Indonesian Journal of Mathematics Education
Vol. 7, No. 1, April 2024, pp: 20~31
p-ISSN: 2654-3907, e-ISSN: 2654-346X
e-mail: ijome@untidar.ac.id, website: journal.untidar.ac.id/index.php/ijome

Development of FlipaClip-Based Learning Media to Improve Problem-Solving Skills

Nila Nifrani[1], Sugeng Sutiarso[1], Rangga Firdaus[1], Ari Suningsih[2*]
[1]Universitas Lampung, Indonesia
[2]Universitas Muhammadiyah Pringsewu, Indonesia
*Corresponding author: ari.suningsih@umpri.ac.id

Abstract

This study aims to evaluate the effectiveness of FlipaClip as a learning media, and to compare the problem-solving abilities of students who learn using FlipaClip and PowerPoint. This study employed the ADDIE development paradigm (Analysis, Design, Development, Implementation, and Evaluate) as a framework for research and development (R&D). The findings demonstrated the validity and viability of learning media that use a contextual approach to linear program content. With extremely valid criteria, the material validation findings came out at 84.38%. The validation results from media experts were 94.79%, which is considered highly valid. Although the student response received an assessment percentage of 83.64%, the response also met the FlipaClip-based learning media's "very interesting" requirements, indicating that it is practical to use. Moreover, the research shows that FlipaClip-based learning media on program material can improve the mathematical problem-solving ability of class XI students. Quantitatively, the difference is shown by the interpretation of *N*-Gain obtained in the experimental class, which is quite an effective category with a percentage of 70.22%. The average mathematical problem-solving ability of grade XI students who are given FlipaClip-based learning media is higher than the average student who is not given the media, as indicated by the results of the independent sample *t*-test, namely the Sig. (2- tailed) value of 0.000 <0.05.
Keywords: FlipaClip, learning media, linear program, problem-solving ability

INTRODUCTION

Education is an absolute necessity in building a nation, especially in education. Education must be given to every individual so that it becomes a basic human need in daily life. Along with time, education has also changed, starting at the elementary school level, secondary school, and even up to college (Malik, Jalal, & Waliyanti, 2022). This is following the objectives of national education based on the National Education System Law number 20 of 2003, namely "National education functions to develop abilities 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 are faithful and devoted to God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens" (Pemerintah Republik Indonesia, 2003).

In addition, according to Hamidah & Setiawan (2019), education is also an important thing to be able to interact in preparing quality human resources, so education must be carried out as well as possible with timely education to achieve learning objectives carried out in the form of a teaching and learning process, where the implementation of the school curriculum through learning activities. One of the fields of education that cannot escape efforts to improve the quality of education is mathematics education, which is a foundation and framework for the development of science and technology. Mathematics not only has a role in the field of education but also in real life (Hamidah & Setiawan, 2019).

Mathematics plays an important role in education and everyday life. This is in line with

the Decree of the Head of Standards, Curriculum and Evaluation of the Ministry of Education and Culture No. 033 / H / KR / 2022 that mathematics is a didactic material that must be understood as a conceptual tool to build and rebuild material, hone and train the thinking skills needed to solve life problems. Mathematics is a universal science that underlies the development of modern technology, has an important role in various disciplines, and advances human thinking (Kemendikbud, 2006). This is in line with Susanto (2013) who said that mathematics is one of the disciplines that can improve thinking skills in solving daily problems and the world of work. Thus, an evaluation is needed to determine students' mathematical problem-solving levels.

Different levels of student understanding require teachers or educators to be more creative in delivering material (Salsabila & Agustian, 2021). Teachers can use learning media at school for learning purposes. Through learning media, teachers are expected to be more creative and innovative in providing learning to students. Learning media is used as a means of teaching and learning in schools to improve the quality of education. Media is a means that can be used as an intermediary that is useful for increasing effectiveness and efficiency in achieving goals (Salsabila & Agustian, 2021)

The materials in mathematics are abstract, one of which is linear program material. Problems regarding abstract linear programs can be actualized by using learning media at the stage of observing problems in everyday life or contextual. Learning media can also present material that can arouse students' curiosity and stimulate students to react physically and emotionally.

The modern era, characterized by the rapid development of information and communication technology has, had a major impact on the world of education (Yoga, 2018). The Internet has now become an alternative learning resource. Students can use it anytime and anywhere without being limited by time and space. Learning is now flexible, not necessarily demanding a standard pattern of teacher and student meetings in class and at a certain time. This means that learning media can be used as a means of indirect learning and can be viewed repeatedly by students anywhere and anytime.

Learning media is also expected to be online and varied with offline media. Currently, the learning media commonly used by teachers are print and electronic media. However, a teacher, always strive to continuously develop their abilities and competencies, especially when choosing and using diverse and quality learning media.

