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"FLIPPED CLASSROOM TYPE PEER INSTRUCTION-BASED LEARNING" BASED ON A WEBSITE TO IMPROVE STUDENT'S PROBLEM SOLVING

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ABSTRACT

This study aims to develop learning tools in the form of lesson plans, student worksheets, learning videos, and PPT, based on WEB for first-grade seventh-school material linear equations with flipped classroom-type peer instruction. The development of this WEB-based learning tool uses the Plomp model. The steps for developing web-based learning tools include preliminary needs analysis, curriculum analysis, concept analysis, student analysis, and literature analysis. Then product development and assessment. This research was carried out during the product development stage based on needs analysis, curriculum analysis, concept analysis, student analysis, and literature analysis and then self-evaluated. The preliminary analysis obtained information that teachers need learning tools that can help students improve problem-solving skills, students need engaging learning media, students are interested in using learning media using videos with a period of 10-15 minutes, and PPT, accessed in the WEB. Then the product is compiled and evaluated on its own, related to the apparent error in using it. Based on the preliminary analysis, learning lessons, student worksheets, learning videos, PPT based on WEB and self-evaluation have been produced, which can then be validated by experts.

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1. INTRODUCTION

Mathematics as one of the basic sciences has an important role in the development of science and technology. The learning objectives of mathematics in The Decree of the Ministry of Education and Culture No 64 of 2013 are related to the learning objectives set by the NCTM (Palgunadi et al., 2021). One of the objectives is that students are required to have basic problem-solving skills. Therefore, it is very important for students to have the ability to solve problems in order to achieve maximum learning outcomes in accordance with the objectives of mathematics learning (Kasem et al., 2018; Roheni et al., 2017). In fact,

the mathematical problem-solving ability of students in Indonesia still requires improvement and special attention, as shown by the results of the 2018 PISA study; Indonesia's mathematics score was 379 below the international average score of 489 and the 2015 TIMSS results for Indonesia reached 397 with an international score of 500 (Guhn et al., 2014; OECD, 2019; Palgunadi et al., 2021).

The National Council for Mathematics Teachers (NCTM) also mentioned the importance of solving learning problems. According to NCTM (Palgunadi et al., 2021), the mathematical thinking process in mathematics education includes five basic standard competencies: problem-solving skills, reasoning skills, communication skills, and presentation skills. This low ability results in the low quality of human resources as indicated by low problem-solving abilities. This is because, until now, education has not provided opportunities for students to develop problem-solving skills. Students can also integrate real-world problem-solving skills to solve real-world problems and competition (Cahyani & Setyawati, 2017). Indicators of mathematical problem-solving ability in this research are based on the combination and modification of Polya (Sam & Qohar, 2016; Siahaan et al., 2019), which are: (1) Understanding the problem by identifying the adequacy of the required data; (2) Developing a problem-solving plan by presenting the problem in a mathematical model; (3) Solving problems by selecting and implementing the strategy; and (4) Inferring or interpreting the solution.

The process standards, learning must be planned, assessed, and supervised (Ramadhani, 2016). On the other hand, with the Covid-19 pandemic affecting learning activities, teachers must innovate in learning, including using technology in learning (Herliandry et al., 2020). Based on observations conducted at one of the junior high schools in Padang, it is known that the learning process is carried out 3 days face-to-face and 3 days at home by giving assignments, one hour of mathematics lessons at the school is only done for 25 minutes. Assignments are developed from student worksheets which mostly contain routine questions, so students have not been able to develop problem-solving skills well. Educators also find it difficult to catch up on materials not understood by students. Based on these problems, it is necessary to design effective learning tools that can help students develop their problem-solving skills, according to the characteristics of students and the Covid-19 pandemic situation. Internet-based learning technology with the Flipped Classroom model is a solution for transitioning traditional learning to a virtual system. Students feel familiar with the materials that will be discussed in class (Gariou-Papalexiou et al., 2017). In several types of the flipped classroom, peer instruction flipped learning models have the most potential to improve problem-solving skills. This is because when in class students are given learning that begins with contextual problems; students are trained to understand and formulate the problems given through the concept test which will be answered individually so that students will get used to answering the questions given independently.

Learning tools will be developed later in the form of lesson plans, student worksheets, learning videos, and power point media to put in the WEB. Studies which use WEB as a means of providing material are still rare, even though WEB provides complete tools, thus helping students learn comprehensively. Based on research conducted by Nakamura (2011), the advantage of the WEB is that there is no limitation on the number of web pages and it is easy to insert new pages to accommodate the needs of students who need to improve or add material.

Research on the development of learning tools using Flipped Classroom and its effect on students' mathematical abilities has been carried out by researchers, such as the research conducted by Prayitno and Masduki (2016) focusing on the development of blended learning media with the flipped classroom model in mathematics education courses. In the research,

learning media were produced in the form of learning videos, quizzes, e-modules, and learning videos suitable for students based on expert tests, and students could use these media as a supplement to lecture materials. The effectiveness of the flipped classroom on attitudes and skills in learning mathematics in vocational high schools showed an increase in aspects of students' attitudes and skills in applying the concepts of sequence and series as well as being more active in problem-solving activities (Damayanti & Sutama, 2016). The development of a flipped classroom-based mathematics learning model in class XI of SMKN 1 Gedangsari Gunungkidul showed that the flipped classroom-based mathematics learning model can maximize learning with one-on-one interaction through learning videos uploaded online and offline (Damayanti & Sutama, 2016). Research Shafique and Irwin-Robinson (2015) on the study of the effectiveness of the Flipped Classroom in 9 mathematics classes showed that learning at the University becomes more effective when flipped learning is implemented. In addition, the flipped classroom will also create a good learning experience for students.

Furthermore, Hayati (2018) focusing on the theoretical study of the Flipped Classroom in mathematics learning showed that the flipped classroom learning model can help students learn both inside and outside the classroom, resulting in students being directly involved in the learning process along with the development of information and technology which requires teachers to apply technology in teaching and learning based on the characteristics of mathematics learning. Furthermore, research conducted by Prayitno and Masduki (2016) on a comparative study of the flipped traditional learning model with peer instruction flipped on problem-solving abilities showed that the average value of the problem-solving ability test results for class VIII students who received learning using the Peer Instruction Flipped learning model was higher than the average score of the test results from students who experienced learning using the Traditional Flipped learning model. In addition, research related to the use of flipped classroom model has been carried out by researchers, such as research conducted by Thohir et al. (2021) and Herliandry et al. (2020).

Based on the description above, this research is different in the products developed, namely learning tools in the form of lesson plans, student worksheets, learning videos, PowerPoint slides, and WEB which is arranged using Flipped Classroom Type of Peer Instruction to see the effectiveness of the problem-solving abilities of the first grade of junior high school students.

2. METHOD

This research employed the research and development design. Product development was conducted through several stages adapted to the model chosen, namely the Plomp (Plomp, 2013) which has been simplified into three stages as follows (1) preliminary research phase. The analysis activities carried out include Needs Analysis. The activity carried out is to analyze what is needed and expected for development. The information collection was carried out by the method of interviews. The results of the needs analysis were considered in the design of learning tools in order to achieve learning objectives and meet the needs of students in improving problem-solving skills. In Curriculum Analysis, the activities carried out were identifying the topic or subject matter, and compiling them in the right order, aiming to study the scope of the material, learning objectives, and the selection of appropriate strategies. The method used is a documentation method using a checklist of learning tools in schools. Analysis of learners, the activities carried out were collecting information on the characteristics of students, and adjusting to the preparation of learning materials and tools. The purpose of student analysis is to find out the product that students want and identify the students' understanding of PPT applications. The method used in the

student analysis stage is the provision of questionnaires. The next is Concept analysis; the activities carried out were identifying the main concepts of the material, detailing, and compiling them with concept maps systematically. Relevant teaching materials are to be taught based on curriculum analysis. In the literature analysis stage, an analysis was carried out on reading/book resources used at schools to see the suitability of books with the curriculum. The appropriate books will be used as a reference for the preparation of learning tools to improve the problem-solving abilities of the first grade of junior high school'. Furthermore, relevant research journals that can be used as the basis for developing products were reviewed. The next was (2) development phase or prototyping phase; in this phase, tools were designed in the form of lesson plans, student worksheets, learning videos, ppt slides, and WEB-based flipped classroom type peer instruction based on the results of the analysis in the preliminary research phase. The result of the design at this stage is called prototype 1. Each prototype was evaluated with reference to the formative evaluation of Tessmer's development in Figure 1.

