Research and Development in Education (RaDEn)

Research Article

Development of flipbook-based digital comics to improve learning outcomes on simple comic material

Eka Yuliani [a,1,*] **, Deni Setiawan** [a,2]

[a] Department of Elementary School Teacher Education, Faculty of Education and Psychology, Universitas Negeri Semarang, Jl. Raya Beringin No.15, Wonosari, Semarang, Central Java 50244, Indonesia
[1] eyuliani998@gmail.com*; [2]deni.setiawan@mail.unnes.ac.id
* Corresponding author

Abstract: According to researchers, they have made observations at SDN Purwoyoso 02 Semarang and obtained results, the problems obtained are limited learning media and student learning outcomes which are still in the low category in the content of Fine Arts lessons. This research aimed to test the effectiveness and feasibility of using Digital Comic learning media in Fine Arts subjects for class IV students at SDN Purwoyoso 02 Semarang-Central Java. The type of research used is research and development (RnD), which follows a modified Borg and Gall 9-stage model. The results of the product assessment in the form of learning media validation carried out by experts in the field of materials and media obtained an average score of 92.5% with a classification of "very feasible". Media effectiveness with the T test obtained a significance value of 0.000. The N-gain calculation obtained a value of 0.5553 with "medium" criteria. So digital comic learning media can be said to be very feasible and effective to be applied in improving student learning outcomes. Researchers suggest that we always develop digital-based learning media and maximize existing applications to encourage educational progress in Indonesia.

Keywords: digital comics; flipbook; learning media; learning outcomes

1. Introduction

Education has an important role in designing and advancing Human Resources (HR) who have various abilities and can compete at the global level. With education is expected to improve community welfare, preserve culture, and build the nation's civilization. According to Permendiknas number 22 of 2006 states that National Education based on Pancasila and the Constitution of the Republic of Indonesia Year 1945 functions to develop the ability and shape the character and civilization of a dignified nation to educate the nation's life, aims to develop the potential of students to become human beings who believe and fear God Almighty, have noble character, healthy, knowledgeable, capable, creative, independent, and a democratic and responsible citizen (Azis & Lubis, 2023). In education, there is learning that must be following optimal learning objectives by building good interactions (Kadir et al., 2020; Senen et al., 2021). Through education can improve the existence of skills and knowledge for students as well as the formation of good character (Firestone, 2020; Isrokatun, 2023; Phuong et al, 2018). Education functions as an innovation based on the development of science and technology to face life in the future (Herlambang, 2018; Kryukov, 2017). Not only that, in more previous researcher's opinion (Engkizar et al., 2018; Yusnita et al., 2018; Syafril et al., 2021), creative learning is also able to develop critical thinking and foster the spirit of innovation in students. Creative learning can bring joy to every student and help elementary school children to be happier to find new things (Taqiyyah, 2023).

Fine arts education is to develop work skills, instil local cultural awareness, develop the ability to appreciate fine arts, provide opportunities for self-actualization, develop mastery of fine arts disciplines, and promote multicultural ideas. Self-actualization in creating works of art makes students have motor, creative, and productive skills (Dayanti et

Citation: Yuliani, E., & Setiawan, D. (2024). Development of flipbook-based digital comics to improve learning outcomes on simple comic material. *Research and Development in Education (RaDEn)*, *4*(1), 291-236. https://doi.org/10.22219/raden.v4i1.32280

Received: 11 February 2024
Revised: 6 April 2024
Accepted: 14 April 2024
Published: 15 April 2024

al., 2021). There are main aspects that must be considered in fine arts, including cognitive (knowledge), affective (attitude/appreciative), and psychomotor (soft skills). So, in the implementation of learning in class, teachers do not only deliver material by just explaining the material orally. However, a teacher is also required to be able to give direct examples of the practice of making a work in class. Learning art in elementary school has many kinds, ranging from fine arts, music, dance, and theatre arts (Soetopo, 2015).Through art, children can hone creativity through their abilities (Angraini et al., 2023).

Based on observations and interviews conducted at SDN Purwoyoso 02 Semarang obtained information that teachers are still lacking in utilizing learning media such as animated videos, and projector media such as LCDs, laptops, and speakers. Teachers find it difficult to create learning media and are only limited to using lecture methods, and printed books in delivering material. As a result, sometimes teachers have difficulty in delivering material, especially in Fine Arts subjects. Learning media is not applied to Fine Arts subjects causing low knowledge and interest of students because teachers do not provide visual examples of the material studied. The above opinion is in line with research which states that the factor that causes students to be less optimal in processing learning materials provided at school is less optimal use of media in learning (Kusnulyaningsih et al., 2022). Therefore, a need for learning media that is interesting and can help students to better understand the subject matter and overcome boring and less effective learning activities to achieve learning objectives. Digital Comic Media can be one of the learning media that is considered effective in the subject of Art and Culture Simple Comics material.

Learning media is a tool or device to carry out processes that allow educators and students to carry out learning activities (Schneider et al., 2020; Widodo, 2018). In addition, the role of learning media can be explored in conveying learning messages to stimulate students' thoughts, feelings, and emotions. By adjusting the messages and information presented in the learning media to suit the needs and abilities of students, they can be more involved in the learning process (Andriani, 2022; Astuti et al., 2020; Heyd-Metzuyanim, 2013; Mangesa & Andayani, 2015; Slavich & Zimbardo, 2012).

Digital transformation occurs in various aspects of life, including education (Suryadi, 2022). Technology has brought the creation of various digital media in the field of learning. Technology has brought the creation of various digital media in the field of learning. Interactive and engaging content can be achieved through the use of contextual, acoustic, and visual digital media (Amaluddin & Machali, 2022). Digitalization in education helps the government to equalize access to education and technology literacy (Anita & Astuti, 2022).