Electronic learning media, such as animation, can be an alternative to learning. The animation media that can be used is FlipaClip learning media. 2D animation learning media is the result of combining several image frames with supporting sounds. According to Nastiti, Mustaziri, & Tompunu (2021), Motion graphics is a type of 2D animation, a combination of fine art and photography to move. Then, according to Neto et al., (2019) FlipaClip is a 2D animation media with images created by themselves or uploaded results by creating animations, simply creating images frame by frame like using a physical notebook.

This application provides the option to display outlines beforehand, facilitating the sequence of illustrations and stimulating students' creativity to create simple drawings. FlipaClip learning media is a learning media in the form of 2D animation. The advantage of FlipaClip-based learning media is that it has quite complete features. Some of them are the onion layer, timeline, and frame setting. Using these features, teachers can create simple animations practically through their cell phones. The use of FlipaClip as a learning media can help students understand the subject matter well and fun. That is, by utilizing FlipaClip, teachers will be more creative, both in preparing the content of the subject matter and presenting the animation, as well as in interacting with students.

FlipaClip learning media has many advantages. According to Neto et al. (2019)),

there are several advantages of using FlipaClip learning media, including allowing students to learn more complete material in a longer time and, of course, a more pleasant atmosphere. Students can learn anywhere and anytime, which differs from traditional classroom lectures. This study will study the development of FlipaClip-based learning media to improve student learning outcomes. This FlipaClip learning media is expected to foster an understanding of the problem, develop a strategy or solution plan, solve the problem according to the plan made, and re-examine the answer as a problem-solving characteristic. Therefore, the authors want to develop FlipaClip learning media to improve students' problem-solving skills.

Mathematical ability is the ability to deal with problems in mathematics and real life. One of the goals of learning mathematics is to develop students' mathematical abilities. The objectives of learning mathematics formulated according to the National Council of Teachers of Mathematics (NCTM, 2000) are: (1) Learning to communicate; (2) Learning to reason; (3) Learning to solve problems; (4) Learning to link ideas; (5) Learning to present ideas. From these learning objectives, it can be seen that problem-solving is one of the abilities students must master to achieve learning objectives.

Problem-solving skills are crucial for every student because problem-solving is a common goal of teaching mathematics. Problem-solving, which includes methods, procedures, and strategies, is a core and main process in the mathematics curriculum. In line with the opinion of Andriani & Nurjaman (2018), the most basic ability in mathematics learning activities is problem-solving.

Problem-solving ability is a high-level ability that students must master. However, only a few students can solve problems. This can be seen from the statement of Heryani and Ramadani (2019) that problem-solving ability is classified as a high-level thinking ability for solving problems in the form of non-routine problems. Until now, mathematical problems are still felt to be "difficult" by students in the process of solving them, so not many students can do problem-solving even though they are required to solve mathematical problems until they find the right answer to the problem (Simalango, Darmawijoyo, & Aisyah, 2018). Problem-solving is a process of overcoming difficulties encountered to achieve a desired goal. Problem-solving can be interpreted using a general interpretation, namely, problem-solving as a goal, problem-solving as a process, and problem-solving as a basic skill (Sumartini, 2016).

The results of observations at a public senior high school in Pringsewu, Lampung, Indonesia, also revealed that one of the materials that are difficult for students to understand in class XI is the Linear Program. This material is related to constraints, objective functions, solution areas, determining the optimum value, and making conclusions. The optimum value can be determined using the corner point test and the crosshairs methods. Linear program is an applied science that is very useful and widely used. A linear program is a method used to solve optimization problems. In other words, a linear program is a technique for obtaining an objective function optimum value (maximum or minimum) within certain constraints. Optimum value knowledge is pivotal and is widely used in mathematics and everyday life activities, making it in the form of story problems (Syahputra, 2015).

Linear program material is always related to story problems that cannot be separated from activities related to mathematics or everyday life. It is always used to find the optimum value (maximum and minimum) according to the stages of solving linear program problems.

Most teachers at the school use a conventional learning approach, namely explaining material in front of students and giving assignments for students. Based on observations made at a public senior high school in Pringsewu, the teaching materials used are only in the form of student worksheets and textbooks. This implies the lack of use of innovative learning media. Only a few of the

teachers use learning media using PowerPoint. This teaching system causes boredom, which students experience due to the use of technology and learning media modifications that have not been maximized. This impacts on the lack of students' mathematical problem-solving skills, especially in Linear Program material.

The results of this study are expected to provide a comprehensive picture of FlipaClip's contribution to improving the quality of learning. Through a strong theoretical foundation, consistent methodology, and in-depth data analysis, this study's results are hoped to significantly contribute to developing technology-based learning media in education. In addition, this research is expected to enrich the literature on the development of technology-based learning media in education.

METHODS

Research and Development (R & D) is the research design used in this study. The project aims to create FlipaClip educational materials that enhance problem-solving abilities using a scientific methodology. This study design is based on the ADDIE instructional development paradigm. Analysis, design, development, implementation, and evaluation are the five phases of development in Branch's (2009) ADDIE development paradigm. The stages of ADDIE are displayed in Figure 1.