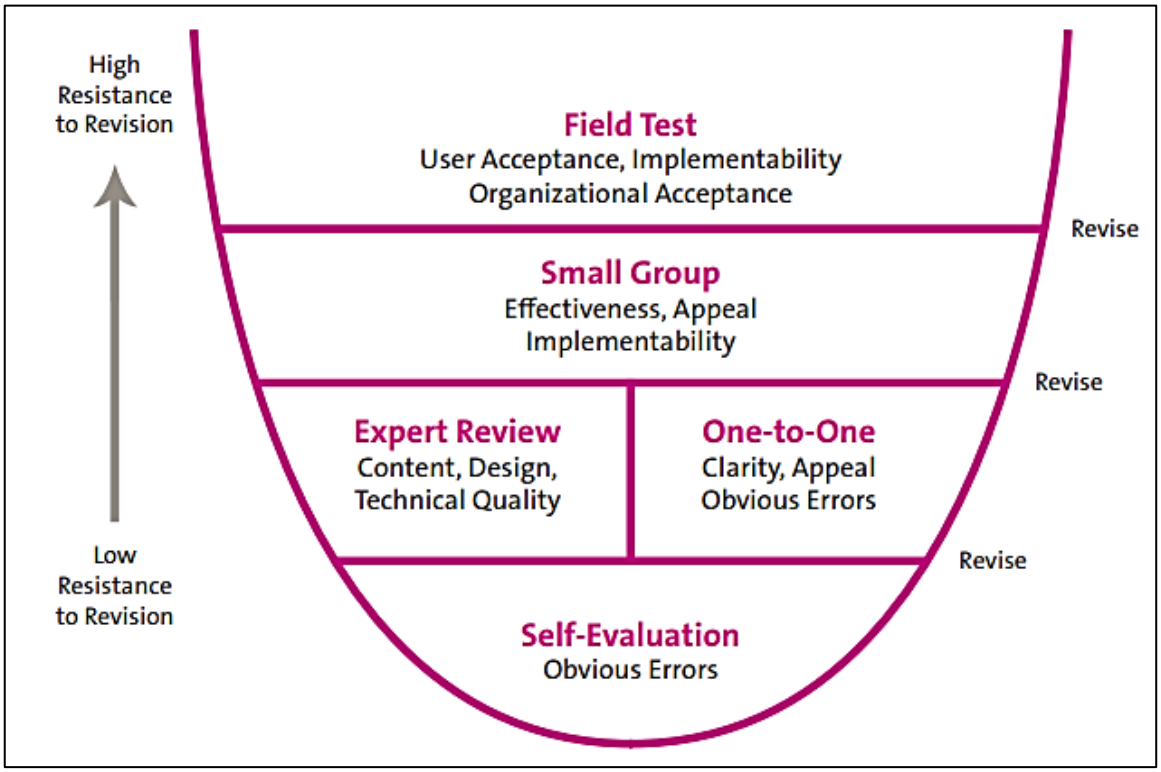


Figure 1. Formative evaluation of Tessmer development in Plomp and Nieveen

The formative evaluation steps used are outlined as follows: (a) Self-Evaluation were carried out to double-check the completeness of the device components. The method used was self-evaluation and discussion with colleagues. The result of the revision of the learning device is called prototype 2. (b) Expert Reviews; expert assessment aims to validate the device by providing assessments and advice according to the expert's field. The validators involved were five people consisting of three mathematics education experts, one linguist, and educational technologist. (c) One-to-one Evaluation, the one-on-one evaluation was carried out by asking for suggestions from users of learning devices, namely an educator and three students. Students were selected based on high, medium, and low ability levels. The purpose of this individual evaluation is to identify possible errors in the student worksheet, learning videos, and website in the form of material, implementation, and to see the technical

quality and practicality of the learning tools compiled. (d) Small Group Evaluation; the revised learning tools produced prototype 3, then an evaluation was carried out involving 6 students selected by mathematics educators. Each of the two learners represents a high, medium and low ability group. In this evaluation, aspects of presentation, time allocation, andreadability of the device were assessed. The data collection methods used in small group evaluation are interviews and observations (e) Field Test; in this stage, a trial was carried out, called a field trial. The goal of this trial is to evaluate learning tools in actual classroom situations. After field tests were carried out, the students were given a practicality questionnaire. (3) Assessment Phase; the assessment phase was carried out to determine the level of effectiveness of the tools by looking at the process and test results of mathematical problem-solving questions of students who have learned using learning devices. Tests were carried out before and after students used the learning tools. The test results were processed based on the rubric of scoring mathematical problem-solving ability. This research was carried out in the stage of preliminary research, product development, and self-evaluation, while expert validation and product effectiveness will be reported in a different article.

3. RESULT AND DISCUSSION

In the preliminary research phase, identification or analysis was carried out to develop a peer instruction type flipped classroom-based learning tool and analyze the limitations of the subject matter to be developed. The purpose of this stage is to establish and define the conditions needed in the development of learning tools. This stage started in July 2022.

3.1. Needs analysis results

The needs analysis stage is carried out with the aim of producing a flipped classroom-based learning device of the peer instruction type that can be adapted to the needs. A needs analysis was conducted by interviewing the seventh-grade mathematics educators. Based on the results of the interview, the following conclusions were obtained; (a) learning activities carried out after post-covid are face-to-face learning; (b) The school has applied flipped classroom learning, but the implementation is fully virtual; so, the material given is not explained again in class. (c) Educators need learning tools that can help students maximize learning time, due to less learning time in class. (d) The problem-solving ability of students is still low, shown by the way the students understand the problem, plan a solution, complete the settlement, and re-examine the answers. (e) Students enjoy learning using technology and using a variety of media.

Based on the results of the analysis, learning tools are needed to adapt to the learning conditions at one of the junior high schools in Padang. At the same time, the tools can help students in solving problems. One of the efforts to overcome the problems in the learning process is to develop a peer-instruction flipped classroom in the form of lesson plans, learning media (PPT, and learning videos), student worksheets, and WEB as pages for students to access materials designed in such a way with the aim of overcoming problems.

3.2. Curriculum analysis results

Curriculum analysis was carried out by examining the curriculum used at one of the junior high schools in Padang. Based on the results of the curriculum analysis, it is known that the curriculum used in schools is an independent curriculum in the seven-grade class semester 1. The curriculum began to be implemented on July 17, 2022. Curriculum analysis aims to find out what materials about linear equations are presented in the curriculum in

accordance with the expected competencies, whether the materials are adequate to achieve learning objectives, and whether the materials have been properly ordered. The results of this curriculum analysis are used as a basis for formulating learning objectives in developing linear forecasting topic learning tools based on flipped classroom type peer instruction classes for the first grade of junior high school students. Curriculum analysis is focused on analyzing learning outcomes in order to obtain learning objectives that become a reference in the development of lesson plans, student worksheets, PPT slides, and learning videos (see Table 1).