In following up on the results of initial observations or observations, there is a desire and expectation from teachers to develop appropriate and fun learning media, so it is necessary to develop learning media with material to make simple comics to help achieve learning objectives. Learning media that are arranged interestingly can be used in the learning process, one of which is comics, where there are still many children to adults who are very fond of reading comics. Comic learning media can be said to be interesting because comics are composed of several storylines that can function to attract the attention of readers or are equipped with more pictures than writing to overcome boredom in children when reading. Comics are an art form that uses motionless images arranged in such a way that they form the fabric of the story (Wibowo & Koeswanti, 2021).

Digital comics are widely used as a means of learning, but there has been no innovation in media development so it needs to be developed. The media developed by researchers is Flipbook-based Digital Comics. Digital Comics are created with the help of the Pixton website. Pixton's website is a digital comic development site that can be used to improve the learning process and allow students to display what they know (Wibowo & Koeswanti, 2021). Digital Comics can be used effectively by teachers to stimulate reading interest and students' abilities.

Comics serve as a learning medium that can improve the ability to read (Beard & Rhodes, 2002; Chen et al., 2018; Matuk et al., 2021). Comics are suitable for alternative learning while playing (Rina et al., 2020). Comics can be used as a means of delivering information and as a visual medium that helps increase student activity and interest Fadella, 2018; Wicaksono et al., 2020; Wolski, 2020). Comics are liked by many children, including the millennial generation, especially digital comics that utilize technological media (Swandi et al., 2020).

Researchers developing flipbook-based digital comic media have also carried out several previous studies (Fitria et al., 2023). Research found that comic media is very interesting and makes children happy, through cheerful colors and imagination to be depicted. The study was compiled with a design research framework to develop a three-session comic test, involving several 13, 6, and 47 children (Terlouw et al., 2020). Based on research (Sari et al., 2021), the method used in data collection is questionnaires. The research conducted uses development research consisting of several stages, namely: research and data collection, planning, product design development, expert validation, expert-based revision, limited trials, product refinement of limited trial results, field trials, and final project improvement. The feasibility of comic media is shown by the assessment of material experts of 3.51 (good), the assessment of media experts of 4.01 (good), the assessment of teachers as education practitioners of 3.9 (good) and the assessment of student questionnaires of 3.93 (good) these results were obtained from research by (Mustikasari et al., 2020).

The novelty of this research lies in the subjects studied which focus on fine arts with simple comic material, then comic media is created using the Pixton website, where the images look more real. Then the comics were made even more simplified for grade 4 elementary school students. Based on the above problems, researchers want to know the feasibility of Digital Comics media. This research aimed to test the effectiveness and feasibility of using Digital Comic learning media in Fine Arts subjects for class IV students at SDN Purwoyoso 02 Semarang. The author chose Digital Comics in this study because comics can be used in channelling information and the existence of comics about one's independence, will provide a real picture of the attitudes that students should have in everyday life, especially in terms of family and friendship. Students who will be applied to Digital Comics media in Fine Arts subjects, through development research, all circles can understand this better, because students seem to be faced with a real context. This can be seen from the suitability of Digital Comics as a learning medium to solve learning problems and to foster interest in reading and writing.

2. Materials and methods

Research design is a procedure or tool used by researchers to conduct research. The research method used is RnD (Research and Development). According to Borg and Gall (1983), research and development methods are used to validate and perfect a product. Research and development methods are used to produce high-quality products while increasing their efficiency. According to Sugiyono (2021) the stages of research and development, among others, identifying potential and problems, collecting data, designing products, validating designs, revising designs, developing products, conducting tests, revising products, and mass production. However, researchers only get to stage 9, which is to revise the product. The subjects in this study were grade IV students of SDN 02 Purwoyoso 02 Semarang. The total population of class IV is 43 students. The sampling technique carried out is purposive sampling or sampling based on certain objectives. The research procedure used is to develop Digital Comics learning media assisted by the Pixton website, in the development assessment process it becomes the main series in the form of teacher response assessment which is then used as a benchmark for development success. Product data analysis consists of two parts questionnaire analysis of teacher and student needs. As well as analysis of teacher and student responses to the media.

We follow the provisions of Arikunto (2014) as in Formula 1, while the Criteria for Teacher and Student Needs Questionnaire are as in Table 1 (Anesia et al., 2018).

$$P = \frac{\Sigma x}{\Sigma xi} \times 100 \quad (1)$$

Information:
P = score Percentage
Sx = number of respondents' answer scores in one item
Σxi = the sum of the ideal scores in one item

Table 1. Criteria for Teacher and Student Needs Questionnaire

Percentage (%)	Criterion
81 – 100	Agree
61 – 80	Agree
41 – 60	Disagree less
21 – 40	Disagree
0 – 20	Strongly disagree

Analysis of Teacher and Student Responses to Media using the Likert scale There are 5 categories used, namely 1 (strongly disagree), 2 (disagree), 3 (quite agree), 4 (agree), and 5 (strongly agree). We follow the provisions of Arikunto (2014) as in Formula 2, while the Teacher Response Questionnaire Criteria are as in Table 2 (Wulandari et al., 2020).

$$P = \frac{\Sigma x}{\Sigma xi} \times 100 \quad (2)$$

Information:
P = Score Percentage
Sx = Number of respondents' answer scores in one item
Σxi = the sum of the ideal scores in one item

Table 2. Teacher Response Questionnaire Criteria

No.	Percentage (%)	Criterion	Information
1.	81 – 100	Excellent	The media is very feasible, it does not need to be revised
2.	61 – 80	Good	Decent media does not need revision
3.	41 – 60	Good enough	Less decent media needs revision
4.	21 – 40	Not good	Inappropriate media needs revision
5.	< 20	Very unfavorable	The media is very unworthy of revision

We follow the provisions of Arikunto (2014) as in Formula 3, while Student Response Questionnaire Criteria are as in Table 3 (Wulandari et al., 2020).

$$P = \frac{F}{N} \times 100 \quad (3)$$

Information:
P = percent value of interest in learning using media
F = the frequency with which the percentage is searched
N = maximum number of scores.

