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Effectiveness of Discovery Learning Model Aided by Digital Comics on Learning Outcomes of IPAS Students in Grade V Elementary School

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Abstract

Learning Natural and Social Sciences (IPAS) for fifth-grade elementary school students has not been optimal due to a lack of active student involvement, resulting in low learning outcomes. The Discovery Learning model was selected to enhance active participation through exploration and experimentation, utilizing digital comics as a teaching aid. This study aimed to measure the effectiveness of implementing the Discovery Learning model assisted by digital comics on the learning outcomes of fifth-grade students at Rengging 1 State Elementary School. The method used was quantitative with a one-group pretest-posttest pre-experimental design, involving 31 students through saturated sampling. Data collection techniques in this study used written tests with instruments in the form of question sheets consisting of 20 multiple-choice questions that had been tested for validity and reliability. The results of the study showed an increase in the average IPAS learning outcomes of students from 54,68 (pretest) to 87,10 (posttest) with significance of 0,000 < 0,05 in the paired sample t-test. The N-gain analysis results showed a value of 0,76 (high) and an effectiveness percentage of 76,42% (practical). This study demonstrates that applying the Discovery Learning model with digital comic media effectively improves student learning outcomes and can be used as one strategy to create innovative and engaging learning experiences.

INTRODUCTION

Natural and Social Sciences (IPAS) is an important foundation for students to understand the natural environment and social life around them. IPAS focuses on the study of interactions between living and non-living things in the universe, as well as analyzing the role of humans in individual and social contexts, including their relationship with the surrounding environment (BSKAP, 2022). IPAS learning contributes to developing scientific attitudes, including curiosity, critical, and analytical thinking. In addition, IPAS learning provides opportunities for students to explore themselves and the environment, and apply the insights gained in daily activities (Ayu & Sholikhah, 2024). Therefore, improving teachers' ability to integrate the concept of IPAS is important as a form of effort to create effective and innovative learning strategies (Komariah et al., 2023).

The success of learning activities is influenced by various factors, including teachers' teaching abilities and competencies, the learning models applied, and the supporting media. Currently, many teachers prioritize memorization over understanding in their teaching approach and focus solely on achieving curriculum targets, while a teacher's ability to provide quality education is reflected in students' success in achieving optimal learning outcomes (Choirunnisa et al., 2024; Saputra et al., 2024). Such conditions can have negative impacts on students, ranging from poor understanding of the material, declining academic performance, to failure in achieving the set learning objectives (Alfarisi et al., 2025). The learning outcomes achieved by students can serve as a benchmark for evaluating the success of instructional implementation in schools. To enhance student learning outcomes, particularly in cognitive aspects, teachers can facilitate active learning that enables students to discover knowledge through their understanding, such as by implementing appropriate instructional models.

The application of appropriate learning models has a significant impact on increasing student engagement, conceptual understanding, and learning outcomes. Therefore, a deep understanding of various learning models will enable teachers to create varied learning activities and avoid monotonous processes (Mea, 2024). Learning models serve as innovative strategies that support teachers in their efforts to improve their professional quality (Lestari & Kurnia, 2023). A learning model is a concept that systematically organizes learning experiences in order to achieve predetermined goals (Kamal, 2020; Ramadhanty et al., 2024). The aim is to ensure that the learning process runs effectively and can achieve indicators covering aspects of knowledge, attitudes, and skills (Attalina, 2020). In addition, teachers need to enhance learning media to support students' needs and make them relevant to the material presented (Fitriana, 2023). Learning media acts as a means that clarifies the delivery of material, so that learning objectives can be achieved effectively (Babinčáková & Bernard, 2020).

The September 23, 2024, observations in class V of Rengging 1 State Elementary School, Jepara, showed that the teaching and learning process was not optimal due to the continued use of conventional learning approaches and lecture methods. Although this model is effective in some situations, it makes students tend to be passive and only listen without being actively involved. The learning process dominated by conventional models and lecture methods results in the suboptimal use of technology-based media, as this approach tends to make teachers rely on textbooks as the primary source of learning. This finding is reinforced by an interview with fifth-grade teacher Mrs. DA, who revealed that IPAS still has difficulty applying effective learning models in the learning process. Teachers admit that they do not use supporting teaching modules and only rely on simple media such as pictures from student books, which shows a lack of variety in teaching approaches.