Table 1. Curriculum analysis results

Element	Learning Outcomes	Learning objectives
Linear equation	At the end of phase D, learners can recognize, predict and generalize patterns in the form of an arrangement of objects and numbers. They can express a situation in an algebraic form. They can use the properties of operations (commutative, associative, and distributive) to produce equivalent algebraic forms. Learners can understand relationships and functions (domain, codomain, range) and present them in the form of arrow charts, tables, sets of sequential pairs, and graphs. They can distinguish some nonlinear functions from linear functions graphically. They can solve one-variable linear equations and inequalities. They can present, analyze, and solve problems by using relationships, functions, and linear equations. They can solve a two-variable linear safekeeping system through several ways to Problem-solving.	1. State the relationship between two magnitudes (<,>,=,≤,≥) in a problem. 2. Understand the correctness of mathematical sentences of equations when letters are substituted with numbers in a problem. 3. Determine the solution of an equation without substituting numbers into letters in a problem. 4. Solve equations using the properties of equations in a problem. 5. Solve equations using the idea of moving tribes in a problem. 6. Solve equations in the form of decimals and fractions in a problem. 7. Solve problems by using linear equations 8. Understand ratio relationships by using linear equations in a problem. 9. Solve problems related to ratios by using linear equations

The elaboration of learning objectives is carried out so that the materials can be explained in an orderly manner. This aims to make the materials easy to understand by students. Regarding inequality, the curriculum guidelines for junior high schools stipulate that "the relationship between the amounts is expressed using the inequality", while the nature and completion of the inequality are studied in the next class. Then, the researcher also paid attention to the small school class time, which is 30 minutes for one class hour. Therefore, it only studied how it was used between the two-class hour. This was also part of a discussion with educators at one of the junior high schools in Padang.

3.3. Concept Analysis

Based on the curriculum analysis, there are 9 learning objectives. To achieve the learning goal, appropriate and relevant materials are needed. The results of concept analysis reveal that teaching on the topic of the System of Linear Equations so far has not developed

the ability to build concepts from linear equations and solve these problems. Teaching the topic of linear equations so far has been directed to the abstract form of the general form of linear equations without starting from concrete/ contextual problems that can be observed by learners. Solving direct linear equations is explained by the steps in the book, such as the method of substitution.

Based on the results of concept analysis, the topic of this linear equation begins by stating the relationship between two magnitudes. Presenting the relationship of two quantities in the form of equations and inequality is an initial concept that students must master before solving the form of linear equations, the use of calculating operations, properties, and the application of linear equations to the form of more complex problem situations. Finally, the comparison material on linear equations is an additional concept that aims to provide students with an understanding of problems that uses a comparison ratio, including the ratio of the size of sugar to one cup of coffee.

Based on the results of the analysis, the main concepts are studied in the material of linear equations and systematically compiled according to the flow of their presentation. The materials and concepts needed in learning linear equations are arranged in the form of concept maps. The concept map can be seen in Figure 2.

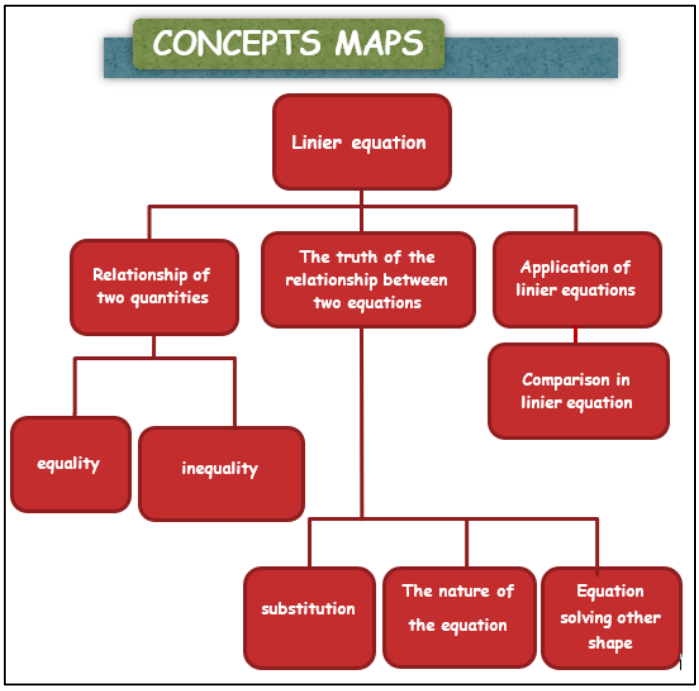


Figure 2. Concepts maps

3.4. Results of student characteristics analysis

Student analysis was carried out to determine the characteristics of students so that the design of the learning tools is in accordance with expectations in the mathematics learning process. The analysis of students was carried out by interviewing educators and distributing a questionnaire on the characteristics of first-grade seventh school of Junior hight school. Based on the results of the interview, students in the class have diverse academic abilities consisting of high, medium, and low abilities. The characteristics of the learners analyzed include academic ability, group work ability, experience background, charm for colors and images, and student attitudes.

Based on the questionnaire given to students, some information about the students was collected. The results obtained using the questionnaire can be seen in Table 2.

Table 2. Results of student characteristic analysis

Aspect	Information	Conclusion
Constraints during the learning process	Learning activities carried out by students at school are going well	Of the 32 respondents, 20 voted against, 9 voted disapproving, 3 voted in favor, 3 voted in favor
	The teaching materials/teaching media used by students have varied and attracted students' interest in learning	Of the 32 respondents, 22 voted disapproving, 8 agreed, and two disagreed.
Learner abilities	Students are less able to solve problems in the form of problem-solving.	Of the 32 respondents, 25 voted in favor, and 5 voted overwhelmingly in favor.
Learning tools to be developed	Learners need student worksheets for engaging and easy-to-understand learning	32 respondents voted in favor
	Learners use electronic media to search for material	32 respondents voted in favor
	Students are interested in using learning videos and power point media to learn over and over again at home that can be easily understood	32 respondents voted in favor
	Students are interested in the learning videos and PPT media provided are distributed through the website	32 respondents voted in favor
	Students interested in using the learning tools used can improve problem-solving skills	32 respondents voted in favor

Based on the answers to the student questionnaire, it is known that students want more interesting learning resources at school; students want more learning time so that when they understand the material better; most students state that they have used and often use smartphones as learning resources, and most students stated that they are not able less able to solve problem-solving problems.

Based on the analysis of the characteristics during the researcher's time at school, a peer instruction type flipped classroom-based learning tool in the form of lesson study, student worksheets, learning videos, power point media, and the WEB can help students in learning at home needs to be developed so that the learning time is available more, and in face-to-face, it focuses more on group discussion activities and solving problems related to the materials that can be accessed on the WEB; also, learning videos and power point media as interesting learning media can motivate students to study harder. In addition, students

with individual character prefer to learn individually in understanding the material and can use the learning tool anytime and anywhere.

3.5. Literature review

literature review; literature analysis was carried out by analyzing the learning resources used at one of the junior high schools in Padang. The results of the analysis of learning resources are presented in Table 3.

Table 3. Literature analysis results

No	Indicator	Valuation	
		Yes	No
1	Learning resources obtained from written sources.	√	
2	Learning resources are obtained from unwritten sources.		√
3	The learning resources used can be found in the library.		√
4	The learning resources used are in accordance with the indicators in Peer Instruction.		√
5	The learning resources used do not facilitate problem-solving skills.	√	
6	The learning resources used are less attractive to students in learning.	√	
7	The learning resources used are easy for learners to understand.		√

Based on the literature analysis carried out, it is known that the books used at one of the junior high schools in Padang are mathematics books of the 2013 curriculum and student worksheets. The book and student worksheet have not facilitated students to solve problems and the question exercises presented on the worksheets have not facilitated problem-solving. Educators are still looking for teaching materials that are suitable for use in learning, especially those that are in accordance with the independent curriculum but due to the constraints on the cost of procuring books, educators still use the 2013 curriculum books.

