# DEVELOPMENT OF INTERACTIVE DIGITAL COMICS ON SIMPLE PLANE TOPICS ON EMPOWERING STUDENTS' THINKING ABILITIES

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**Abstract:** The purpose of the research was to develop interactive digital comics about simple machines and to investigate the effect for using interactive digital comics in student thinking skills at grade VIII. The hypothesis of this research was that using interactive digital comics in simple machines gave a significant effect to student thinking skills. This type of research was development research, which refers to the Four-D (Define, design, develop, disseminate). The result shows simple machine digital interactive comic is categorized as valid and feasible because of the percentage of expert media judgment is 98.91% and the percentage of expert material judgment is 98.21%. In practicality test, this is indicated by the good response from students with a percentage of 82.44% in the limited trial class and 77.81% in the extended trial class. The Effectiveness, indicated by statistics analyzing the pretest and posttest of control and experimental groups. The test analysis with Wilcoxon test. The Wilcoxon test shows Asymp. Sig (2 tailed) < 0.001 which is less than 0.005 that means the hypothesis is accepted and proven.

**Keywords:** digital interactive comic, thinking skills, 4D

## Introduction

There are 4 principles in 21st century learning skills, namely; students as actors in learning activities, education must be collaborative. Students are taught to work productively with other people, lessons require a context that is appropriate to the students' environmental conditions, schools are integrated with social life (Syahputra, 2018). The principles of learning 21st century skills should be considered so that the quality of learning and updating learning concepts can meet the needs of learning activities. Apart from that, applying the principles of learning 21st century skills will have a positive impact on students. Students are able to be more actively involved in learning, have the ability to think critically and creatively, dare to express opinions and ask questions, and collaborate both in class activities and group collaboration. As a result, students develop skills to meet the demands and challenges of the 21st century.

The curriculum used in educational units must respond to changing eras digital, where science and technology are developing rapidly, and require mastery of 21st century skills such as creativity, critical thinking, communication and collaboration. With the government announcing the independent curriculum as the official curriculum for use. The aim of the Merdeka Curriculum is to encourage the expansion of education in Indonesia through diverse intracurricular learning. In its application, the independent curriculum emphasizes fun, independent, active, individual and meaningful learning

The Pancasila student profile is a product of the independent curriculum where graduates have the character and ability to uphold the noble values of Pancasila. There are six aspects in the Pancasila student profile, namely, 1. devotion to God Almighty, and noble morals, global diversity, mutual cooperation, independence, creativity and critical reasoning. The Pancasila Student Profile is a description of achievements or graduates who have the character and abilities to uphold the noble values of Pancasila. This is included in literacy and numeracy skills so that students can use these skills in everyday life (Hamdi, Triatna, & Nurdin, 2022).

Based on the characteristics of these explanations, media that supports achieving literacy and numeracy skills is very necessary in order to empower students' thinking abilities. Learning media are tools that help the learning process become easier and more efficient. The function of learning media is to organize and direct educators to convey messages and materials to the recipients of the message, namely students. The use of media helps students to absorb material into students' cognitive thinking skills and stimulates them to use it (Lemi, 2019)

Media is all the equipment used in learning activities to convey information and stimulate students' thoughts and feelings so they can process the information well. The scope of learning media in question includes: materials, tools and channels used to support learning activities (Mashuri, 2019)

Comics as a learning medium can combine text, images and animation to convey the message of the learning material so that students find the learning material easy. This makes it easier for students to achieve their academic and learning goals (Khotimah & Hidayat, 2022). In natural science learning activities, comics are very useful as a learning medium. (Listianingsih, Astuti, Dasmo, & Bhakti, 2021).

The benefits of using comics in natural science learning activities are explained by increasing good understanding of concepts in science learning and can improve science process skills. Based on expert statements, it can be clarified that the use of comic media in science learning can help students achieve learning outcomes which can be cognitive understanding (H, Casumpang, C, & Enteria, 2019).