Analysis of students' daily test scores shows that the learning outcomes of Grade V IPAS are still low. Nine out of 31 students (29%) achieved the minimum Learning Objective Achievement Criteria (KKTP) score of 70, while 22 students (71%) did not meet the minimum score. The average overall score is 59,40 with a top score of 88 and a minimum score of 39. Thus, a solution step is needed to resolve these problems, which can be realized through the application of a learning model that involves students actively creating more meaningful learning activities and a deeper understanding of the material (Widiyono, 2021; Burhan et al., 2022). One learning model that can increase student activity and learning outcomes is the Discovery Learning model (Hamidah et al., 2024).

The Discovery Learning model places students in activities of exploration, experimentation, and discovery (Yulianti & Andrijati, 2024). Through this model, students are encouraged to engage in independent learning activities, from observation to conclusion, to develop their competencies comprehensively (Noor et al., 2022). This approach aims to shift the teaching paradigm from teacher-centered to student-centered. Thus, in this learning process, teachers do not directly deliver all the material but instead motivate students to actively seek information from various sources and build conceptual understanding based on the knowledge they acquire (Pujiningsih et al., 2022). This model is expected to enhance not only short-term motivation but also contribute to long-term improvements in students' academic performance (Astiti et al., 2021). The Discovery Learning stage comprises several steps, namely; 1) Stimulation; 2) Problem statement; 3) Data collection; 4) Data processing; 5) Verification; 6) Generalization (Darmayanti et al., 2022). Namun, dalam pelaksanaannya sering kali terdapat kendala. Salah satu kendala dalam menerapkan model *Discovery Learning* adalah perlunya sumber daya dan waktu yang lebih besar. However, its implementation often faces challenges. One of the challenges in applying the Discovery Learning model is the need for greater resources and time. Teachers must create a learning environment encouraging students to explore and providing sufficient equipment and materials. Additionally, teachers are crucial as facilitators, guiding students to ensure their discovery process remains focused and systematic.

To overcome these challenges, applying a learning model combined with supporting media can increase teaching effectiveness. Integrating information technology and multimedia in the learning process can create an innovative learning environment to increase student participation (Kusnadi & Azzahra, 2024). One of the media tools that teachers can use optimally with the support of technological advances is digital comics (Luthfi et al., 2023). Comics as a learning medium are considered adequate for clearly describing everyday life through a combination of visuals, language style, and codes that can attract students' interest and facilitate their understanding of concepts (Nurhakim et al., 2024). As a medium, digital comics offer flexibility in learning to support and encourage student independence and build knowledge independently (Waisakanitri et al., 2023). In the context of IPAS, digital comic media facilitates students' mastery of the material, creates an engaging learning experience, and fosters a love for learning (Oktaviana & Ramadhani, 2023). Thus, integrating digital comics into the Discovery Learning model provides the necessary preliminary understanding before students engage in further exploration. Based on this potential, this study was designed to test the effectiveness of combining the Discovery Learning model and digital comic media. The objectives of this study are: 1) To compare the differences in IPAS learning outcomes before and after implementing the Discovery Learning model assisted by digital comic media in fifth-grade elementary school students; 2) To measure the effectiveness of the Discovery Learning model assisted by digital comics on the IPAS learning outcomes of fifth-grade elementary school students.

LITERATUR REVIEW

Discovery Learning Model

Jerome Bruner introduced the Discovery Learning model as a learning approach. According to Brunner, in the learning process, students actively interact with their environment through exploration, manipulation of objects, asking questions, and experimentation (Alfirdaus et al., 2024). The Discovery Learning model is a learning model based on constructivist theory, where the primary focus is on facilitating students to independently and actively construct their knowledge (Astiti et al., 2024). Discovery Learning is an approach that encourages active student participation in building knowledge through direct experience (Yulianti & Andrijati, 2024). Learning through discovery places students as active seekers of knowledge. When students strive to solve a problem on their own, the process not only provides the best learning outcomes but also creates authentic and significant understanding for them (Tohari & Rahman, 2024).

The Discovery Learning model encourages students to engage in the learning process actively. Through activities that involve independently discovering and investigating solutions to problems, students build knowledge that will remain in their memory longer and is not easily forgotten (Larasati, 2020; Prasetyo & Kristin, 2020). The advantages of the Discovery Learning model include encouraging active student participation through thinking and discovery, enhancing interaction between students and teachers, and supporting deep and sustained understanding of the material. This model can also create an engaging learning environment that fosters students' enthusiasm for learning (Nurmawati et al., 2022).