Table 3. Student Response Questionnaire Criteria

No.	Score Percentage (%)	Criterion
1.	81 – 100	Very interesting
2.	61 – 80	Pull
3.	41 – 60	Quite interesting
4.	21 – 40	Less attractive
5.	< 20	Unattractive

The effectiveness of results before treatment and results after treatment that have been done by students before can be analyzed on student cognitive learning outcomes by calculating the scores that have been obtained by students and testing the results before treatment and results after treatment. The normality test was used in this study to determine whether the data is normally distributed or not. Priyatno (2018) stated that the data normality test is important because normally distributed data can represent the population. In this study, researchers used a normality test with Kolmogorov-Smirnov on SPSS version 23 to see whether the data was normally distributed or not (Table 4) with provisions referring to (Priyatno, 2018).

Table 4. Normality Test Criteria

Result	Information
If the significance value is 0.05≤	Ho was rejected
If the significance value > 0.05	Ho accepted

Next, there is the Paired Samples T-Test or paired sample t-test performed to determine the average difference test between two paired samples. Priyatno stated that paired samples were used on sample groups that included the same subjects but underwent two different treatments, such as before and after treatment. In this study, researchers used SPSS version 23 to test the results before treatment and the results after treatment with paired samples t-test. This t-test can be used on parametric normally distributed data (see Table 5 and Table 6 with provisions referring to Priyatno (2018).

Table 5. Paired Samples T-Test Criteria

Result	Information
If -t calculate -t table or greateror≥ t calculate t table≤	Ho accepted
If -t calculate -t table lessr< t calculate t table>	Ho was rejected

Table 6. Decision Making Based on the Significance of the Paired Samples T-Test

Result	Information
If the significance value is 0.05≤	Ho was rejected
If the significance value > 0.05	Ho accepted

If the data is not normally distributed, another alternative test is needed, namely the Wilcoxon test on nonparametric data to replace the *paired samples t-test*. The Wilcoxon test is also used to determine the average of two paired samples. Table 7 and Table 8 with provisions referring to Suyanto and Gio (2017) stated that the data used were ordinal or

interval data. In this study, researchers were able to use SPSS version 23 for the Wilcoxon test.

Table 7. Decision-Making in the Wilcoxon Test

Result	Information
If the significance value < 0.05	Ha accepted
If the significance value > 0.05	Ha rejected

Followed by the gain index analysis is used to calculate the assessment between the pretest value and the post-test value. In this study, the gain in question is normalized gain (N-gain). N-Gain is the normalization of gain obtained from comparing the difference between pretest and post test scores with the difference in Ideal Minimum Scores (SMI) and pretests in Fine Arts lesson content after using Digital Comics learning media. Normalized gain is as in Formula 4.

$$N - Gain = \frac{Skor\ posttest - skor\ pretest}{Skor\ maksimal - skor\ pretest} \quad (4)$$

Information:

N-gain = magnitude of gain factor
Skor posttest = final test score after treatment
Skorposttest = initial value before treatment
Maximum score = maximum value

Table 8. Test Average Gain (N-Gain)

Interval	Criterion
N-Gain 0.7≥	Tall
0,3 N-Gain 0,7≤≤	Keep
N-Gain < 0.3	Low

3. Results

This research is research on the development of Flipbook-based Digital Comics learning media on *the* content of Learning Fine Arts Simple Comics material which was carried out at SDN Purwoyoso 02 Semarang. Several things are studied from the results of research on the development of Flipbook-based Digital Comics learning media, these things include; (1) the results of the development of Flipbook-based Digital Comics, (*2) feasibility assessment* of Flipbook-based Digital Comics, and (3) the effectiveness of Flipbook-based Digital Comics.

3.1 Product data analys

The design of digital comic development to improve learning outcomes on simple comic material is designed based on the results of teacher and student needs questionnaires and is developed with learning objectives contained in the independent curriculum and tailored to student needs. The steps for making digital comic designs are divided into several stages including 1) Determining the theme in comics, 2) Reviewing learning outcomes and goals to be achieved in grade IV Elementary School, 3) Determining comic characters, 4) Determining the storyline by the material that has been set, 5) Making covers from covers, backgrounds, and coloring interesting comics according to the needs of elementary school students 6) Creating guidelines for using comic learning media digital flipbook-based. Comic media created using website https://www.pixton.com, the Pixton

website is used to create comic characters to look real according to the age of elementary school children, then for editing is done using Canva to create a more attractive digital comic look with a combination of appropriate colors. Digital Comic Media in the form of product output with HTML (Hypertext Markup Language) format using the website https://fliphtml5 So that the resulting digital comics can be accessed like digital books that can be flipped around. Learning media can be accessed via the link https://rb.gy/khi5a6. The comic product can be seen in the Figure 1 (Digital comic cover display) and Figure 2 (Display the contents of digital comics).

Figure 1. Digital comic cover display

Figure 2. Display the contents of digital comics

3.2 Product Validation

Based on calculations using the validity formula, a percentage value of 96% was obtained (Table 9). Based on the validity criteria table, the final validation value for digital comics is in the range of 85.1% - 100% or very valid criteria.

Table 9. Digital Comic Credential Test Results

Validator	Score Percentage (%)	Criterion
Media	96	Very valid
Material	86	Very Valid
Average (%)	91	Very Valid

3.2.1. Analysis of Teacher and Student Needs Questionnaire

Initial data was obtained in the form of interviews with observation activities at school. Based on the teacher's initial analysis, it can be concluded that teachers experience difficulties in conveying simple comic material so that it has a direct impact on students' learning outcomes, which tend to be low. The main factor in this problem is the unavailability of learning media that supports the learning process in class. Researchers carried out follow-up by creating a questionnaire on teacher and student needs to solidify the concept of learning media. The Table 10 are the results of a questionnaire on teacher and student needs.