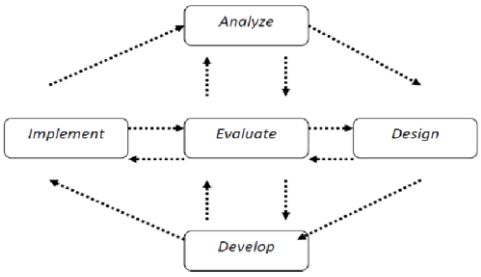

Figure 1. ADDIE Stages

This study on class XI linear program content was carried out at a public senior high school in Pringsewu, Lampung, Indonesia. This study's topic was divided into two phases, specifically: 1) Small group trial subjects. Six grade XI students who had taken linear program content outside the control and experimental classes served as participants in the small group trial stage. In order to gather information on the effectiveness of FlipaClip learning materials based on a scientific methodology to enhance linear program problem-solving abilities, an initial field study was conducted. 2) Field trial subjects: XI students from two classes—the experimental class and the control class—were the subjects of the field test. Random sampling was used in this study's subject selection process. There were learning activities in both classes and two sessions for pretests and post-tests. A pretest-post-test experimental control group design was employed in the study.

This study used two different kinds of instruments: test and non-test instruments. Non-test tools included media validation sheets, learning device validation sheets, teacher and student response questionnaire sheets, and interview guidelines for gathering information on the educational process. Simultaneously, a test of math problem-solving skills in the form of description questions was incorporated into the instrument. Both the experimental group and the control group received this test instrument. While the control class used PowerPoint (PPT) materials, the experimental class used FlipaClip media.

Field tests on research subjects were conducted using test instruments deemed valid, trustworthy, and they have a good degree of difficulty and differentiating power. The effectiveness of the FlipaClip learning materials was assessed by a problem-solving ability test, the results of which were derived from two tests—the pretest and the post-test. Furthermore, statistical tests were conducted on the average value of *N*-Gain in the experimental and control classes to ascertain the effectiveness of the FlipaClip learning media's results in enhancing the ability to solve linear program problems.

RESULTS AND DISCUSSION

The ADDIE instructional development model guides this research design. The results of the five stages of development carried out in this study were described in the following.

Analysis

In this analysis stage, the researcher analyzes the problems that occur based on observations made at the school, where the teaching materials used are only in the form of student worksheets and package books that refer to mathematics learning related to Linear Program material. Most of the teachers at the school used a conventional learning approach, namely explaining in front of students and giving assignments that students must complete.

This also implies the lack of use of innovative learning media. Only a few of the teachers use learning media using PowerPoint. This teaching system causes boredom experienced by students due to the use of technology and learning media modifications that have not been maximized. Ultimately, it cannot maximize students' mathematical problem-solving skills, especially in Linear Program material. This is in line with the opinion (Zaini & Marsigit, 2014) that learning mathematics with a conventional approach is ineffective regarding students' mathematical reasoning and communication skills. Meanwhile, Hodiyanto, Darma, & Putra (2020) said that learning media affects students' mathematical problem-solving ability.

The learning media used in the school are Student Worksheets and package books. The development of technology is currently accelerating so fast, penetrating all sectors of education. According to Simbolon & Purba (2023), using printed teaching materials does not follow one of the implementations of the 2013 Curriculum, namely the use of technology-based media. So, technology-based media or teaching material is needed to make students an active subject by implementing an independent curriculum. FlipaClip-based learning media contains output in visual videos utilizing attractive animated image designs. This media is made using a laptop or Android and can be accessed through Google or the Play Store.

Design

After analyzing the objects and subjects in the study, the next step is to design a FlipaClip-based learning media. There are several stages or steps in making this design, including the following.

Fisrt, creating a learning media framework that will be used to deliver of FlipaClip-based learning materials. The structural framework in question includes theme design, musical accompaniment, symbols related to material, animation, menus contained in the media, character selection, and naming FlipaClip-based learning media. Furthermore, determining the order of presentation of material, which includes the initial appearance, learning outcomes, learning objectives, subject matter (Linear Program), examples, and problem-solving. The learning outcomes were Concept and Types of Linear Programs, Equality of two Linear Programs and Linear Program Transpose and Linear Program Operations (Addition, Subtraction, Scalar Multiplication on Linear Programs and Multiplication of two Linear Programs).

Next, prepare materials related to Linear Program material to improve students' mathematical problem-solving skills. The references to compile materials include Learning Process Plans and syllabuses. Then, making FlipaClip-based learning media in the form of videos that have been completed in the form of 3 videos to be tested at the next stage. Figure 2 and 3 are some views on the FlipaClip application that has been designed.