Digital Comics

Comics are a medium that combines text with sequential images to present a story, with the primary purpose of providing entertainment while capturing the reader's attention to make it easier to understand the information presented (Willya et al., 2023). With advances in technology, comics have also evolved into a digital form (Sulistriyaniva et al., 2024). Digital comics are electronic comics that contain illustrated text and have the advantage of being accessible on any device, making it easier for readers to receive information (Sandika et al., 2024). Digital comics serve as an effective supporting medium for teachers to present lesson material. This finding is in line with Mayer's Cognitive Theory of Multimedia Learning, which states that student understanding can be optimized when information is presented verbally (text) and visually (images) simultaneously (Mayer, 2024).

Digital comics in an educational context have great potential because the combination of text and images provides a unique appeal when used as a learning aid (Rizki et al., 2022). Comics as a learning medium are considered appealing because they are structured in the form of a narrative that captures readers' attention, and they rely more heavily on images than text, thereby reducing boredom among children while reading (Wibowo & Koeswanti, 2021). Through the combination of visuals and text, this medium can stimulate learning interest and facilitate students' understanding of a concept. As an effective teaching aid, comic books can concretize abstract science concepts through attractive visual presentations. Their use not only facilitates students' understanding of the material but also encourages them to participate more actively, thereby creating a more meaningful learning process (Akcanca, 2020).

Previous research

Previous studies have proven the effectiveness of the components addressed in this study, either separately or in different contexts. Research conducted by Yulianti & Andrijati (2024) Revealed that the implementation of the Discovery Learning model in IPAS lessons successfully increased student active participation and learning outcomes from the pre-cycle to cycle II. Through stimulation in the form of questions and images that encourage students to discover knowledge on their own actively, this approach enhances understanding and retention of learning materials (Fitriyawati & Harjono, 2023). Samputri (2020), findings indicate that students' active engagement in the Discovery Learning strategy enhances their ability to solve practical problems and respond to natural phenomena around them. These findings indicate that the average science process skills and learning achievements of students taught using the Discovery Learning model are in the high category. These findings align with (Dafira & Widodo, 2021) states that success in the experimental group involves the application of the Discovery Learning model, which can be achieved through implementation by the established syntax or stages. The learning process is carried out by the syntax of the Discovery Learning model, which includes stimulation, problem identification, data collection, data processing, verification, and conclusion drawing, while integrating visual and interactive elements from digital comics. The stages and steps in Discovery Learning can enhance thinking skills, strengthen conceptual understanding, and assist students in solving problems relevant to the material they are studying. (Thalib et al., 2020).

Research by Oktaviana & Ramadhani (2023) proves that using science learning media integrated with digital comics effectively improves students' cognitive learning outcomes, with an average N-gain of 61,51%. Research by Anggraeni et al., (2023) proving that applying the Discovery Learning model supported by digital flipbook comics affects social studies learning outcomes in elementary schools, with an effect of 79,4% in the experimental class. Although the effectiveness of both components has been proven separately and in the context of other subjects, such as social studies, the application of the Discovery Learning model, supported explicitly by digital comics in the context of IPAS learning, is still rarely studied, especially at the elementary school level. Based on the above research, the researcher is interested in expanding on the findings of previous studies by focusing on the subject, the material discussed, and the methods used. Based on the research gaps identified, this study's novelty lies in applying the Discovery Learning model, specifically integrated with digital comic media, to enhance learning outcomes in the IPAS subject for fifth-grade elementary school students. The aim is to provide new insights into the importance of innovation in optimizing the quality of learning and achieving better learning outcomes

METHODS

This study uses a quantitative approach and follows a pre-experimental design of the one-group pretest-posttest type. Pre-experimental designs focus on a single group without a control or comparison class (Pujiningsih et al., 2022; Sugiyono, 2023). The One Group Pretest-Posttest Design was chosen because the researcher aimed to compare students' learning outcomes before and after being exposed to the Discovery Learning model of instruction, assisted by digital comic media in IPAS learning (Wati et al., 2024). The design applied in this study is illustrated in Table 1 (Sugiyono, 2023):