Table 10. Results of the Teacher and Student Needs Questionnaire

Teacher/Student	Percentage
Teacher	86%
Student	73%
Average	79.5%

Table 10 shows the results of the teacher and student needs questionnaire. It was found that the average result of the questionnaire of teacher and student needs for the development of digital comic learning media was 79.5% and entered the criteria of strongly agreeing.

3.2.2. Analysis of Teacher and Student Responses to the Media

The aim of filling out the teacher and student response questionnaire is to identify comments and opinions regarding the use of digital comic media. The Table 11 are the results of the teacher's response questionnaire after the use trial was carried out.

Table 11. Results of the Teacher Response Questionnaire

Teacher	Percentage
Class A Teacher	100%
Class B Teacher	95%
Average	97.5%

The results of the teacher's response to digital comics on simple comic material can be seen from the results of the teacher's response questionnaire. It was found that the average result of teacher response to the treatment of flipbook-based digital comic learning media was 97.5% and entered the criteria very feasible without the need for revision.

The results of student responses to digital comics on simple comic material can be seen from the results of student response questionnaires. The results of the responses from these students were obtained from limited trial activities and extensive trials, then the average was sought from the results of the student response questionnaire. It was found that the average result of student response in the previous limited trial was 90%, after giving a questionnaire the student response in the wider trial increased to 95%, so the final average student response result was 92.5% and the criteria was very interesting (Table 12). Based on student responses, it is stated that digital comic media makes students feel happy when learning and can understand simple comic material.

Table 12. Student Response Questionnaire Results

Limited Trial Results	Results of Extensive Trials	Average
90%	95%	92.5%

3.3 Initial Data Analy

The normality test is carried out to determine whether the pretest and post-test learning results are distributed normally or not. The normality test can help researchers to be able to determine the data analysis technique to be used from the data obtained. Normally distributed data will use parametric statistical techniques. The normality test is performed using the Shapiro-Wilki test formula with the help of SPSS application version 23

3.3.1 Normality Test

The normality test is the initial data analysis stage in this research. Normality testing is used as a tool to find out whether data is normally distributed or not. In this case, the data tested are the values before treatment and after treatment in the large and small groups. Researchers used the Shapiro-Wilk method assisted by SPSS version 23 software. Below is a table of results from the data normality test before and after small group treatment.

The results of the large group normality test are presented in the Table 13. Table 13 shows the results of the normality test in limited trial activities. Based on the output table on the Shapiro-Wilk sig column. For pre-treatment values of 0.109 > 0.05 and values after treatment of 0.378 > 0.05. Both values are greater than 0.05, so it can be concluded that the two values are normally distributed, thus the requirements for the paired sample t-test are met. Because the results of the normality test show that the data has a normal distribution, the t-test can be performed. The t-test results were obtained from the results of the pretest and post-test data processed through SPSS 23.

Table 13. Normality Test Results on Limited Trials

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Say.**	**Statistic**	**df**	**Say.**
Before the treatment	.285	6	.139	.831	6	.109
After treatment	.182	6	.200*	.901	6	.378

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The Table 14 are the results of the t-test on the limited trial. Table 14 shows normality test results in broad trial activities. Based on the output table on the Shapiro-Wilk sig column. For values before treatment 0.482 > 0.05 and values after treatment 0.107 > 0.05. Both values are greater than 0.05, so it can be concluded that the two values are normally distributed, thus the requirements for the paired sample t-test are met. Because the results of the normality test show normally distributed data, the t-test can be carried out. The results of the t-test were obtained from the results of data before treatment and after treatment processed through SPSS 23.

Table 14. Normality Test Results on Wide Trials

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Say.**	**Statistic**	**df**	**Say.**
Before the treatment	.096	37	.200*	.973	37	.482
After treatment	.128	37	.134	.951	37	.107

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

3.3.2 Uji T-Test

The t test or t - test is carried out to detect whether or not there is a significant difference in the average scores before treatment and after treatment of students. The method used is paired sample t - test (test between two parties). This decision was taken because this test uses two paired samples. This test was carried out using SPSS version 23 software. The results of the paired sample t-test in small groups are presented in the Table 15.

Table 15. T-Test Results on Limited Trials (Paired Samples Test)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Before treatment – After treatment	-18.50000	14.47411	5.90903	-33.68965	-3.31035	-3.131	5	.026

Table 15 shows the t-test results in the limited trial showing the sig values. (2-tailed) 0.026 < 0.005, so that H_0 is rejected and Ha is accepted, it can be concluded that there is a difference in the average results before treatment and results after treatment, meaning that the effect of using digital comics on simple comic material was found to make improvements to the learning outcomes of grade IV elementary school students.

The results of the t-test in large groups are presented in the Table 16. Table 16 shows the t-test results in broader trials showing sig values. (2-tailed) 0.000 < 0.005, so that H_0 is rejected and Ha is accepted, it can be concluded that there is a difference in the average results before treatment and after treatment, meaning that there is an influence on the use of digital comics. Judging from the table above the results after treatment are superior compared to the results before treatment. Based on the results after the treatment, shows that students' grades increase after using digital comic media learning media. So, the conclusion is that digital comic media can make improvements to student learning outcomes on digital comic material.

Table 16. T-Test Results on Wide Trials (Paired Samples Test)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Before treatment - After treatment	-22.189	11.170	1.836	-25.913	-18.465	-12.083	36	.000

3.3.3 N-gain Test

The average improvement test is performed to determine the average increase before treatment and after treatment. Calculation of the average increase in values before treatment and after treatment using the N-Gain analysis technique. N-Gain is a normalized gain obtained by comparing the difference in scores before treatment and after treatment

with the difference in SMI and before treatment. Gain is the average increase in learning outcomes on presentation and data collection materials after the use of Digital Comics learning media based on *Flipbook* Presentation and Data Collection.

The results of the n-gain test in small groups are presented in the Table 17. Based on the calculation of the average increase test (N-Gain) in limited trials, it is known that there is an average increase of 0.79 which is included in the high criteria.