In terms of appearance, the worksheets used have not been able to attract students' learning interest because the design is simple. In addition, the presentation of materials from the package books used is still difficult for students to understand, and the package books can only be borrowed for use in the school area. The boks cannot be brought home because they are limited. Based on the literature analysis, student worksheets will be designed to attract the students and guide them in conducting an investigation and solving problems in learning mathematics, especially linear equation materials. The next is product development based on the analysis, curriculum needs, concepts, and students, a peer instruction-type flipped classroom-based learning tool was designed in the form of student worksheets, learning videos, power point media, and WEB on the topic of seven-grade linear equations.

Peer instruction type flipped classroom-based lesson plan is a learning tool specifically designed for junior high school students in seven grades. The lesson plan format is designed to contain components based on flipped classroom-type peer instruction. The flipped classroom-based lesson plan type of peer instruction is designed to consist of three components that have been arranged in the independent curriculum. (a) General Identity. General information contains information about the identity of the author, initial competencies, facilities and infrastructure, target students, and the learning model used. (b) Core competencies. Core competencies contain learning objectives and learning activities. (c) Appendix. The attachment contains the learner worksheet. The pictures of the lesson plan can be seen in Figure 3.

LESSON PLAN LINIER EQUATION MATHEMATICS

C. COMMON IDENTITY

Name	:	Tuti Azizah	level / class	:	VII
School origin	:	SMPN 22 Padang	subjet	:	Mathematics
Time allocation	:	3x30 menit	Total students	:	32
Semester/Fase	:	1/D	Elemen subject	:	Linier equation

Initial competence	Students have understood the concept of algebraic forms
Pancasila student profile	Students will develop the ability to believe and fear God Almighty, global diversity, think critically and independently, be creative and work together in solving problems.
Fasilities and infrastructure	1. tools: Laptop, LCD, android phone 2. teaching resources : students worksheet 3. teaching media : PPT, learning video, WEB, and Internet
Target students	1. regular/typical students 2. students with learning difficulties 3. students with high achievement

Figure 3. Lesson plan

Characteristics of student worksheet based on flipped classroom type peer instruction the model used in the student worksheet developed is a peer instruction type flipped classroom learning model that has the following steps: pre-class activities (students watch learning videos at home), class activities where the teacher gives the first question test which should be done individually, discussions between students regarding the answers to the first question, then the second question test which is done in groups, measuring students' understanding at the end of the lesson; all of which consist of questions from a problem-solving problem. The structure of the student worksheet that has been compiled can be seen in Table 4.

Table 4. Student worksheet structure

No	Student worksheet Section	Student worksheet Structure
1	Introduction	Cover Title page Foreword Table of contents Learning Objectives Instructions for using student worksheet Concept map
2	Fill	Learning materials (meeting 1-5)
3	Cover	Bibliography

The writing of student worksheet based on flipped classroom peer instruction type is based on the arrangement of the student worksheet structure that has been made. The writing of student worksheet on prototype 1 that the researchers have designed can be seen in the Figure 4.

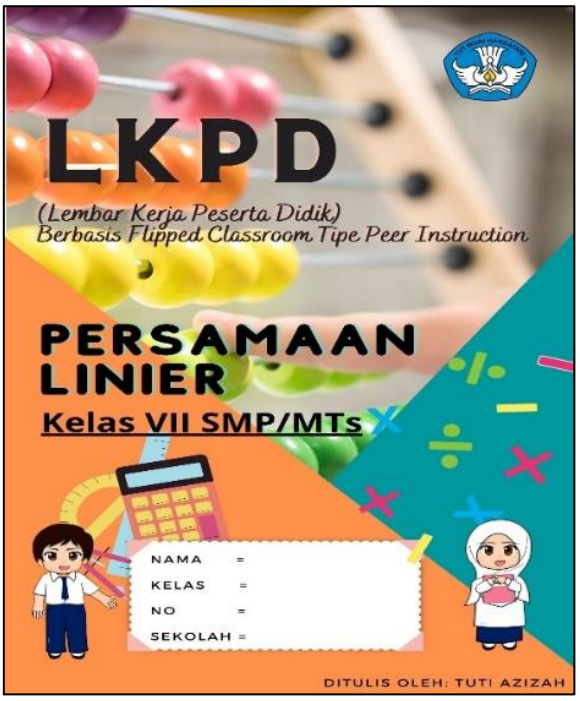
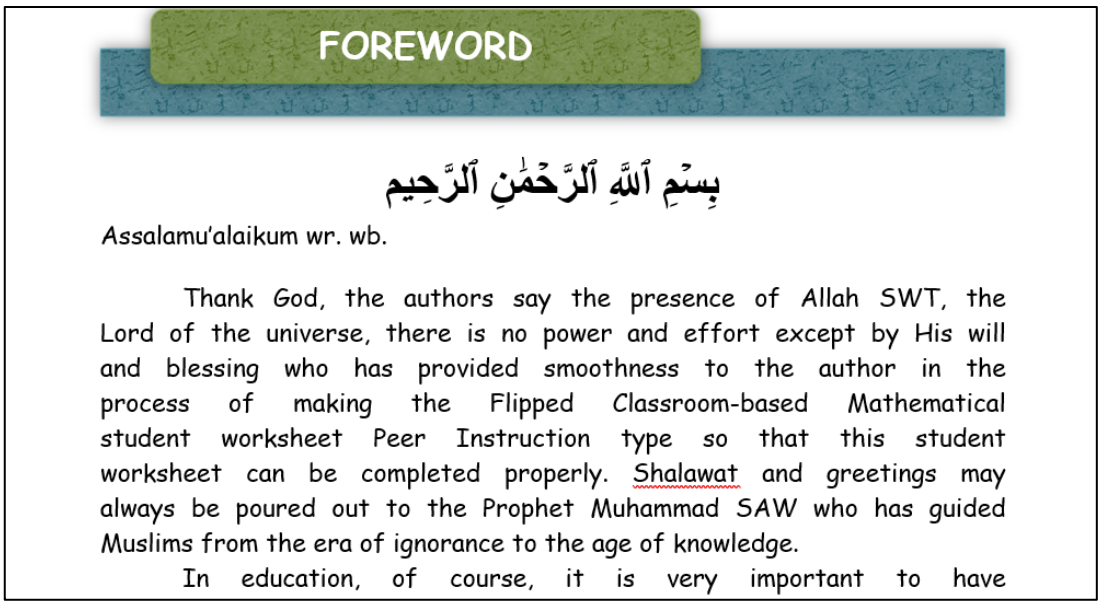


Figure 4. Student worksheet front cover

The front cover page contains the student worksheet title, class, target user, and creator identity. The foreword page view can be seen in Figure 5.


FOREWORD

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

Assalamu'alaikum wr. wb.

Thank God, the authors say the presence of Allah SWT, the Lord of the universe, there is no power and effort except by His will and blessing who has provided smoothness to the author in the process of making the Flipped Classroom-based Mathematical student worksheet Peer Instruction type so that this student worksheet can be completed properly. Shalawat and greetings may always be poured out to the Prophet Muhammad SAW who has guided Muslims from the era of ignorance to the age of knowledge.

In education, of course, it is very important to have

Figure 5. Foreword

In the foreword section, the introductory preface page contains a general review of the content of the student worksheet, Forework acknowledgment from the author, and the

author's expectations. Student worksheet based on flipped classroom type peer instruction compiled is expected to be a guide and help students in learning linear equation materials. The student worksheet usage instructions page can be seen in Figure 6.