Table 1. Research Design

Pretest	Treatment	Posttest
O_1	X	O_2

Description:
X = Treatment (the application of the Discovery Learning Model aided by Digital Comics)
O_1 = Pretest (before treatment)
O_2 = Posttest (after treatment)

This study was conducted at Rengging 1 State Elementary School in the IPAS subject, Chapter 5, "Respiratory and Digestive Systems in Humans" for the 2024/2025 academic year. The study lasted two weeks with four meetings, from February 24 to March 6, 2025. The population in this study consisted of 31 fifth-grade students at Rengging 1 State Elementary School, comprising 22 male students and 9 female students. Using the saturated sampling technique, all students in the population were included as the research sample (Ramadini et al., 2021). Data was collected using a written test with a research instrument in a multiple-choice test sheet of 20 questions, tested for validity and reliability. The test was conducted in two stages: a pretest to measure students' initial knowledge and a posttest to measure learning outcomes after the intervention (Wulandari & Attalina, 2023).

Data analysis in this study used a paired sample t-test with the help of IBM SPSS Statistics 25 to answer the research questions. Prerequisite testing included a normality test using the Shapiro-Wilk test, given the small sample size of <50 (Pandriadi et al., 2023). The paired sample t-test was used to compare significant differences in IPAS learning outcomes before and after implementing the Discovery Learning model assisted by digital comics. The testing criteria were determined based on the pretest and posttest analysis results with a significance level 0,05. If the Sig. (2-tailed) value is <0,05, then H_0 is rejected and H_a is accepted, indicating a significant difference in IPAS learning outcomes of fifth-grade students before and after implementing the Discovery Learning model assisted by digital comics. Conversely, if the Sig. value is > 0,05, then H_0 is accepted while H_a is rejected, indicating no significant difference. In addition, N-gain analysis was used to measure the effectiveness of the Discovery Learning model assisted by digital comics on the IPAS learning outcomes of fifth-grade elementary school students. Effectiveness was measured through the N-gain score calculated from the comparison of pretest and posttest scores, interpreted based on Hake's criteria in (Rahayu & Ismawati, 2022):

Table 2. N-gain Score Criteria

N-gain Score	Criteria
g > 0,7	High
0,3 < g < 0,7	Medium
g – 0,3	Low

The value criteria above are applied to assess the level of progress, which is measured using the N-gain score. The N-gain percentage serves to assess the effectiveness of an intervention by referring to the calculation results (Sukarelawan et al., 2024):

Table 3. N-gain Percent Criteria

N-gain Value	Criteria
>76	Effective
56-75	Effective enough
40 – 55	Less Effective
<40	Ineffective

RESULTS AND DISCUSSION

This research was conducted in several stages. First, a trial test was conducted on multiple-choice questions administered to 23 sixth-grade students to determine the validity and reliability of the questions. Next, statistical validity and reliability tests were conducted using the test trial data. Validity testing was conducted using a significance level of 0,05. A total of 23 students participated in the testing, so the value of r table was set at 0,413. The criterion for item validity is met when the computed $R_{count} > R_{table}$. Conversely, if $R_{count} < R_{table,}$ then the item is considered invalid (Ramadhani & Bina, 2021). The validity test analysis showed that out of the 25 questions tested, 20 questions were found to be valid, while the other 5 questions were invalid. A total of 20 questions showed a calculated r value of more than 0,413, so these questions were declared valid. However, five items, numbers 3, 10, 16, 21, and 22, were deemed invalid because they did not meet the validity criteria. Subsequently, the items that did not meet the validity criteria were removed, leaving only 20 items for reliability testing. The results of the reliability analysis are presented in Table 4 below:

Table 4. Reliability Test

Reliability Statistic	
Crombach's Alpha	N of item
.875	20

The reliability testing based on 20 question items yielded a Cronbach's alpha of 0,875. According to Priyatno (2024), reliability is considered poor if it is below 0.6, acceptable if it is 0.7, and very good if it is above 0.8. Based on these results, it can be stated that the reliability of the 20 items above shows good consistency. These results indicate that each item in the instrument consistently supports the others in measuring the same concept. After undergoing a series of validity and reliability tests, the 20 items were deemed suitable for pretest and posttest to measure the learning outcomes of fifth-grade elementary school students in the IPAS subject. Thus, the 20 items were deemed suitable for use as an instrument to measure IPAS learning outcomes in fifth grade.