Figure 2. Flipaclip App Home Page

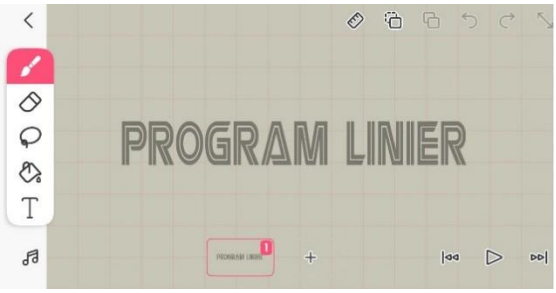

Figure 3. Design Stage on Flipaclip Application

Development

At this stage, the results of the learning media design have been developed in the form of learning videos related to Linear Program material. The three videos produced can be accessed through links, including linear program part 1: https://youtu.be/gPB_MFZh0AQ; linear program part 2: https://youtu.be/lbiVdf_uqyo; linear program part 3: https://youtu.be/eab12b6lE3g. Validators, specifically material and media expert validators, are evaluated at this point in the creation process. The following is a description of the precise development steps:

First step: Three people administered the material expert test: a high school math instructor, two lecturers acting as material experts, and one validator. Five questions on the validation sheet instrument include mathematical problem-solving techniques and the acceptability of the material content. The material expert validation results are shown in Table 1.

Table 1. Material Expert Validation

No.	Assessment Aspect	Score	%	Category
1.	Content	20	87.5	Highly Valid
2.	Problem-Solving Ability	15	81.25	Valid
	Average		84.38	Highly Valid

The value obtained from the validation data by the media expert validator is known that the results of the media expert validation cumulatively get an average percentage of 84.38% with the criteria "Highly Valid". These results conclude that the material on FlipaClip-based learning media for improving mathematical problem-solving skills is suitable for teaching material and tested on students.

Step Two: It was conducted the expert judgement of the media by two experts. This step was conducted to determine the feasibility of the product as a FlipaClip-based learning media. This validation test sheet has 12 statement items consisting of three aspects: language suitability, program appearance, and program effectiveness. A recapitulation of the results of the media expert test of FlipaClip-based learning media in improving mathematical problem-solving skills can be seen in Table 2.

Table 2. Media Expert Test Results

No	Assessment Aspect	Sco	%	Category
1.	Language	14	100	Highly Valid
2.	Program Display	42	87.5	Highly Valid
3.	Program Effectiveness	15	96.88	Highly Valid
	Average		94.7	Highly Valid

The value obtained from the validation data by the media expert validator is known that the results of the media expert validation cumulatively get an average percentage of 94.79% with the criteria " Highly Valid". It can be concluded that the FlipaClip learning media feasible for use.

Step Three: Test instrument test, carried out to develop problem-solving ability assessment instruments to measure student performance from the attitude, knowledge, and skill domains. The results of the analysis obtained in the development of assessment instruments on test instruments include (1) test grids that are adjusted to the competency indicators to be observed by the answers given by students, (2) test questions, and (3) answer descriptions along with scoring given based on the specified answers. Furthermore, the analysis is based on the problem-solving ability of the students, based on the components of their answers, in solving the problem later.

One of the validities used in the research is content validity testing, which is for instruments in the form of tests. Then, content validity testing can be done by comparing the instrument's content with the subject matter stated following the basic competencies and indicators measured and based on teacher assessment. The technique used to test empirical validity was carried out using the product moment correlation formula in Table 3.

Table 3. Validity Test Results

Item Number	*r*-count	*r*-table	Decision
1	0.965	0.3246	Valid
2	0.971	0.3246	Valid
3	0.940	0.3246	Valid
4	0.961	0.3246	Valid
5	0.936	0.3246	Valid

Based on the calculation results in Table 3, the validity through the product moment correlation formula can be concluded that each item on the research test instrument is said to be valid because the *r*-count value of all question items is greater than *r*-table value.

The next test is reliability, which is used to show the consistency of a test. A test is reliable if it gives fixed or consistent results, and if it changes, the change is insignificant. In this study, the reliability test results of the calculation of the r_{11} value of 0.976, and it can be concluded that the r_{11} position is at $0.81 \leq r_{11} \leq 1.00$. So, based on the criteria, all items in this study have very high criteria.

The next item analysis is the difficulty level; the question can be seen in the criteria for difficulty level criteria, $p < 0.30$ difficult question criteria, $0.30 < p \leq 0.70$ medium question criteria, $p > 0.70$ easy question criteria. The results of the calculation and guided by the criteria for the level of difficulty obtained decisions as in Table 4.

The next aspect was the distinguishing power of the items, based on the results of the overall calculation in the range 0.20 to 0.40. Thus, the items in the overall test questions are in the sufficient category range.

Table 4. Level of Difficulty Index Values

Item Number	Index Values	Decision
1	0.469	Medium
2	0.469	Medium
3	0.469	Medium
4	0.476	Medium
5	0.476	Medium

Step Four: After the development product is declared valid, the next product testing is carried out, including small and large group trials. Small group trials were conducted with 12 students to determine the attractiveness of FlipaClip-based learning media to improve students' problem-solving skills on the Linear Program material developed. The assessment was carried out on students by filling out a student response questionnaire, and then the data was collected and analyzed. The questionnaire results from 11 question items given to students obtained a percentage assessment of 83.64% with the criteria "Very interesting".