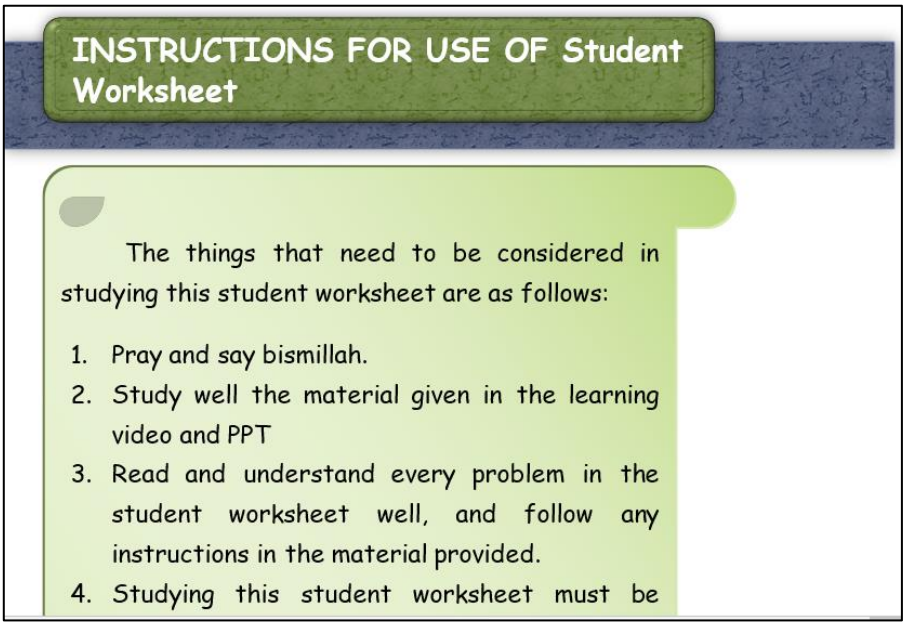


Figure 6. Instructions for use of student worksheet

Instructions for use of the student worksheet contain things that need to be considered in studying the student worksheet. On the student worksheet, there is an explanation page for step-by-step peer instruction. This page contains an explanation of the steps of peer instruction which aims to make it easier for students to understand the steps of peer instruction. The step-by-step peer instruction can be seen in Figure 7.

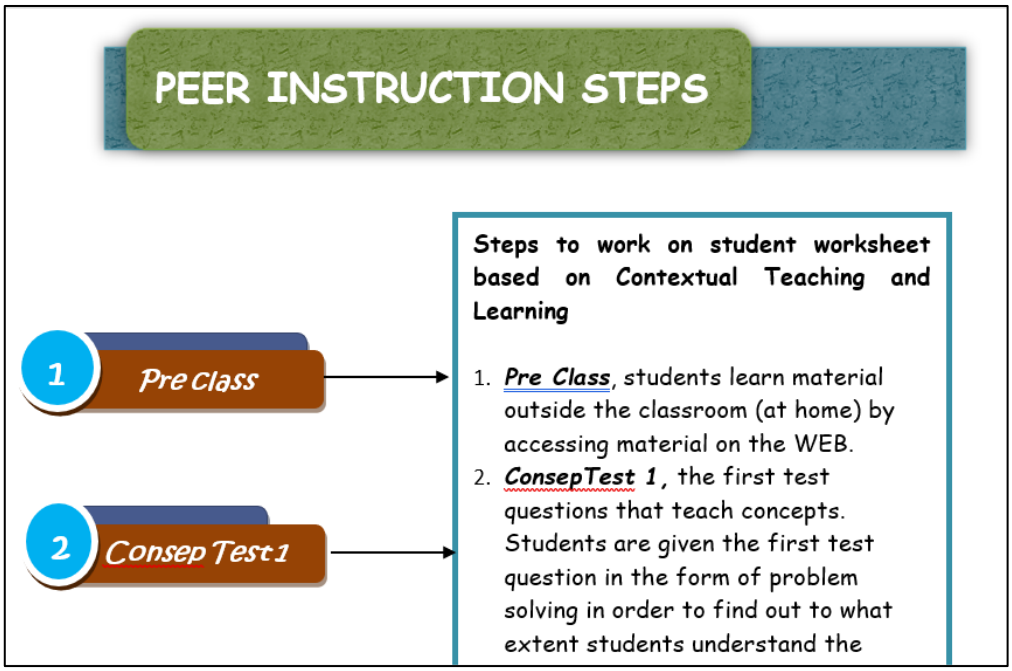


Figure 7. Peer instruction steps

The concept map contains a sequence of concepts or an overview of the material to be studied. The concept map can be seen in Figure 8.

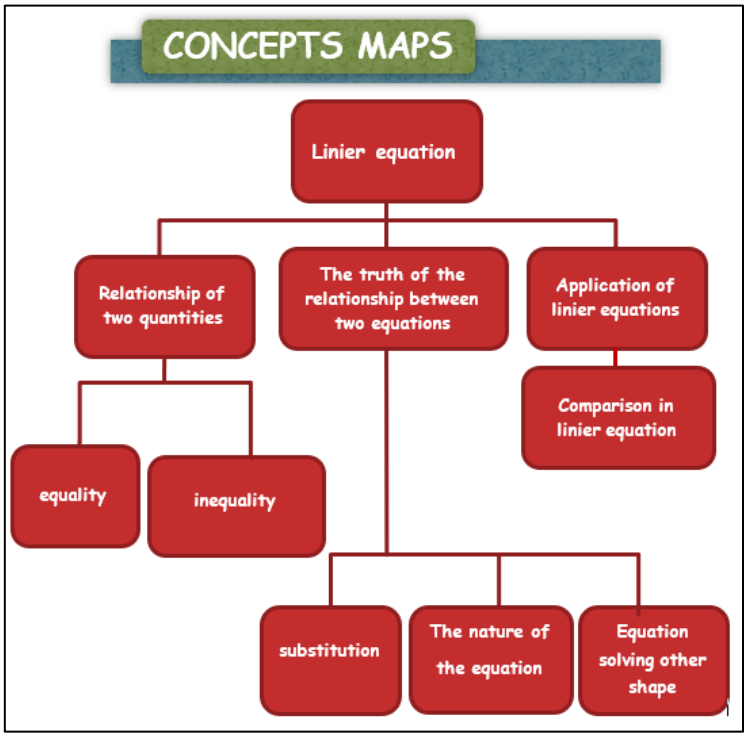


Figure 8. Concepts maps

In the mathematical figures of linear equations, to presents the history of mathematical figures of linear equations, related to biographies and experiences related to mathematics. The page view of the mathematical figures of linear equations can be seen in Figure 9.