Thinking ability can be determined based on the percentage of achievement of the value obtained. The percentage categories of thinking ability are as follows; $81 \leq n \leq 100$ very high, $61 \leq n \leq 80$ high thinking ability, $41 \leq n \leq 60$ moderate ability, $21 \leq n \leq 40$ low ability, $0 \leq n \leq 20$ very low ability (Ma'rifah & Mawardi, 2022)

Thinking means manipulating or processing and changing information in memory.

All this information is used to form concepts, reason logically, make decisions, think creatively, and solve problems (Santrock, 2008). Thinking is the mental activity of managing information to develop understanding, synthesis, and draw conclusions.

Thinking is a human activity that involves the cognitive process of obtaining all types of information in order to decide on appropriate action for a problem (Lismaya, 2019).

Bloom's taxonomy of remembering, understanding and applying includes the level of basic thinking skills (Lower Ordinary Thinking Skill). Analyzing, evaluating, creating are included at the level of complex thinking (Higher Ordinary Thinking Skill). By providing questions with complex thinking models, it is hoped that it can have a good impact on students' potential (Herman, Akbar, & Alman, 2024)

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With the existence of interactive digital comic materials that are valid and practical, it is hoped that students' thinking abilities will increase. Seventh researchers look at media validity from the aspect of content suitability; (2) language appropriateness; (3) appropriateness of presentation; and (4) graphic feasibility (Siregar & Harahap, 2020). To see the practicality of comic media, researchers looked at the material, benefits and media aspects (Angga, Sudarma, & Suartama, 2020). To see cognitive abilities, researchers adjusted to Bloom's taxonomy of the material to be taught.

## Methods

This research method is development research following the 4D model. The first stage is define which aims to determine learning conditions. Starting with front-end analysis, student analysis, task analysis, concept analysis, and formulating learning objectives. Next is the design stage which aims to prepare test references and select media that suit the purpose of delivering the material. The next stage is Development. This stage includes: Expert validation of the tools, including revisions, simulations, especially curriculum operationalization, and limited trials with real students. The final stage is Disseminate to explore the use of the device on a larger scale (Sutarti & Irawan, 2017)

This research uses a quasi-trial model with a nonequivalent control group research design. (Dantes, 2023) explains the nonequivalent control group design as follows;

O1  X  O2
———————————
O3  -  O4

Di mana:

O1 : *pre test* kelompok eksperimen
O2 : *post test* kelompok eksperimen
O3 : *pre test* kelompok pembanding
O4 : *post test* kelompok pembanding
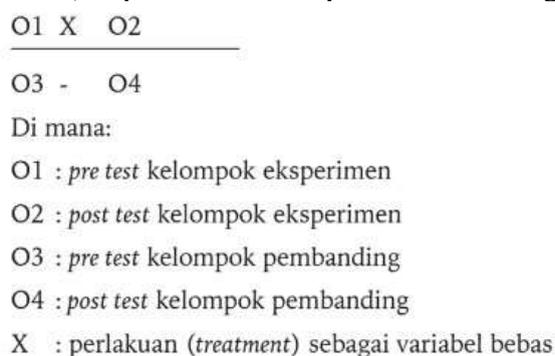X  : perlakuan (*treatment*) sebagai variabel bebas

Figure 1 Nonequivalent control group design

In this study, a purposive model was used. The respondents involved in this research were 86 students for needs analysis, 2 validators for validating the comic model, 7 students for small group trials and 20 students for limited scale trials. In this research, the instrument used to test validity was an expert validation questionnaire. To obtain practicality values, a questionnaire instrument was used to see student responses in using interactive digital comics. Data related to effectiveness was obtained through pretest and posttest data. The response questionnaire and test questions have been tested for validity and reliability through direct testing on 30 students and analyzed using SPSS.