After the product was improved by criticism, suggestions, and input from teachers and students, a large group trial compared learning using FlipaClip media with learning often done by teachers using PowerPoint as a learning medium. Learning was conducted for class XI A as the experimental class and class XI B as the control class at the school. Learning was conducted for four weeks (October 2 to October 23, 2022) with the following activities: (1) Meeting 1: introduction, initial pretest of material delivery and learning exercise 1 (Video 1); (2) Meeting 2: material delivery and learning exercise 2 (Video 2); (3) Meeting 3: material delivery and learning exercise 3 (Video 3); and (4) Meeting 4: final post-tests and acknowledgments. The assessment criteria assume that a value of $0 < N \leq 40$ is very poor, $40 < N \leq 55$ is poor, $55 < N \leq 70$ is quite good, $70 < N \leq 85$ is good, and $85 < N \leq 100$ is very good. Based on the results of the learning activities carried out, the results of the pretest and post-test scores in the control class and experimental class are described in Table 5.

Table 5. Results of Pretest and Post-test

Description	Control		Experiment	
	Pretest	*Post-test*	*Pretest*	*Post-test*
Average	39.07	58.32	47.19	84.13
Max	50	71	60	93
Min	29	45	31	74

Table 5 shows the results of 37 students in the control group and 37 students in the experimental group can be seen. In the control group, the pretest average was 39.07, included in the criteria for not being good enough. After getting treatment PowerPoint media, the average post-test value is 58.32, with fairly good criteria. In the experimental group, the pretest average value of 47.19 is included in the criteria, which is not good enough. After getting treatment through FlipaClip media, the average post-test value is 84.13, with good criteria.

Step Five Evaluation: The assessment stage is the last. At this stage, a summative assessment is carried out to evaluate the overall development process and results. Two tests were carried out, namely prerequisite and hypothesis tests.

Prerequisite tests carried out include normality tests and homogeneity tests. Normality test using Kolmogorov Smirnov. Obtained a Sig value. Kolmogorov Smirnov's value in the experimental class was 0.133> 0.05, while in the control class, it was 0.058> 0.05. Based on the decision-making criteria in the normality test, it can be concluded that the data is normally distributed. The homogeneity test is used through the ANOVA test. The calculation results obtained a sig value. > 0.05 (0.567 > 0.05), it is concluded that the variants of the two groups are the same. This fulfilled the basic assumption of homogeneity.

The hypothetical test is administered following the completion of the prerequisite test. This test uses the n-gain score values from the two courses to determine whether there is a significant difference in the mathematical problem-solving skills in the control and experimental classes. This test is conducted if the information gathered from both classes is regularly distributed. The researcher employed the SPSS software and the t-test for the test. H0 is rejected and H1 is accepted in light of the test results (provided in the significance section 2-tailed) of 0.000, which is less than 0.05. Therefore, it can be said that in Linear Program material class XI, studying with FlipaClip-based learning media is more effective than traditional learning in enhancing mathematical problem-solving skills.

Additionally, using the Linear Program material, the *N*-Gain formula is derived using the data on the mathematical problem-solving performance of the students in the experimental and control classes. In order to ascertain the degree of progress the students had experienced, the pretest and post-test data were evaluated for *N*-gain. Additionally, the average *N*-gain score results are evaluated to provide answers to questions about how well FlipaClip learning materials help students develop their ability to solve mathematical issues. At this point, the *t*-test of two independent samples uses the *N*-gain score results.

The estimated effectiveness determines the statistical data of the *N*-Gain score related to students' mathematical problem-solving ability. If the *N*-Gain score is less than 40, it is less effective; if it is between 40 and 55, it is quite effective; and if it is over 70, it is effective. Table 6 displays the *N*-Gain score data for the students in the experimental class and the control class.

Table 6. *N*-Gain Results

Description	*N*-Gain			
	Control		Experiment	
	Total	Description	Total	Description
Average	31.77	NE	70.22	NE
Max	42.11	LE	87.5	E
Min	0.18	NE	53.33	LE

Note: E: Effective; LE: Less Effective; NE: Not Effective

Based on Table 6, the *N*-Gain value can be seen in the control and experimental classes. It can be concluded that the *N*-Gain value in the control class averages 31.77% or is considered ineffective. While in the experimental class, the *N*-Gain value had an average of 70.22% or was rated effective.

Analysis of Students' Problem-Solving Ability

Analysis of students' problem-solving skills includes students' ability to (1) Understand the problem, (2) Develop a strategy or solution plan, (3) Solve the problem according to the plan that has been made, and (4) Recheck the answer. Analysis of problem-solving ability is done by reviewing the suitability of the results of written answers to the problem-solving ability questions given from the experimental class to the problem-solving ability of each problem. Students' answers to questions number 1 to 5 are presented in Figure 4-8.