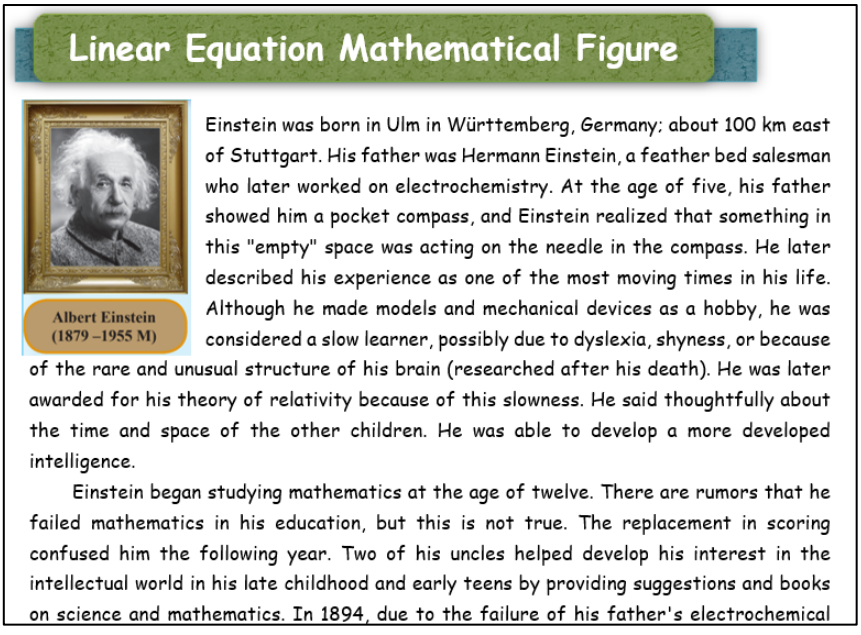
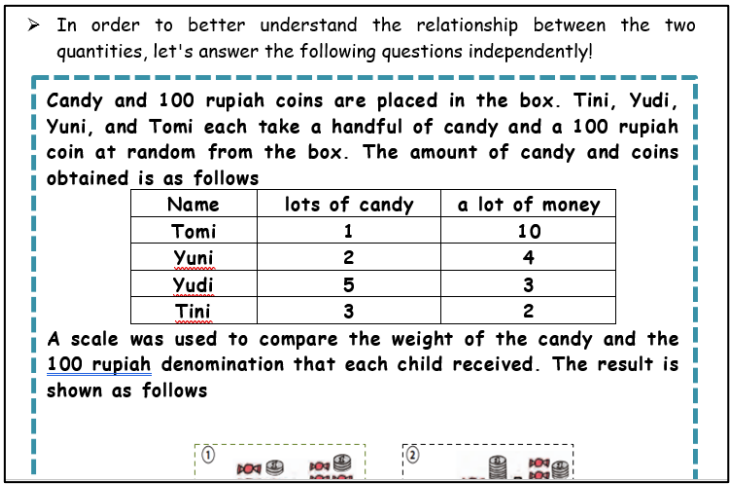


Figure 9. Linear equation figure

Learning Materials. The learning materials in the student worksheet are designed in accordance with the peer instruction type flipped classroom component which is summarized as follows.

Test Concept 1

This component is a problem in the form of the first test question regarding a basic concept of the material. Learners are given this test to find out the extent to which they learners understand the material being studied. Learners are given time to answer the questions individually. The Test 1 Concept view can be seen in Figure 10.


➢ In order to better understand the relationship between the two quantities, let's answer the following questions independently!

Candy and 100 rupiah coins are placed in the box. Tini, Yudi, Yuni, and Tomi each take a handful of candy and a 100 rupiah coin at random from the box. The amount of candy and coins obtained is as follows

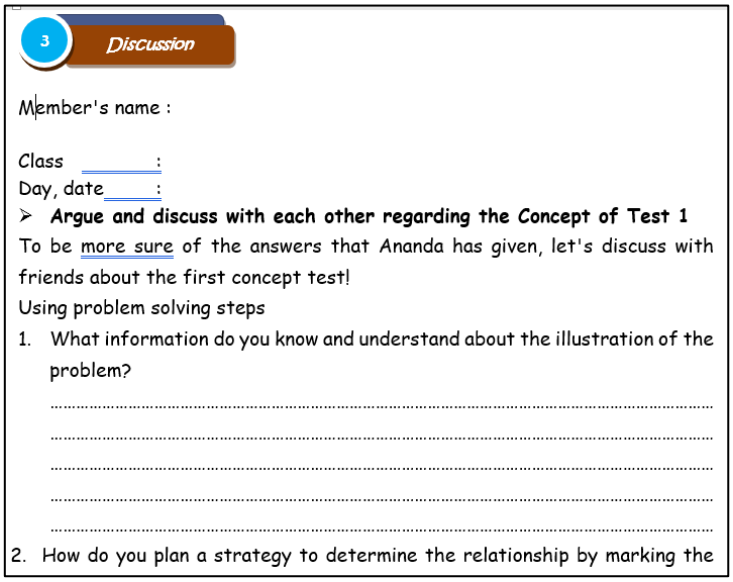
Name	lots of candy	a lot of money
Tomi	1	10
Yuni	2	4
Yudi	5	3
Tini	3	2

A scale was used to compare the weight of the candy and the 100 rupiah denomination that each child received. The result is shown as follows

Figure 10. Concept test 1

Discussion of Test Concepts 1

In this component, students are given the opportunity to discuss and argue with each other about the first test questions given. In this stage, the discussion is carried out in groups. After the students' correct answer to the discussion is more than 80%, it is continued to the second question. The discussion page is shown in Figure 11.


3 Discussion

Member's name :

Class :
Day, date :

➢ **Argue and discuss with each other regarding the Concept of Test 1**

To be more sure of the answers that Ananda has given, let's discuss with friends about the first concept test!

Using problem solving steps

1. What information do you know and understand about the illustration of the problem?

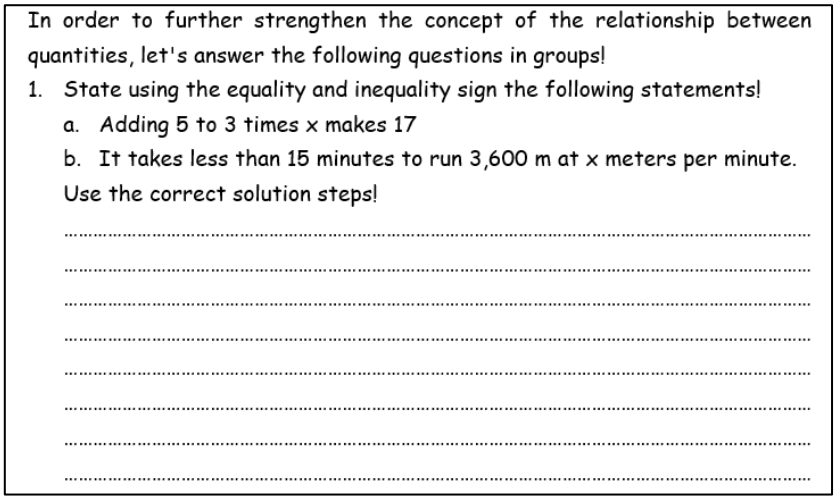
.....
.....
.....
.....
.....

2. How do you plan a strategy to determine the relationship by marking the

Figure 11. Discussion of test concepts 1

Test Concept 2

In this component, the second test question is given to further strengthen the concepts that have been obtained by the students. The work on this question is carried out in groups. The test 2 concept page is shown in Figure 12.


In order to further strengthen the concept of the relationship between quantities, let's answer the following questions in groups!

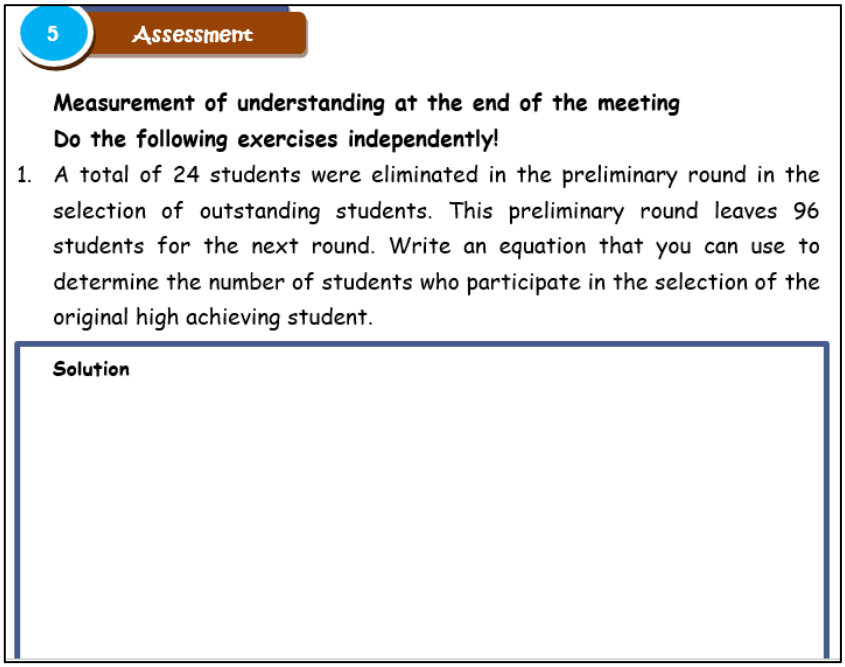
1. State using the equality and inequality sign the following statements!
   a. Adding 5 to 3 times x makes 17
   b. It takes less than 15 minutes to run 3,600 m at x meters per minute.