**Table 1:** Media Expert instrument grid

| Criteria | Indicator | Question Number |
|---|---|---|
| | | |

| I. Aspect Content Eligibility | A. Conformity of material with SK and KD | 1,2,3 |
|---|---|---|
| | B. Accuracy of Material | 4,5,6,7,8 |
| | C. Update of Material | 9,10 |
| | D. Encourage Curiosity | 11,12 |
| II. Feasibility Aspect Presentation | A. Learner Presentation Techniques | 13,14 |

Table 2: Instrument grid Expert method

| Criteria | Indicator | Question Number |
|---|---|---|
| I. Graphic Feasibility Aspects | A. Comic Cover Design<br>B. Comic Content Design | 1.2.3.4,5,6,7,8<br>9,10,11,12,13,14,15 |
| II. Feasibility Aspect Language | A. Straightforward, Communicative, Dialogic | 16,17,18,19 |
| | B. Suitability to student development. | 20,21 |
| | C. Conformity to Language Rules. | 22,23 |

Table 3: Student Response Questionnaire Grid

| Criteria | Indicator | Question Number |
|---|---|---|
| Student Response | Material Benefit Media | 1,2,3,4 5,6,7,8 9,10,11,12 |

Instrument analysis for questionnaire and questionnaire data uses qualitative descriptive analysis methods and quantitative descriptive methods. This method is used to process data from the results of learning material experts, learning media, small group trials and large group trials. Media validity follows the following criteria; 80% - 100% very good criteria, 80% - 100% good criteria, 50% - 59% sufficient criteria, 0% - 49% poor criteria. Media practicality follows the following criteria; 81%-100% Very Good or very practical. 61%-81% good or practical. 41%-60 % Sufficient or not practical. 20%-40% less or impractical. 0%-19% very less very impractical.

Statistical tests are carried out to see the distribution of the data that has been obtained, namely that it is distributed normally. Then proceed with the Pair Sample t-Test for parametric statistics or the Wilcoxon Test for non-parametric statistics. Then a univariate test was carried out. As for the following hypothesis;

H0: The use of interactive digital comics does not have a significant effect on students' thinking abilities

H1: The use of interactive digital comics has a significant effect on students' thinking abilities.

The conclusions drawn if using paired sample t-Test are as follows; If the significance value is > 0.05 then the null hypothesis is accepted, and the research hypothesis is rejected.

If the significance value is <0.05 then the null hypothesis is rejected and the research hypothesis is accepted.

Conclusions drawn using the Wilcoxon Test are as follows; If asymp sig (2 tail) > 0.05 then the null hypothesis is accepted, and the research hypothesis is rejected. If asymp sig (2 tail) < 0.05 then the null hypothesis is rejected and the research hypothesis is accepted

## Results and Disscusion

At the development stage, researchers developed an interactive digital comic prototype by paying attention to media development theory and revisions from experts. In expert validation there were 23 statements related to cover design, comic content design, language, suitability to student development, linguistic rules. The following is a display of the comic cover, materials, interactive quiz at prototype stage 1.

**Picture    2 Cover Design**



**Picture    3 Interactive Quiz Design**



**Picture    4Content DesignStory**

With this comic appearance, media experts provide revision feedback in the form of; At the beginning of the comic, a pretest is added, and at the end of the comic, a posttest is added. In addition, media expert feedback is that menus for operations should be added such as back and continue menus. Thus, in the second prototype, the researcher made revisions, resulting in a comic appearance like the following image;



**Picture    5Revised Cover View**



**Picture    6Qadream  Comic**



**Picture    7RevisionPosttest**



**Picture    8 RevisionPretest**



**Picture    9 RevisionInteractive Quiz**

In the second prototype, the researcher revised the appearance of the cover, navigation buttons and added pretest and posttest so that there was an increase in the validation presentation of interactive comic media. The following is a tabulation of data from media experts from prototype 1 to prototype 2;

Table 4 Media Expert Validation Results

| Indicator | Prototype 1 | Prototype 2 |
|---|---|---|
| Comic Cover Design | 50% | 100% |
| Comic Content Design | 92% | 100% |
| Language that is straightforward, communicative and dialogical | 87% | 93% |
| Suitability of Student Development | 100% | 100% |
| Compliance with spelling rules | 100% | 100% |

Prototype 1 has a validation value of 78.28% while Prototype 2 after revision, has a validation rate of 98.91%. Thus, based on media expert validation, it can be reiterated that interactive digital comic media is suitable for use as a learning medium.