Table 17. N-gain Test Results on Limited Trials (Descriptive Statistics)

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_score	6	.58	1.00	.7971	.16941
Ngain_percentage	6	58.33	100.00	79.7123	16.94121
Valid N (listwise)	6				

The results of the n-gain test in the large group are presented in the Table 18. Based on the calculation of the average increase test (N-Gain) in broad trials, it is known that there is an average increase of 0.55 which is included in the moderate criteria.

Table 18. N-gain Test Results on Wide Trials (Descriptive Statistics)

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_score	36	.00	1.00	.5553	.26027
Ngain_percentage	36	.00	100.00	55.5311	26.02651
Valid N (listwise)	36				

4. Discussion

With a focus on the possibilities and challenges faced in grade IV education SDN Purwoyoso 02 Semarang. Interviews and observations were conducted to collect data. Through observation and interviews, it is known that students are less interested in learning a topic because it is considered uninteresting and boring. The media used by teachers when learning fine arts does not help students understand the material and does not attract students' attention. Comics are a medium in the form of books that present a story of (Febriyanti & Mustadi, 2020). Elementary students usually like digital comic illustrations so much that they are motivated and entertained to explore the contents of the comic (Rais et al., 2022). This is in line with Alit et al (2021), stating that interesting media can increase student understanding when used in accordance with students' cognitive theory.

Based on research of Darmayanti and Sugianto (2022), comics can be used as a learning medium. Learning is said to be good if it meets three criteria, namely valid (worth trying), practical (easy to use as measured by student questionnaires), and effective (facilitating learning measured by student learning outcomes tests). Comics are very influential in helping readers understand things quickly with educational content. This is because the language of images and cartoon text can convey understanding and information about a problem more quickly than just using text alone (Ahdar et al., 2022). A study conducted by Rahmatullah et al (2020) found that comics can be used in the learning process to help students in understanding learning material. They also state that students are more motivated to learn by using comics. The difference between learning using comics and conventional learning is usually explained by Sarkadi and Al-Ghozali (2020) stated that comic media offers different learning than traditional learning. Visual learning is claimed to provide better results compared to traditional learning systems.

The developed comic media is different from the previous media because no one has developed digital comic media, simple comic materials. Students can experience firsthand reading comics as well as understand learning about simple comic material. The

advantage of this digital comic media is that this comic media can be shared by teachers through the WhatsApp application so that students can access digital comics from home. The flipbook program is considered one of the most commonly used programs. In addition, comics also do not need to be printed so there is no need to spend a lot of money (Aprillia et al., 2022).

Data on the feasibility of digital comics on simple comic material was obtained through material expert validation questionnaires, and qualitatively analyzed media which obtained a percentage of 86% of material experts in accordance with Narestuti et al (2021) that the material in comics can explain the whole story because there are illustrations that facilitate students' understanding of certain forms or examples of material meaning. While the assessment from media experts is 96%, one aspect of media assessment is the selection of comic character characters that are appropriate for the age of students. In accordance with Young-Min's opinion in Septaria and Fatharani (2022) stating that the comic element is the most important aspect to describe events and allows comic readers to imagine themselves as if they are directly participating in the story. In line with this, the developed media is feasible to be implemented as a medium for the learning process. Digital comic media is at a very decent qualification supported by its visual quality and presentation (Andryani & Wibawa, 2021).

Tested on research subjects, namely grade IV students of SDN Purwoyoso 02 Semarang totalling 6 children. Learning using digital comic media uses a scientific approach. The application of scientific approaches through cartoons can increase students' creative thinking power and effectively increase student literacy (Cahyono et al., 2023). The limited trial began with carrying out pretest activities, then continued with testing digital comics that had been developed in Fine Arts learning activities, after that providing questionnaires of student responses to the implementation of learning activities and ending with evaluation. The developed media is adapted to the characteristics of elementary school students. At the elementary school level, the child begins to memorize things based on the aspects and objects he learns. Through these subjects' students begin to develop new concepts of knowledge and develop various other thinking skills (Ranting & Wibawa, 2022). This is evident from the results of the student response questionnaire obtained by 90% and entered the very good criteria.

Tested on research subjects, namely grade IV students of SDN Purwoyoso 02 Semarang totalling 37 children. It was found that the average result of student response in the previous limited trial was 90%, after giving questionnaires the response of students in wider trials increased to 95%, so that the final average result of student response was 92.5% and entered the criteria very good. The improvement of learning outcomes of grade IV elementary school students as explained above shows that the learning environment of digital comics can affect students' mastery of concepts. This is in line with the theory of cognitive development, the appearance of human perception at the stage of development of the environment, when a person learns a new way of mentally presenting information (Juneli et al., 2022).

From the research that has been conducted at SDN Purowoyoso 02 Semarang can be done, the application of digital comic learning media is effective to help the success of the learning process. The results of the data obtained, namely an increase in learning after learning digital comics, namely the percentage of 79.71% in small-scale tests and 55.53% in large-scale tests. This is because it has advantages in digital comic learning media such as research conducted by Mustikasari et al (2020) that learning with comic media affects student learning outcomes.

5. Conclusion

This research has developed digital comic learning media on simple comic material. Based on the results of expert test analysis, it shows a score from the material expert team

of 86% and from the media expert team of 96% which is included in the very valid category and is declared digital comics suitable for use. From the results of the questionnaire of teacher and student responses with an average final grade of 95% included in the very good category, this shows that the response of use (teachers and students) is very good when carrying out the learning process using digital comics on simple comic material. There is a difference in the average learning outcomes before the use of media with learning outcomes after the use of digital comic media in the slash test and the broad test, namely the t test, in limited trials showing the value of sig. (2-tailed) 0.026 < 0.05 then in broad trials showed the value of SIG. (2-tailed) 0.000 < 0.05 This shows the positive influence of the development of digital comic learning media on learning outcomes. So it can be concluded that there is a significant difference between learning outcomes before and after the use of digital comics learning media.