   Use the correct solution steps!

Figure 12. Concept test 2

Final assessment

At the end of the discussion, students are given a final assessment test related to the evaluation of the linear equation material that has been studied. The final assessment can be seen in Figure 13.


5 Assessment

Measurement of understanding at the end of the meeting

Do the following exercises independently!

1. A total of 24 students were eliminated in the preliminary round in the selection of outstanding students. This preliminary round leaves 96 students for the next round. Write an equation that you can use to determine the number of students who participate in the selection of the original high achieving student.

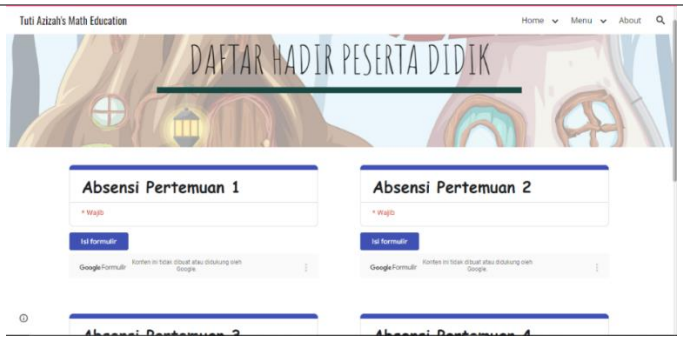
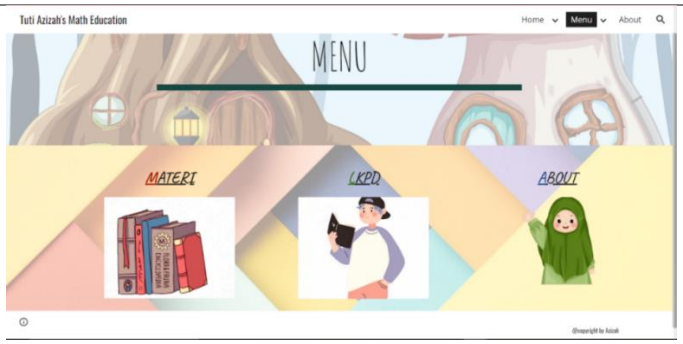
Solution

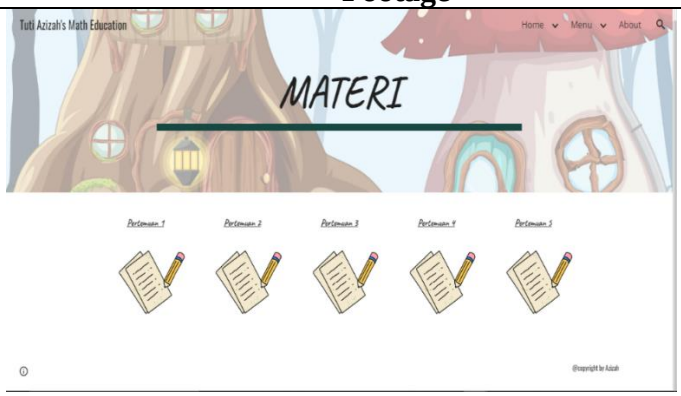
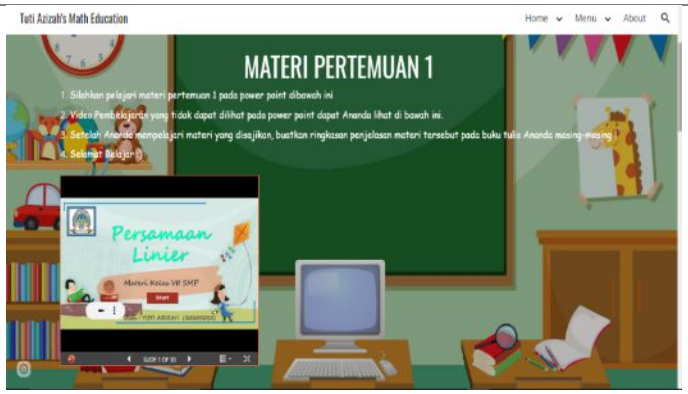
Figure 13. Final assessment

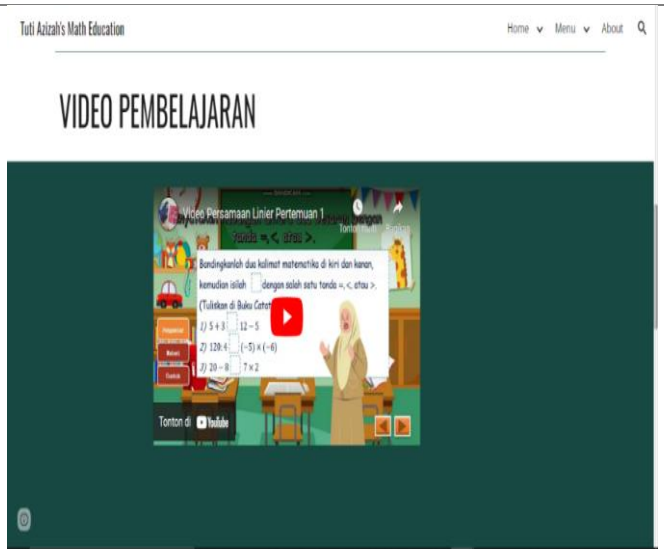
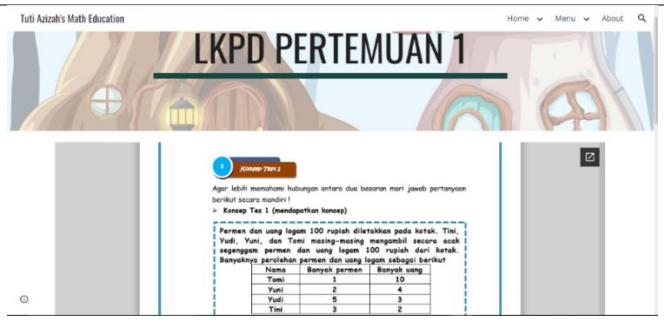
The design stage of learning videos, power point media, and wesite began by establishing the main concepts so that the preparation of the material can achieve learning objectives. The material is presented in the form of learning videos and also in PowerPoint

media that is adapted to the independent curriculum and can help students develop problem-solving skills. The WEB was created by using Google Site which can be accessed at https://sites.google.com/view/tuti-azizahs-math-education/material site. The WEB that has been designed has several navigations, namely home navigation which contains the student's attendance list, menu navigation which consists of materials for each meeting (PPT slides contain learning objectives, materials, quizzes, and learning videos), and the student worksheet menu at each meeting which can be viewed directly or downloaded by students. Here are some views of Learning Videos, Power Point Media, and Website that have been designed. The development of the homepage can be seen in Table 5.