The material in interactive digital comics is a simple plane. Validation of material experts to see the suitability of the material in comics and the basic competencies being taught. In material expert validation there are 5 indicators with 15 statements. The following is a tabulation of data on the achievement of material expert validation aspects;

Table 5 Percentage of Material Expert Validation

| Indicator | Results |
|---|---|
| Material suitability | 100% |
| Material accuracy | 100% |
| Update | 100% |
| Curiosity | 87.5% |
| Presentation | 100% |

Overall, the validity of interactive digital comic material is 98.21%, thus it can be reaffirmed that interactive digital comics in terms of material are suitable for use in learning activities. In a small group test of 7 people. When finished using the media, students must answer a questionnaire regarding the practicality of interactive digital comic media. There are 3 indicators, namely material, benefits and media. The questionnaire consists of 12 questions. The following is a tabulation of the achievements of each indicator in the small and large groups;

Table 6 Practicality Test Results for Small Groups and Large Groups

| Indicator | Achievement | |
|---|---|---|
| | Small Group Test | Large Group Test |
| Number of Respondents | 7 students | 20 Students |
| Material | 83.03% | 75.93% |
| Benefit | 83.03% | 82.18% |
| Media | 83.9% | 75.31% |
| Practicality Percentage | 82.44%. | 77.81%. |

Overall, based on the small group test, it can be seen that the achievement of the material indicators in the questionnaire is 83.03%, for the benefit indicators it is 83.03%, and for the media indicators it is 83.9%. Thus, the percentage of practicality for small group trials is 82.44%. With a percentage of 82.44%, interactive digital comics proved practical in small group tests.

`      The next stage is a large group test, this test is carried out after testing effectiveness through tests. Questionnaires were distributed to 20 trial class students who had taken the pretest and posttest. The results of the large group test showed that the achievement for the material indicators in the questionnaire was 75.93%, for the benefit indicators it was 82.18%, for the media indicators it was 77.81%. Thus, the percentage of practicality for large group trials is 77.81%. With a practicality percentage of 77.81%, interactive digital comics have been proven practical through large group tests

In the following stage, an effectiveness test will be carried out regarding students' cognitive abilities obtained from the students' test results. The test results were tested for normality with the SPSS display as follows;

Table 6 Normality test of data Tests of Normality

| Class | | Kolmogorov-Smirnov | | | Shapiro-Wilk | | | |
|---|---|---|---|---|---|---|---|---|
| | | Statistics | df | Sig. | Statistics | df | Sig. | |
| Results | Pretest-Trial test | ,279 | 20 | ,000 | ,699 | 20 | ,000 | |
| | Posttest-Experiment | ,172 | 20 | .124 | ,918 | 20 | ,092 | |
| | Pretest-Control | ,202 | 20 | .031 | ,897 | 20 | ,036 | |
| | Posttest-Control | ,164 | 20 | ,162 | ,919 | 20 | ,093 | |

a. Lilliefors Significance Correction

Based on this table, it is shown that the Kolmogoroof Smirnov pretest sig value for the experimental class is o.ooo with the posttest sig value for the trial class 0.124. The pretest sig value for the control class was 0.031 and the posttest sig value for the control class was 0.162. This means that the sig value is > 0.05, so the data is not normally distributed, so the non-parametric Willcoxon test is used for statistical analysis.

Based on the results of the normality test, the pretest and posttest data for the control and trial groups will be analyzed using non-parametric statistics because the data is not normally distributed. Data will be analyzed using the Wilcoxon test. The following are the results of the Wilcoxon test with spss;