Based on the results of research and development of digital comics, the development of learning media in the following research is limited to only one material, namely simple comic material, it is recommended that further researchers can develop the content of material on digital comic media that is developed so that it is unlimited and can be wider in scope so that it can increase knowledge and make improvements to student learning outcomes in fine arts subjects.

Author's Contribution: Eka Yuliani is the main researcher and author of this article. Yuliani is in charge of collecting data, making needs questionnaire instruments, response questionnaires, media validation assessments and material expert validation, and evaluation. In addition, Yuliani also develops and tests research products, and plays a role in data processing. Not only that, but also served as a draft article writer. Deni Setiawan is the researcher and author of both of these articles. Setiawan is in charge of validating the instrument In addition, it also validates the initial design of the product before going to media validators and experts. As well as a supervisor who guides and directs the first author.

Acknowledgments: Thank you to the leadership, teaching staff, and teachers at SDN Purwoyoso 02 Semarang-Central Java who have provided opportunities and service facilities while carrying out research and thank you to the supervisors who have guided me in completing this article.

Conflict of Interest: Authors declare there are no conflicts of interest.

6. References

Ahdar, A., Musyarif, M., Ramlia, N., Hikma, N., & Munalestari, E. (2022). The effectiveness of using comic media in social science subject in madrasah tsanawiyah of Parepare City. *Lentera Pendidikan : Jurnal Ilmu Tarbiyah Dan Keguruan*, *25*(2), 349–357. https://doi.org/10.24252/lp.2022v25n2i14

Alit, K., Adnyani, D., Made, I., Wibawa, C., & Margunayasa, G. (2021). Alternative energy sources on digital comic media. *International Journal of Elementary Education*, *5*(1), 61–70. https://doi.org/10.23887/ijee.v5i1.34333

Amaluddin, M. R., & Machali, I. (2022). *Pemanfaatan media digital sebagai sarana pembelajaran di SMA Babussalam Pekanbaru* (Vol. 05). https://vicon.uin-suka.ac.id/index.php/ACoMT/article/view/1133

Andriani, K. (2022). Teaching media in EFL classrooms: What are they and why select them? *Journal of Language Testing and Assessment*, *2*(1), 87–97. https://doi.org/10.56983/jlta.v2i1.214

Andryani, N. K. D. R., & Wibawa, I. M. C. (2021). Socio-cultural diversity in the form of digital comics for fourth grade students: Validity and feasibility. *Jurnal Ilmiah Sekolah Dasar*, *5*(1)., 87-98. https://doi.org/10.23887/jisd.v5i1.34282

Anesia, R., Sri Anggoro, B., & Gunawan, I. (2018). *Pengembangan* media komik berbasis android pada pokok bahasan gerak lurus. *Indonesian Journal of Science and Mathematics Education, 1*(1), 53-57. http://dx.doi.org/10.24042/ijsme.v1i2.2774

Angraini, Y. S., Mayar, F., & Desyandr, D. (2023). Pengaruh pembelajaran seni terhadap perkembangan kreativitas anak sekolah dasar. *Didaktik : Jurnal Ilmiah PGSD STKIP Subang, 9*(2), 1870 - 1875. https://doi.org/10.36989/didaktik.v9i2.911

Anita, A., & Astuti, S. I. (2022). Digitalisasi dan ketimpangan pendidikan: studi kasus terhadap guru sekolah dasar di Kecamatan Baraka. *Jurnal Pendidikan dan Kebudayaan*, *7*(1), 1–12. https://doi.org/10.24832/jpnk.v7i1.2509

Aprillia, A., Dewi, R. S., & Setiawan, S. (2022). Digital comic media: Pancasila relationships in daily life. *MIMBAR PGSD Undiksha*, *10*(2), 183–189. https://doi.org/10.23887/jjpgsd.v10i2.41811

Arikunto, S. (2014). *Research procedure a practice approach*. Rineka Cipta.

Astuti, F. N., Suranto, S., & Masykuri, M. (2020). The appropriateness of developing the media: experts' validation and students' response of learning media based on augmented reality technology for natural science lesson. *Journal of Physics: Conference Series*, *1567*(4), 042023. https://doi.org/10.1088/1742-6596/1567/4/042023

Azis, A. C. K., & Lubis, S. K. (2023). Pembelajaran seni rupa berdasarkan perspektif kurikulum merdeka di sekolah dasar. *Pena Anda: Jurnal Pendidikan Sekolah Dasar*, *1*(1), 10–19. https://doi.org/10.33830/penaanda.v1i1.4948

Beard, C., & Rhodes, T. (2002). Experiential learning: Using comic strips as 'reflective tools' in adult learning. *Journal of Outdoor and Environmental Education*, *6*(2), 58–65. https://doi.org/10.1007/BF03400756

Borg, W. R., & Gall, M. D. (1983). Educational research: An introduction. Longmann.

Cahyono, B., Rohman, A. A., Setyawati, R. D., & Dzakiyyah, R. 'Ilmi. (2023). Pengembangan media pembelajaran e-komik berbasis etnomatematik dan kemampuan berpikir kreatif pada materi geometri MTs. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(2), 2283. https://doi.org/10.24127/ajpm.v12i2.7398

Chen, G.-D., Fan, C.-Y., Chang, C.-K., Chang, Y.-H., & Chen, Y.-H. (2018). Promoting autonomy and ownership in students studying English using digital comic performance-based learning. *Educational Technology Research and Development*, *66*(4), 955–978. https://doi.org/10.1007/s11423-018-9597-7

Darmayanti, R., & Sugianto, R. (2022). Digital comic learning media based on character values on students' critical thinking in solving mathematical problems in terms of learning styles. *Jurnal Pendidikan Matematika*, *13*(1). https://ejournal.radenintan.ac.id/index.php/al-jabar/article/view/11680