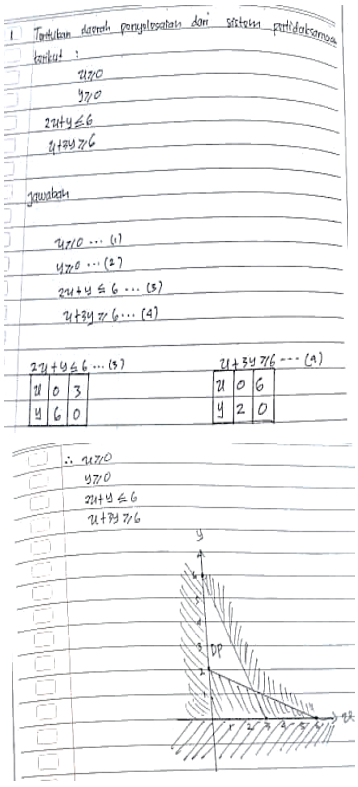

Figure 4. Student Responses to Question 1

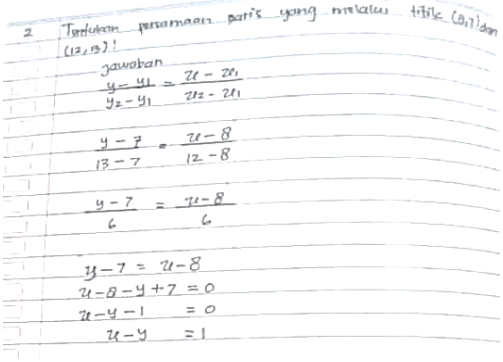

Figure 5. Student Responses to Question 2

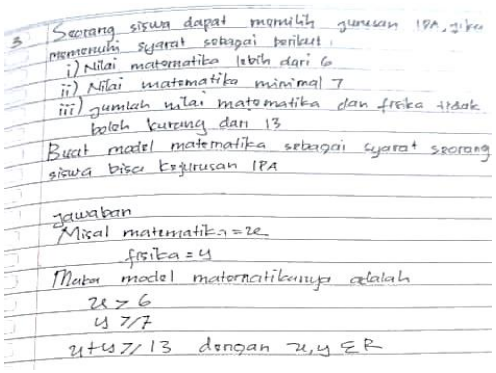

Figure 6. Student Responses to Question 3

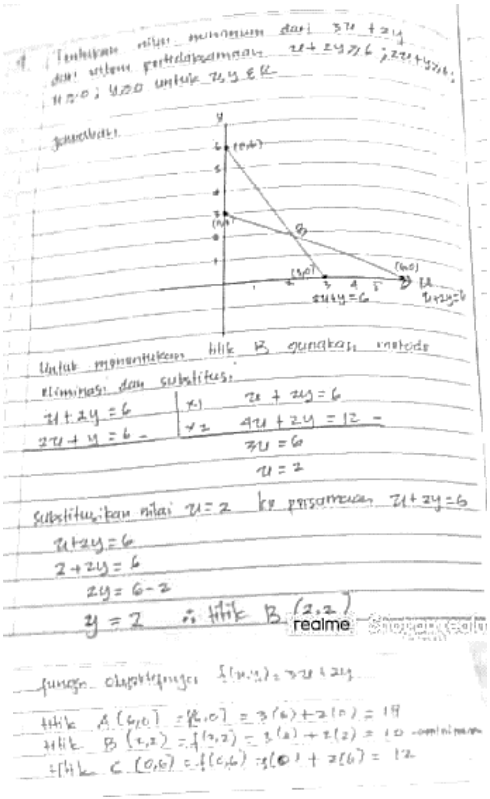

Figure 7. Student Responses to Question 4

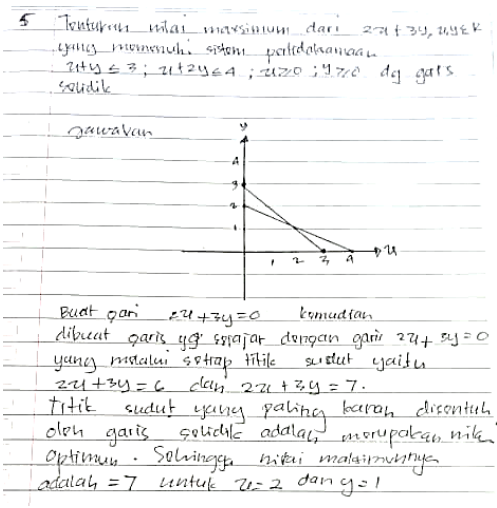

Figure 8. Student Responses to Question 5

Based on Figures 4-8, the results of students' answers are described and explained in depth about the Linear Program material. To strengthen the results of students' written answers, researchers conducted interviews to find out the students' thought processes in solving the problems given, from understanding the problem to developing a strategy or solution plan, solving the problem according to the plan that has been made, and re-examining the answer.

Problems are a natural element of life for humans; they typically stem from either our surroundings or ourselves. The significance of mathematical problem-solving in the acquisition of mathematics is explained based on Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 21 of 2016 (Ghurfah et al., 2023). By applying mathematical problem-solving in everyday life, students are expected to benefit from the application. According to Trends in International Mathematics and Science Study (TIMSS), Indonesia's mathematical problem-solving skills are below international standards. Indonesia is in position 49 out of 53 countries is reinforced by the reality at the school. Researchers conducted preliminary tests to determine the problem-solving ability at the school. The results show that the problem-solving ability was still low.