**Ranks**

| | | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Posttest_Eksperiment - Pretest_Eksperiment | Negative Ranks | 0[a] | .00 | .00 |
| | Positive Ranks | 20[b] | 10.50 | 210.00 |
| | Ties | 0[c] | | |
| | Total | 20 | | |
| Posttest_Kontrol - Pretest_Kontrol | Negative Ranks | 4[d] | 3.75 | 15.00 |
| | Positive Ranks | 15[e] | 11.67 | 175.00 |
| | Ties | 1[f] | | |
| | Total | 20 | | |

a. Posttest_Eksperiment < Pretest_Eksperiment

b. Posttest_Eksperiment > Pretest_Eksperiment

c. Posttest_Eksperiment = Pretest_Eksperiment

d. Posttest_Kontrol < Pretest_Kontrol

e. Posttest_Kontrol > Pretest_Kontrol

f. Posttest_Kontrol = Pretest_Kontrol

Figure 10 Wilcoxon Rank Table

Based on the ranks table data in the experimental class, there were 20 respondents who were tested. All twenty respondents experienced an increase as seen from the positive ranks of 210. In the control group there were 20 respondents, 15 respondents experienced an increase, 4 respondents experienced a decrease, 1 respondent had the same value. Apart from that, the sum of rank of the experimental group was 210, this value was greater than the sum of rank of the control group of 175. Next, we continued with Asymp analysis. Sig (2 tailed). If Asymp. Sig < 0.05 then the research hypothesis is accepted.

**Test Statistics[a]**

| | Posttest_Eksperiment - Pretest_Eksperiment |
|---|---|
| Z | -3.923[b] |
| Asymp. Sig. (2-tailed) | <,001 |

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Figure 11 Wilcoxon Statistical Test Table

In the statistical test table, the Asymp value. Sig (2 tailed) is < 0.001, this means Asymp. Sig (2 tailed) < 0.005. Thus, Ho is rejected and the research hypothesis is accepted. The research hypothesis is: The use of interactive digital comics on the topic of simple airplanes has a significant effect on students' thinking abilities. Based on these conclusions, it can be reiterated that the use of interactive digital comics on the topic of simple airplanes has an effect on students' thinking abilities. This influence can be seen through the following data distribution on students' thinking abilities;

**Kognitif_Eksperiment**

|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Sangat tinggi | 2 | 2.5 | 10.0 | 10.0 |
|  | Tinggi | 6 | 7.5 | 30.0 | 40.0 |
|  | Cukup | 11 | 13.8 | 55.0 | 95.0 |
|  | Kurang | 1 | 1.3 | 5.0 | 100.0 |
|  | Total | 20 | 25.0 | 100.0 |  |
| Missing | System | 60 | 75.0 |  |  |
| Total |  | 80 | 100.0 |  |  |

Figure 11 Table of Distribution of Thinking Ability in Test Group

**Kognitif_Kontrol**

|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Sangat Tinggi | 1 | 1.3 | 5.0 | 5.0 |
|  | Tinggi | 2 | 2.5 | 10.0 | 15.0 |
|  | Cukup | 5 | 6.3 | 25.0 | 40.0 |
|  | Kurang | 7 | 8.8 | 35.0 | 75.0 |
|  | Sangat Kurang | 5 | 6.3 | 25.0 | 100.0 |
|  | Total | 20 | 25.0 | 100.0 |  |
| Missing | System | 60 | 75.0 |  |  |
| Total |  | 80 | 100.0 |  |  |

Figure 12 Distribution Table of Control Group Thinking Ability

Based on data from the trial and control groups, there were 2 respondents in the group of children who had very high abilities in the trial group and 1 in the control group. The group of children who had high ability to think in the test group consisted of 6 respondents and in the control group there were 2 respondents. The group of students who were grouped as having sufficient thinking skills in the trial group consisted of 11 respondents and in the control group there were 5 respondents. The group of students who were classified as lacking in thinking ability in the experiment amounted to 1 respondent and in the control group there were 7 respondents. In the test group there were no respondents with very low abilities, while in the control group there were 5 respondents with very low abilities.

### b) Discussion

Appropriate learning media is media that meets the following characteristics; in accordance with learning objectives, in accordance with student development, in accordance with the skills of teachers and students as users, and adapting to school situations. These things must be considered in using the learning environment so that learning becomes more interesting and interactive (Miftah, 2022).