Dayanti, Z. R., Respati, R., & Gyartini, R. (2021). Pengembangan bahan ajar elektronik flipbook dalam pembelajaran seni rupa daerah siswa kelas V di sekolah dasar. *Journal of Elementary Education*, *04*(05), 704–711. https://doi.org/10.22460/collase.v4i5.8187

Engkizar, E., Muliati, I., Rahman, R., & Alfurqan, A. (2018). The importance of integrating ICT into Islamic study teaching and learning process. *Khalifa: Journal of Islamic Education*, *1*(2), 148. https://doi.org/10.24036/kjie.v1i2.11

Fadella, E. F. , S. & P. A. (2018). *Keefektifan problem-based learning berbantuan komik matematika terhadap kemampuan pemecahan masalah dan rasa ingin tahu siswa*. https://www.researchgate.net/publication/343636053_Keefektifan_Problem Based_Learning_Berbantuan_Komik_Matematika_terhadap_Kemampuan_Pemecahan_Masalah_dan_Rasa_Ingin_Tahu_Siswa

Febriyanti, R., & Mustadi, A. (2020). Developing edutainment-based comic media in integrative-thematic learning in the elementary school. *Al Ibtida: Jurnal Pendidikan Guru MI*, *7*(2), 179. https://doi.org/10.24235/al.ibtida.snj.v7i2.6676

Firestone, A. R. , R. A. , Cruz. , & J. E. (2020). Teacher study groups: an integrative literature synthesis. *Review of Educational Research*, *90*(5), 675–709. https://doi.org/10.3102/0034654320938128

Fitria, Y., Malik, A., Mutiaramses, M., Halili, S. H., & Amelia, R. (2023). Digital comic teaching materials: It's role to enhance student's literacy on organism characteristic topic. *Eurasia Journal of Mathematics, Science and Technology Education*, *19*(10), em2333. https://doi.org/10.29333/ejmste/13573

Herlambang, Y. T. (2018). *Pedagogik: Telaah kritis ilmu pendidikan dalam multiperspektif [Pedagogy: A critical study of educational science in multiperspectives]*. Bumi Aksara.

Heyd-Metzuyanim, E. (2013). The co-construction of learning difficulties in mathematics—teacher–student interactions and their role in the development of a disabled mathematical identity. *Educational Studies in Mathematics*, *83*(3), 341–368. https://doi.org/10.1007/s10649-012-9457-z

Isrokatun, I., Hanifah, N., Abdul, Y. A. , Rosmiati, R., & Khoerunnisah, R. (2023). The development of android-based learning mobile app to practice critical thinking skills for elementary school students. *Pegem Journal of Education and Instruction*, *13*(2), 161-172. https://doi.org/10.47750/pegegog.13.02.20

Juneli, J. A., Sujana, A., & Julia, J. (2022). Pengembangan media pembelajaran komik digital pada penguasaan konsep peserta didik SD kelas V. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, *11*(4), 1093. https://doi.org/10.33578/jpfkip.v11i4.9070

Kadir, M. S., Yeung, A. S., Ryan, R. M., Forbes, A., & Diallo, T. M. O. (2020). Effects of a dual-approach instruction on students' science achievement and motivation. *Educational Psychology Review*, *32*(2), 571–602. https://doi.org/10.1007/s10648-018-9449-3

Kryukov, V. , & G. A. (2017). Digital technologies as education innovation at universities. *Australian Educational Computing*, *32*(1), 1-16. https://journal.acce.edu.au/index.php/AEC/article/view/114

Kusnulyaningsih, D., Husniati, H., & Jiwandono, I. S. (2022). Pengembangan media pembelajaran berasis video animasi pada muatan seni budaya dan prakarya kelas IV SDN 39 Mataram. *Jurnal Ilmiah Profesi Pendidikan*, *7*(2), 480–486. https://doi.org/10.29303/jipp.v7i2.677

Mangesa, R. T., & Andayani, D. D. (2015). *The effectiveness of media implementation in competence-based learning integrated with character building in vocational high schools*. The 3rd UPI International Conference on Technical and Vocational Education and Training (TVET). http://eprints.unm.ac.id/23003/1/2015_%20Atlantis%20Press.pdf

Matuk, C., Hurwich, T., Spiegel, A., & Diamond, J. (2021). How do teachers use comics to promote engagement, equity, and diversity in science classrooms? *Research in Science Education*, *51*(3), 685–732. https://doi.org/10.1007/s11165-018-9814-8

Mustikasari, L., Priscylio, G., Hartati, T., & Sopandi, W. (2020a). The development of digital comic on ecosystem for thematic learning in elementary schools. *Journal of Physics: Conference Series*, *1469*(1), 012066. https://doi.org/10.1088/1742-6596/1469/1/012066

Narestuti, A. S., Sudiarti, D., & Nurjanah, U. (2021). Penerapan media pembelajaran komik digital untuk meningkatkan hasil belajar siswa. *Bioedusiana: Jurnal Pendidikan Biologi*, *6*(2), 305–317. https://doi.org/10.37058/bioed.v6i2.3756

Phuong, T. T.; Cole, S. C.; Zarestky, J. (2018). A systematic literature review of faculty development for teacher educators. *Higher Education Research & Development*. *37*(2), 373–389. http://dx.doi.org/10.1080/07294360.2017.1351423

Priyatno, D. (2018). *SPSS: Panduan mudah olah data bagi mahasiswa dan umum*. CV. Andi Offset.