Learning media is important on mathematics learning in improving problem-solving skills, but the fact shows that the media is still lacking. Teachers still do conventional learning, and there is no innovation in learning media when presenting mathematics material. The development of technology can be utilized to make FlipaClip learning media in dealing with these problems. Technology-based learning media can present learning materials contextually, interestingly, and interactively in audio and visual to increase student interest in learning and achieve learning goals (Mutamam et al., 2022).

FlipaClip learning media is learning media in the form of audio-visuals that can improve students' math problem-solving skills. This is because the media using sound, images, and visual elements can provide a more comprehensive learning experience (Mohd Nawi, 2020; Aliyyah et al., 2021; Ibrahim, Hendrawan, & Sunanih, 2023).

FlipaClip learning media improves students' math problem-solving skills because sound can be used to facilitate concept communication. After all, sound can be used to explain mathematical concepts verbally. At the same time, visual elements such as pictures or diagrams can be used to provide visual representation. The combination of the two can help students understand and communicate mathematical concepts well (Septianingsih, Safitri, & Sujarwo, 2023).

FlipaClip media also increases student involvement. This is because the media can make learning more interesting and dynamic. Students tend to focus more and understand more when solving math problems. In addition, audio-visual media can also present concrete examples. It happens because of the application of mathematical concepts in real-world situations, so it can help students see the relevance and practical application of what they are learning. Another reason is combining audio and visual stimuli in FlipaClip learning media can improve memory. Because information presented in two formats can stick long in students' brain memory (Lestari, Halimatusha'diah, & Lestari, 2018).

CONCLUSION

Digital learning media with a contextual approach to linear equation material is valid and feasible for the learning process. The results of material expert validation of 84.38% were declared highly valid. The results of media expert validation of 94.79% were declared highly valid. The student response obtained a percentage assessment of 83.64%, with this response getting the results that this FlipaClip-based learning media shows "very interesting" criteria, so it is feasible to use.

FlipaClip-based learning media on matrix material effectively improves the

mathematical problem-solving skills of grade XI students. This is indicated by the interpretation of *N*-Gain obtained by the experimental class, which is quite an effective category with a percentage of 70.22%. The average mathematical problem-solving ability of grade XI students subjected to FlipaClip-based learning media on matrix material is more than that of those not subjected to the media. This is indicated by the results of the independent sample t-test test, namely the Sig. (2- tailed) value of 0.000 <0.05 that there is a difference in the mathematical problem-solving ability of experimental and control class students.

REFERENCES

Aliyyah, R. R., Amini, A., Subasman, I., Sri, E., Herawati, B., & Febiantina, S. (2021). Upaya meningkatkan hasil belajar IPA melalui penggunaan media video pembelajaran. *Jurnal Sosial Humaniora*, *12*(1), 54–72. https://doi.org/10.30997/jsh.v12i1.4034

Andriani, D., & Nurjaman, A. (2018). Analisis Kemampuan pemahaman konsep materi segitiga dan segiempat pada siswa SMP. *Jurnal Pembelajaran Matematika Inovatif*, *1*(2), 1015–1026. https://doi.org/https://doi.org/10.22460/jpmi.v1i3.219-228

Ghurfah, A., Sripatmi, S., Novitasari, D., & Baidowi, B. (2023). Kemampuan pemecahan masalah matematika materi pola bilangan ditinjau dari tingkat kepercayaan diri siswa. *Jurnal Riset Pendidikan Matematika Jakarta*, *5*(1), 10–21. https://doi.org/10.21009/jrpmj.v5i1.23022

Hamidah, N., & Setiawan, W. (2019). Analisis minat belajar siswa sma kelas XI pada materi matriks. *Journal on Education*, *01*(02), 457–463.

Heryani, Y., & Ramadani, R. (2019). Analisis kemampuan pemecahan masalah matematis peserta didik berdasarkan gaya belajar model Honey-Mumford. *Jurnal Metaedukasi*, *1*(2), 66–71. https://jurnal.unsil.ac.id/index.php/metaedukasi/article/view/1210

Hodiyanto, Darma, Y., & Putra, S. R. S. (2020). Pengembangan media pembelajaran berbasis macromedia flash bermuatan problem posing terhadap kemampuan pemecahan masalah matematis. *Mosharafa: Jurnal Pendidikan Matematika*, *9*(2), 323–334. https://doi.org/10.31980/mosharafa.v9i2.614

Ibrahim, F., Hendrawan, B., & Sunanih, S. (2023). Pengembangan media pembelajaran PACAS untuk meningkatkan hasil belajar siswa. *JLEB: Journal of Law, Education, and Business*, *1*(2), 102–108. https://doi.org/10.57235/jleb.v1i2.1192

Kemendikbud. (2018). *Programme for International Student Assessment (PISA)*. Bskap.Kemdikbud.Go.Id.