The validity of comics as a medium is due to the fulfillment of comic elements related to the layout and typology of comic writing. Comics as a learning medium must fulfill the following elements; panels frame images and text, trenches connect panel boxes to form an interesting and imaginative storyline, comic illustrations can describe events or feelings. events, people or objects, word balloons are a form of image that contains character conversations (Batubara, 2020)

The validity of comics in terms of media is because interactive comics can make it easier to convey concepts related to presentation so that students can quickly understand the material being

studied, learning media can open up new experiences in students' learning, seen through updating and a sense of curiosity. Apart from that, learning media functions. to concretize concepts and the efficiency of learning time can be seen through the suitability and accuracy of the material (Mashuri, 2019)

With a material validation level of 98.21%, it means that interactive comics can confirm concepts in science learning (Zulen, Silvia, & Jannah, 2022) and can convey the message of learning material because they are a combination of text, images and animation so that it is easier for students to understand. learning materials (Khotimah & Hidayat, 2022)

Interactive digital comics are a medium that is practical to use, this is because one of the benefits of comics is that they are a learning medium that can be used online or offline. This supports the practical aspect of learning media. In developing learning media, it is necessary to pay attention to ease of media access, media access costs, use of technology in learning media, availability of interactive media, media facilities and infrastructure, and newness of the media. This is important because the aim of developing interactive media is to increase students' motivation and interest in learning, increase understanding of learning material, improve students' skills in using technology, and improve thinking abilities (Arifannisa, Yuliasih, and Hayati, 2023).

In developing the media used in learning activities, educators must be able to present innovative learning media that is in line with technological advances. Learning media that is easy to use and innovative is one aspect of successful learning. The learning media developed must be designed to be effective and efficient. (Nurfadhillah, 2021) explains that educators should pay attention to the following things when designing learning media: namely simplicity, suitability of teaching materials, easy availability of media raw materials, shapes, pictures, models or diagrams that are easy for educators to use.

The use of interactive digital comic media has an effect on thinking abilities, because the trial group that received treatment using interactive digital comics had a larger number of students in the group of students who had very high, high and sufficient abilities. Apart from that, the number of respondents in the experimental group who were more or less capable than the control group. Thus it can be clarified that the use of interactive digital comics can influence thinking abilities.

Comics as a learning medium, namely because they are a combination of text, images and animation, can convey the message of the learning material and students can more easily understand the learning material. This makes it easier for students to achieve their academic and learning goals (Khotimah & Hidayat, 2022). The advantage of using comics in science learning is that it helps students understand and explain learning material (Listianingsih, Astuti, Dasmo, & Bhakti, 2021). Comic media can explain natural science phenomena and thus help students understand problems related to these phenomena (Priadi & Prabowo, 2023).

Through comics, students are encouraged to explore information from the reading materials provided. Through reading comprehension skills, students can understand the meaning of information, improve their ability to analyze information, and improve their ability to think about the information they receive (Saragih, 2021). Comics can also help develop higher-level thinking skills because they encourage children to think critically and analyze the problems presented (Guntur, Sahronih, & Ismuwardani, 2023).

## Conclusion

The results of the development of interactive digital comic media on the topic of simple airplanes have been validated by media experts using an instrument of 23 statements and produced a validation rate of 98.91%. Furthermore, validation was carried out by material experts using an instrument with 14 statements resulting in a material accuracy level of 98.21%. Thus, interactive digital comic media on the topic of simple planes is valid and suitable for use.

The practicality test was carried out through a small group test and a large group test by answering a questionnaire totaling 12 statements. The small group test produced a practicality level of 82.44%, while the large group test produced a practicality level of 77.81%. Thus, interactive digital comic media on the topic of simple airplanes is considered practical and easy to use.

In the effectiveness test, the Wilcoxon test was carried out with conclusions drawn if Asymp. Sig (2 tailed) < 0.005 then the research hypothesis is accepted. Asymp. The Sig (2 tailed) obtained is <0.001 so the research hypothesis is accepted, while the research hypothesis is that the use of interactive digital comics has a significant effect on students' thinking abilities.

For future researchers, they can develop comics by maximizing the use of VR and AR technology. Next, you can develop a comparative analysis model comparing the effectiveness of two media, between comics and other media

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