Rahmatullah, R., Inanna, I., Rakib, M., Mustari, M., & Rabania, R. (2020). Developing tematic economic comic with characters for early childhood. *Journal of Educational Science and Technology (EST)*, *1*(1). https://doi.org/10.26858/est.v1i1.14949

Rais, M., Hartoto, H., & Aryani, F. (2022). The influence of android-based digital comics on the social skills to prevent the Covid-19 through student social interaction. *Journal of Educational Science and Technology (EST)*, *8*(3), 180. https://doi.org/10.26858/est.v8i3.37318

Ranting, N. W., & Wibawa, I. M. C. (2022). Media komik digital pada topik sumber energi. *Jurnal Edutech Undiksha*, *10*(2), 262–270. https://doi.org/10.23887/jeu.v10i2.47743

Rina, N., Suminar, J. R., Damayani, N. A., & Hafiar, H. (2020). Character education based on digital comic media. *International Journal of Interactive Mobile Technologies*, *14*(3), 107–127. https://doi.org/10.3991/ijim.v14i03.12111

Sari, Y., Sari, R. P., Sumantri, M. S., & Marini, A. (2021). Development of digital comic for science learning in elementary school. *IOP Conference Series: Materials Science and Engineering*, *1098*(3), 032060. https://doi.org/10.1088/1757-899X/1098/3/032060

Sarkadi, S., & Alghozali, M. I. (2020). Teaching materials of thematic comics in the 2013 curriculum learning in basic schools. *JPI (Jurnal Pendidikan Indonesia)*, *9*(4), 618. https://doi.org/10.23887/jpi-undiksha.v9i4.20908

Schneider, B., Reilly, J., & Radu, I. (2020). Lowering barriers for accessing sensor data in education: lessons learned from teaching multimodal learning analytics to educators. *Journal for STEM Education Research*, *3*(1), 91–124. https://doi.org/10.1007/s41979-020-00027-x

Senen, A., Sari, Y. P., Herwin, H., Rasimin, R., & Dahalan, S. C. (2021). The use of photo comics media: Changing reading interest and learning outcomes in elementary social studies subjects. *Cypriot Journal of Educational Sciences*, *16*(5), 2300–2312. https://doi.org/10.18844/cjes.v16i5.6337

Septaria, K., & Fatharani, A. (2022). Manga versus webtoon: Alternative science learning module based on Dr Stone. *Jurnal Inovasi Pendidikan IPA*, *8*(1), 11–22. https://doi.org/10.21831/jipi.v8i1.43389

Slavich, G. M., & Zimbardo, P. G. (2012). Transformational teaching: Theoretical underpinnings, basic principles, and core methods. *Educational Psychology Review*, *24*(4), 569–608. https://doi.org/10.1007/s10648-012-9199-6

Soetopo, S. (2015). Pembelajaran seni di sekolah dasar. *Jurnal Inovasi Sekolah Dasar*, *2*(1), 25–32.

Sugiyono, S. (2021). *Metode penelitian kuantitatif, kualitatif, dan R&D* (Cetakan Ke-3, 2021). Afabeta.

Suryadi, A. , Darmawan, D. , Rahadian, D. , Wahyudin, D. , & Riyana, C. (2022). Pengembangan aplikasi sistem database virtual community digital learning nusantara (VCDLN) menggunakan model waterfall dan pemrograman terstruktur. *Jurnal PETIK*, *8*(1), 48–56. http://dx.doi.org/10.31980/jpetik.v8i1.1424

Suyanto, & Gio, P. U. (2017). *Statistika nonparametrik dengan SPSS, Minitab, dan R*. Medan: Usu Press.

Swandi, W., Pageh Wibawa, A., Yoga, G., & Pradana, K. (2020). The digital comic Tantri Kamandaka: A discovery for national character education. *International Journal of Innovation, Creativity and Change, 13*(3), 718-732. https://repo.isi-dps.ac.id/3740/1/Jurnal%20Internasional.pdf

Syafril, S., Yaumas, N. E., Engkizar, E., Jaafar, A., & Arifin, Z. (2021). Sustainable development: Learning the Quran using the tartil method. *Al-Ta Lim Journal*, *28*(1), 1–8. https://doi.org/10.15548/jt.v1i1.673

Taqiyyah, F. (2023). Learning crafts to support the creativity of elementary school. *ArTiES: International Journal of Arts and Technology in Elementary School*, *1*(2), 55–060.

Terlouw, G., van 't Veer, J. T., Prins, J. T., Kuipers, D. A., & Pierie, J.-P. E. N. (2020). Design of a digital comic creator (It's Me) to facilitate social skills training for children with autism spectrum disorder: Design research approach. *JMIR Mental Health*, *7*(7), e17260. https://doi.org/10.2196/17260

Wibowo, S. A., & Koeswanti, H. D. (2021). Pengembangan media pembelajaran berbasis komik untuk meningkatkan karakter kemandirian belajar siswa sekolah dasar. *Jurnal Basicedu*, *5*(6), 5100–5111. https://doi.org/10.31004/basicedu.v5i6.1600

Wicaksono, A. G., Jumanto, J., & Irmade, O. (2020). Pengembangan media komik komsa materi rangka pada pembelajaran IPA di sekolah dasar. *Premiere Educandum : Jurnal Pendidikan Dasar Dan Pembelajaran*, *10*(2), 215. https://doi.org/10.25273/pe.v10i2.6384

Widodo, S. A. , & Wahyudin. (2018). Selection of learning media mathematics for Junior School Students. *Turkish Online Journal of Educational Technology*, *17*(1), 154–160.

Wolski, M. (2020). Type in pictures. Comic book lettering in contemporary American comics. An overview. *Kultura Popularna*, *60*(2). https://doi.org/10.5604/01.3001.0013.7342

Wulandari, Y., Ruhiat, Y., & Nulhakim, L. (2020). Pengembangan media video berbasis powtoon pada mata pelajaran IPA di Kelas V. *Jurnal Pendidikan Sains Indonesia*, *8*(2), 269–279. https://doi.org/10.24815/jpsi.v8i2.16835

Yusnita, Y., Eriyanti, F., Engkizar, E., Anwar, F., Putri, N. E., Arifin, Z., & Syafril, S. (2018). The effect of professional education and training for teachers (PLPG) in improving pedagogic competence and teacher performance. *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah*, *3*(2), 123. https://doi.org/10.24042/tadris.v3i2.2701