Kemendikbud. (2006). *Peraturan Menteri Pendidikan Nasional Republik Indonesia Nomor 22 tahun 2006 Tentang Standar Isi Untuk Satuan Pendidikan Dasar dan Menengah*.

Lestari, I. D., Halimatusha'diah, H., & Lestari, F. A. P. (2018). Penggunaan media audio, visual, audiovisual, dalam meningkatkan pembelajaran kepada guru-guru. *Jurnal PkM Pengabdian Kepada Masyarakat*, *1*(1), 55-60. https://doi.org/10.30998/jurnalpkm.v1i01.2361

Malik, R. M., Jalal, A., & Waliyanti, I. K. (2022). Analisis kemampuan pemecahan masalah matematis siswa pada materi matriks ditinjau dari minat belajar siswa SMA. *Jurnal Pendidikan Guru Matematika*, *2*(3), 219–235. https://doi.org/10.33387/jpgm.v2i3.5144

Mohd Nawi, M. Z. M. (2020). Transformasi pengajaran dan pembelajaran multimedia dalam pendidikan islam: Satu perbincangan. *Journal of ICT In Education*, *7*(2), 14–26. https://doi.org/10.37134/jictie.vol7.2.2.2020

Mutamam, A. N., Susilawati, W., Maryono, I., & Nuraida, I. (2022). Kemampuan berpikir reflektif abstraktif matematis siswa melalui pembelajaran kontekstual. *Gunung Djati Conference Series*, *12*, 68–72. https://conferences.uinsgd.ac.id/index.php/gdcs/article/view/713/515

Nastiti, M. D., Mustaziri, M., & Tompunu, A. N. (2021). Animasi 2D (motion graphic) sebagai media pembelajaran mata kuliah etika profesi. *Jurnal Elektro*, *3*(1), 37–42. https://jurnal.untag-sby.ac.id/index.php/EL-SAINS/article/view/37-42

NCTM. (2000). *Principles and Standards for School Mathematics*. Reston, VA: NCTM.

Neto, S. J., De, M., Costa, H. R., & Lima, M. C. (2019). Produção de significados sobre roldanas a partir do uso dos aplicativos "Física na escola LITE" e "FlipaClip." *Olhares & Trilhas*, *21*(1), 96–110. https://doi.org/https://doi.org/10.14393/ot2019v21.n.1.46278

Pemerintah Republik Indonesai. (2003). *Undang-Undang Republik Indonesia Nomor 20 tahun 2003 Tentang Sistem Pendidikan Nasional*.

Septianingsih, R., Safitri, D. & Sujarwo. (2023). Media audio visual dalam konteks pembelajaran IPS: Implikasinya untuk pendidikan di era digital. *Cendekia Pendidikan*, *1*(5), 20–34. https://ejournal.warunayama.org/index.php/sindorocendikiapendidikan/article/view/769

Salsabila, U. H., & Agustian, N. (2021). Peran teknologi pendidikan dalam pembelajaran. *Jurnal Keislaman Dan Ilmu Pendidikan*, *3*(1), 123–133. https://doi.org/10.36088/islamika.v3i1.1047

Simalango, M. M., Darmawijoyo, & Aisyah, N. (2018). Kesulitan Siswa dalam menyelesaikan soal-soal PISA pada konten change and relationship level 4, 5, dan 6 di SMP N 1 Indralaya. *Jurnal Pendidikan Matematika*, *12*(1), 43–58. https://ejournal.unsri.ac.id/index.php/jpm/article/view/4246

Simbolon, G. S., & Purba, G. I. D. (2023). Pengembangan bahan ajar interaktif berbasis pendekatan kontekstual untuk meningkatkan kemampuan pemecahan masalah matematis siswa. *Journal of Student Research*, *1*(2), 422–439. https://doi.org/10.55606/jsr.v1i2.1050

Sumartini, T. S. (2016). Peningkatan kemampuan pemecahan masalah matematis siswa melalui pembelajaran berbasis masalah. *MOSHARAFA: Jurnal Pendidikan Matematika*, *5*(2), 148–158. https://doi.org/10.31980/mosharafa.v5i2.391

Susanto, A. (2013). *Teori Belajar dan Pembelajaran di Sekolah Dasar*. Jakarta: Kencana Prenada Media Group.

Syahputra, E. (2015). *Program Linear*. Medan: Unimed Press.

Yoga, S. (2018). Perubahan sosial budaya masyarakat indonesia dan perkembangan teknologi komunikasi. *Jurnal AL-Bayan*, *24*(1), 29–46. http://dx.doi.org/10.22373/albayan.v24i1.3175

Zaini, A., & Marsigit, M. (2014). Perbandingan keefektifan pembelajaran matematika dengan pendekatan matematika realistik dan konvensional ditinjau dari kemampuan penalaran dan komunikasi matematik siswa. *Jurnal Riset Pendidikan Matematika*, *1*(2), 152–163. http://dx.doi.org/10.21831/jrpm.v1i2.2672