The next stage of this research was the implementation of a pretest, which 31 fifth-grade students attended to measure initial learning outcomes before the action was given. The pretest results showed low scores, indicating that an intervention was needed to improve student understanding. After that, learning was carried out by applying the Discovery Learning model supported by digital comic media, which focused on IPAS Chapter 5 regarding the human respiratory and digestive systems. This action was carried out during three meetings, during which researchers used digital comic media with varied content. The approach captured students' interest, as evidenced by their enthusiasm throughout the instructional activities. The students participated enthusiastically in the group discussions, exploration, discovery, and understanding

of how the process of the respiratory and digestive systems in humans occurs. This can be seen from their interaction during the learning activities. This finding aligns with research by Khoiriyah & Fatonah (2024), which showed that applying the Discovery Learning model significantly increased students' active involvement in the learning process and understanding of science concepts. This is also supported by Sari & Ahmadi (2025), who revealed that Discovery Learning increased students' enthusiasm, as shown by their high participation in group discussions and active interaction with the teacher. Furthermore, as the final stage of the research, a posttest was carried out after the action was given to gauge changes in student learning outcomes. The data are shown in Table 5:

Table 5. Learning Outcomes Pretest-Posttest

	Pretest	**Posttest**
Minimum	30	60
Maximum	85	100
Mean	54,68	87,10

As reflected in the table, the learning achievements of fifth-grade students significantly improved. This improvement is seen from the average posttest score, 87,10, while the average pretest score was only 54,68. In the pretest, the maximum value recorded was 85, while the lowest value was 30, with a percentage of completeness of 25,8%. After the treatment, there was a significant increase, where 27 students achieved a complete score with a mastery percentage of 87,1%. The maximum posttest score recorded was 100, while the minimum was 60. Findings from the analysis demonstrated that applying the Discovery Learning model supported by digital comics in IPAS content significantly improved student learning outcomes. Next, the data were analyzed, including a normality test as a prerequisite, a hypothesis paired sample t-test, and an N-gain test. The normality test is conducted to identify whether the data are typically distributed. The results derived from the normality test are outlined in the following table:

Table 6. Normality Test Results

Test of Normality						
	Kolmogorov-Smirnov			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**sig**
Pretest	.110	31	.200*	.962	31	.339
Posttest	.097	31	.200*	.966	31	.411

The Shapiro-Wilk normality test revealed that the pretest had a significance value of 0,339 and the posttest had a value of 0,411. The normality test's criterion is that the data is regularly distributed if the significance value exceeds 0,05. (Yanti & Hamzah, 2024). Thus, because the significance value obtained is more than 0,05, it indicates that both pretest and posttest data are typically distributed. The paired sample t-test hypothesis test was conducted to compare whether there was a significant difference in IPAS learning outcomes before and after implementing the Discovery Learning model assisted by digital comics. The results of the test are presented in Table 7:

Table 7. Paired Sample T-test Result

Paired Sample Test						
		Paired Differences		t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference				
		Lower	Upper			
Pair 1	Pretest - Posttest	-34.781	-30.058	-28.036	30	.000

The paired sample t-test hypothesis yielded a significance (2-tailed) of 0,000 < 0,05, signifying that H_0 is rejected while H_a is accepted. In addition, the calculated t value is 28,036 at a significance of 0,05 with a degree of freedom of (df) 30, the t table is 2,042. So it is stated 28,036 > 2,042. Hence, it may be inferred that a significant difference exists in IPAS learning outcomes before and after applying the Discovery Learning model assisted by digital comics. Furthermore, the researchers employed the N-gain analysis to assess the effectiveness percentage of the Discovery Learning model supported by digital comics on students' IPAS learning outcomes. Table 8 shows the results obtained from the N-gain:

Table 8. N-gain Results

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_Score	31	.43	1.00	.7642	.18017
Ngain_Percent	31	42.86	100.00	76.4247	18.01661
Valid N (listwise)	31				

The data shown in the table above reflect the outcome of the N-gain computation, demonstrating an enhancement in IPAS learning results with an N-gain score of 0,7642 and an N-gain percentage of 76.4247%. Referring to Table 2, the N-gain score of 0,7642 > 0,7 falls under the high category criteria (Rahayu & Ismawati, 2022). The N-gain Percent results obtained 76.4247% > 76, including effective criteria. Accordingly, using the Discovery Learning model, aided by digital comics, effectively improves the IPAS learning outcomes of grade V students.