Table 5. Learning video view, PPT, and WEB

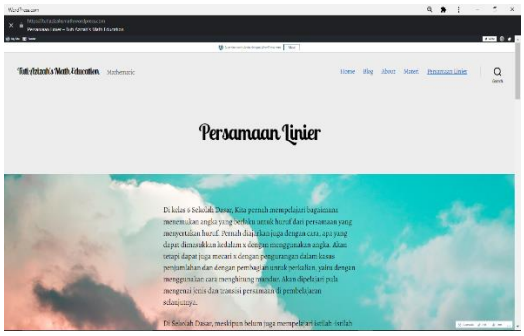
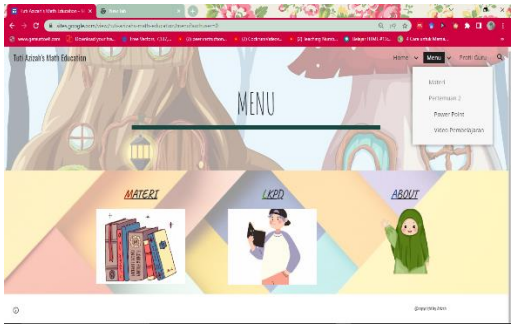
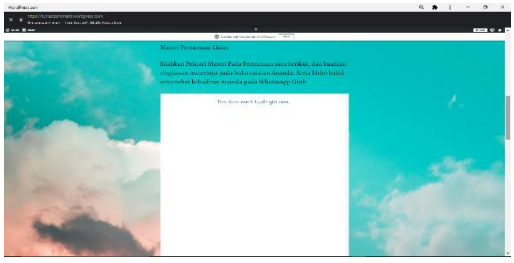
Part	Footage
Homepage. The home page is a WEB start page that contains the identity of the author and there is a student attendance menu.	
Learner attendance page. On this page, students can fill the attendance of the meeting according to the meeting carried out	
Homepage. The home page is a WEB start page that contains the identity of the author and there is a student attendance menu.	

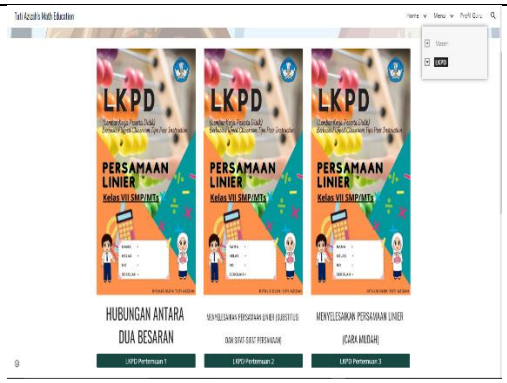
Part	Footage
Display Materials On this page, students can select the material they want to learn at each meeting by clicking on the available meeting icon.	
Meeting Materials 1. On this page, students can learn about the material available in the PPT display by clicking on the PPT section.	
PPT displays. In the PPT, there is an identity menu, concept map, learning (containing materials), quizzes, and teacher profiles. Ppt is equipped with audio that explains the functions of the available menus section.	 

Part	Footage
Download PPT materials In addition, students can learn the material on ppt directly on the WEB. Learners can also download PPT by clicking download	
Learning Videos. On this page, students can watch the learning video by clicking play. Learners can also stop the video by clicking pause. Students can also download videos by going to the video link uploaded on Youtube	
Student worksheet On this page, learners can view and download student worksheets at each meeting	
Teacher profile on this page contains the identity and biography of the author	

Based on the results of the evaluation with colleagues, there are revisions related to the preparation of menus; then, in the PPT, recorded audio is added by the researcher so that students are not confused in operating the menus on the PPT; then, improvements were made to the animations on the PPT slides, improvements on the explanations in the learning video that are a bit slow, and the WEB display. The results of the improvement can be seen in Table 6.

Table 6. Self-evaluation results

Repair Suggestions	Before and after revision
Before the revision, there was only a linear equation menu that contained an introduction, PPT, learning videos After the revision, the menus provided are arranged according to the meeting, and are more complete	Before revision  After Revision 
Before Revision PPT cannot be accessed by other users After the PPT revision can be run on the WEB and the menu button is smooth	Before revision  After revision 

Repair Suggestions	Before and after revision
Before the revision, there was no student worksheet menu that students could download After the revision, the student worksheet menu is given for each meeting so that students can access it as needed	

Based on the results of product development that have been described, it is hoped that this media can improve students' problem-solving abilities. Student problem solving is influenced by how the teacher behaves (Harisman et al., 2019b). If teachers can develop creative learning media such as videos, ppt, and the web, they will be able to change students' problem-solving to be more sophisticated (Harisman et al., 2018, 2019a; Harun et al., 2019). The background of teachers in teaching and the experience of the teachers in teaching also affect how the teachers develop media in the learning process (Fauzan et al., 2019; Harisman et al., 2020; Kariman et al., 2019).

The literature review was also carried out in previous research and found some information related to mathematics learning that can be used as a basis for designing peer instruction-type flipped classroom-based learning tools. Flipped classroom-based mathematics learning model can maximize learning through one-on-one interactions through learning videos uploaded online and offline (Abdelaziz, 2014; Fraga & Harmon, 2014; Kim & Jeong, 2016; Rontogiannis, 2014). Next, the effectiveness of the Flipped Classroom shows that learning at the University becomes more effective with flipped learning (Ma et al., 2018; McCabe et al., 2017; Wachira & Absaloms, 2017; Wong & Chu, 2014).

The theoretical study of Flipped classrooms in mathematics learning shows that the flipped classroom learning model can help students learn both inside and outside the classroom, resulting in students being directly involved in the learning process and along with the development of information and technology that does require teachers to apply technology in learning activities and is based on the characteristics of mathematics learning (Choi et al., 2015; Iverson et al., 2017; Lin & Hwang, 2019; McCabe et al., 2017; Wachira & Absaloms, 2017). Next, flipped learning model with peer instruction can improve problem-solving abilities (Bokosmaty et al., 2019; Gough et al., 2017; Kim & Jeong, 2016; Matzumura-Kasano et al., 2018; Wang et al., 2019; Zhang et al., 2018).

4. CONCLUSION

The development of this product is based on a preliminary analysis comprising needs analysis, analysis of student characteristics, curriculum analysis, concept analysis, and literature analysis. Based on the preliminary analysis, the material arrangement of linear equations is arranged into 5 meetings, the first meeting is studying the relationship between two magnitudes ($<$, $>$, $=$, $\leq$, $\geq$) in a problem. Understanding the correctness of mathematical sentences of equations when letters are substituted with numbers in a problem, the second meeting determines the solution of an equation without substituting numbers into letters in a problem; Solving equations using the properties of equations in a problem, third meeting

solves equations using the idea of moving tribes in a problem; fourth meeting solving equations in the form of decimals and fractions in a problem, solving problems by using linear equations; the fifth meeting is understanding ratio relationships by using linear equations in a problem and solving problems related to ratios by using linear equations. Furthermore, based on the distribution of materials, a learning video with a duration of 10-15 minutes was prepared based on the results of the preliminary analysis; the material is also provided in the form of PPT slides which have menus that are provided with audio features to make it easier for students to carry out PPT. In the end, there is a quiz that can be done by students to measure their ability of students after studying the materials, and the student worksheet contains practice problem-solving questions that are arranged based on a flipped classroom type of peer instruction which consists of the first test question, discussion of the first test, second test, and final assessment. The lesson plans are prepared following the curriculum used in schools and contain this activity with the steps of a flipped classroom type of peer instruction, namely pre-class students' study first at home by accessing the WEB which includes learning videos, and PPT and providing the results of material resumes by uploading them to the menu. The main activities in the classroom are students completing student worksheets according to the steps of the flipped classroom type of peer instruction.

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