope of media use is wider and the results can be compared in terms of effectiveness between materials. Future researchers are expected to prepare mobile phones so that the practical value of e-comic media can be seen. Future researchers should pay attention to the readiness of facilities, especially a stable internet network, because the media is digital, so that the testing process runs smoothly.

4. CONCLUSION

This study shows that e-comic-based digital learning media play a major role in pedagogical learning and have great potential in managing conceptual, innovative, and interactive learning media that enable students to understand abstract and difficult material in a short time. E-comic learning media can

serve as a solution in the world of innovative education and can increase student learning motivation to improve optimal learning outcomes, in line with 21st-century learning and sustainable development with digital development in the field of education.

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