The learning outcomes of IPAS material on the human respiratory and digestive systems in fifth-grade students at Rengging 1 State Elementary School before and after implementing the Discovery Learning model supported by digital comic media are explained as follows. In the first meeting before the implementation of the model, the researcher measured the students' prior knowledge through a pretest. As shown in Table 5, the mean student pretest score was 54,68 with a percentage of completeness of 25,8%, indicating that student learning outcomes were low and needed improvement. Furthermore, treatment was given by applying the Discovery Learning learning model, supported by digital comics, for three meetings. On the fourth meeting, a posttest was given to measure students' knowledge, as evidenced by enhanced student achievement. The average posttest score increased to 87,10, with the percentage of completeness reaching 87,1%. The paired sample t-test analysis revealed a significance value of 0,000 < 0,05. Therefore, H_0 is rejected and H_a is accepted, which means there is a significant difference in IPAS learning outcomes before and after applying the Discovery Learning model assisted by digital comics.

The results of the data analysis prove that there has been an increase in students' IPAS learning outcomes. This improvement was achieved by applying the Discovery Learning model assisted by digital comics, in which the teacher acts as a facilitator. In its implementation, the

teacher presents comic media, strategically provides initial stimuli, asks questions to guide student exploration, and guides group discussions until the conclusion. In line with these findings, the research was conducted. Supporting these findings, Anggraeni et al. (2023) conducted a study demonstrating that the Discovery Learning model, implemented with digital flipbook comics in social studies, significantly improved students' learning outcomes, reaching 79.4% in contrast to instruction that does not implement the Discovery Learning model, where students primarily listen to lectures and are often disengaged during the learning process (Pure et al., 2024). Furthermore, Sasingan & Wote (2022) strengthened this research by acquiring t count > t table of 14,42 > 2,228; thus, it was concluded that H_0 was rejected and H_a was accepted. This suggests a significant gap in science learning outcomes between Discovery Learning classes and those with conventional models.

Applying the Discovery Learning model, which aligns with the steps, is the main factor of success in learning. Material delivery is done using digital comics relevant to the content being taught. This model encourages students to explore concepts through exploration activities and develops their ability to plan, discuss, solve problems, and draw conclusions (Astiti et al., 2021). The following is an explanation of the syntax that researchers apply to learning.

The first step, namely stimulation, had variations in implementation at each meeting. In the first meeting, the researcher introduced images from the digital comic "Human Respiratory System" and invited students to practice breathing as the first step of the experiment, while asking triggering questions. In the second meeting, the researcher displayed the digital comic "Disorders of the Human Respiratory System" and asked questions about the causes of coughing in children when inhaling vehicle fumes. In the third meeting, the researcher displayed an anatomical image of the human digestive organs in the digital comic to introduce the topic "Human Digestive System". Furthermore, the second step is the problem statement. Students are given time to identify problems relevant to the images displayed. They formulate problems in the form of hypotheses as temporary conjectures. This activity encourages students to analyze existing problems. This section divides students into small groups of 5-6 members. Each group is given and provided with Student Worksheets in which a digital comic QR code can be accessed via smartphone to support their learning process.

The third step is data collection, through group collaboration, students actively work together to find evidence that supports the hypothesis by collecting relevant information through experiments and observations from digital comics. In the first meeting, two student worksheets were worked on, where students were asked to record the names of respiratory organs and their functions. This was followed by an experiment using human respiratory system props. In the second meeting, students were asked to observe the surrounding environment and categorize the types and causes of human respiratory system disorders. In the third meeting, students work on two student worksheets, the first of which records the digestive organs' names and functions. Furthermore, students conducted a simple experiment on the digestive process that occurs in the human body according to the instructions of student worksheet 2 with the tools and materials they brought. During the three meetings, students showed high enthusiasm by actively working on student worksheet questions and scanning digital comic barcodes using the smartphones they brought. They also actively conducted experiments and observed the environment to thoroughly understand the respiratory and digestive systems. This process is continued in the fourth step, namely data processing, where students discuss the information obtained through observations and exchange opinions. During this process, students were enthusiastic and active in expressing their opinions.

The fifth step is verification, where students discuss the results of observations and verify their experiments through data from digital comics, package books, and modules, so that they can understand the material through relevant examples in everyday life. The sixth step is generalization. Based on the outcomes of their experiments and observations, students formulate conclusions to address the problem. Researchers allow students to share their views based on the outcomes of group discussions. One group is selected to present, while others may add to or respond to their answers.

The learning process involves utilizing the Discovery Learning model supported by digital comics, and interaction between students becomes more intensive. The researcher acts as a facilitator, assisting students and relating learning topics to real-life situations, while guiding them to obtain data from various sources such as experiments, observations, digital comics, textbooks, and modules. Research by Pujiningsih et al., (2022) Based on student experiment results, these findings support that using simulation in the Discovery Learning learning process can produce concepts that become the foundation for conceptual, situational, and procedural knowledge. Another study also revealed that employing Discovery Learning-based learning media encourages students to be better able to identify problems, find solutions, and evaluate their learning outcomes (Mahardinata et al., 2024).

Using digital comics in learning contributes positively to learning outcomes and fosters students' interest and active involvement. In this study, digital comics can be accessed via smartphones. In digital comics, students can access interactive learning videos through links and QR codes, and are equipped with 3D visual images of the respiratory organs and the human digestive system. Images presented attractively can enhance student engagement and support a clearer understanding of the subject matter (Pinatih & Putra, 2021). The use of digital flipbook comics can increase student activeness, as evidenced by the questionnaire, which shows an increase in learning motivation from 53% to 76% after using this media. Furthermore, research (Nafi'ah et al., 2024) developing Interactive Electronic Comic Modules based on Discovery Learning found that students were very excited and interested in using Emoktif, because of the combination of interactive images and quizzes presented, and equipped with comic readings that contain explanations of the material. This is evidenced by the percentage of success of small-scale trials reaching 96.29% and 90.80% in large-scale trials, including in the exciting category. In addition, research by (Anisa et al., 2023) Supports these findings, student learning outcomes on human digestive organ material with the help of digital comic media have a positive effect, as evidenced by the average pretest score of 50.50 increasing by 88.67 after using digital comics.

The effectiveness of applying the Discovery Learning model with digital comics media on IPAS learning outcomes was measured through the N-gain. The results of the N-gain score analysis reached 0,76, and the N-gain percent was 76,42%. In tables 2 and 3, the N-gain score > 0,7 is categorized as high, and the N-gain percent of more than 76 is categorized as effective. Hence, it can be stated that the Discovery Learning learning model, aided by digital comics, effectively improves the learning outcomes of IPAS class V students of Rengging 1 State Elementary School.

Various studies prove that the Discovery Learning model not only improves learning outcomes but also motivates and encourages active participation of students, making it an effective strategy in IPAS content. The advantage of using digital comics in this study lies in its innovative and engaging approach. This model creates an engaging learning experience that motivates students by integrating interactive visual elements. Students can also identify problems and seek answers to hypotheses through experiments and discovery activities. Thus, combining

the Discovery Learning model, aided by digital comic media, improved learning outcomes and engagement in the student learning process. With this improvement, it is expected that the Discovery Learning model, aided by digital comics, can be used to present innovative and engaging learning in education.

CONCLUSION

This study shows that applying the Discovery Learning model supported by digital comic media effectively improves IPAS learning outcomes in fifth-grade elementary school students. The pretest results showed a low average score of 54,68, which increased to 87,10 in the posttest. The teacher's success in implementing this model is reflected in the improvement in academic scores and students' high enthusiasm and active participation during the learning process. The combination of structured independent discovery processes and engaging visual media has proven effective in creating a more meaningful and innovative learning environment. The paired sample t-test yielded a sig value (2-tailed) of 0,000 < 0,05, indicating that H_0 was rejected and Ha was accepted. The N-gain analysis confirmed the effectiveness of this model, with an N-gain score of 0,76 in the high category and an N-gain percentage of 76,42%, categorized as effective.

However, the researchers acknowledge the limitations of this study, namely the lack of a control group and the limited sample size, which was restricted to one school. Therefore, future studies are strongly recommended to use a comparison group to ensure more objective results and expand the sample to include various schools to improve the generalizability of the findings. Additionally, future studies could be enriched by examining the impact of this model on other variables, such as critical thinking skills or student motivation. Despite its limitations, this study offers an innovative and engaging learning strategy through combining the Discovery Learning model with digital comics. It has proven effective and can be implemented by teachers to improve the quality of IPAS learning in elementary schools.

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