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Interactive e-student worksheet based on computational thinking with South Sumatera Traditional Game context

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Abstract

This research aims to develop an interactive e-student worksheet on integers in the context of traditional South Sumatran games that is valid and practical. This research was carried out at SMP in Martapura class VII in the odd semester of the 2023/2024 academic year. This research uses a type of development research (Research and Development) using the ADDIE model but researchers only use three stages, namely Analysis, Design and Development. The validity of the interactive e-student worksheet is checked through 3 factors, namely construct, content and language contained in the validation sheet at the Expert Review stage and input or comments from the experimental results at the One to One stage. The practicality of interactive e-student worksheet is based on the results of questionnaire calculations given at the Small Group stage. The results of the research show that the development of interactive e-student worksheet has a validity of 95.3125% with very valid criteria and a practicality percentage of 86.25% which is classified as very practical

Keywords*: Development, Interactive E-Student Worksheet, Computational Thinking, Integers*

Abstrak

Penelitian ini bertujuan untuk mengembangkan E-LKPD interaktif materi bilangan bulat dengan konteks permainan tradisional Sumatera Selatan yang valid dan praktis. Penelitian ini dilaksanakan pada SMP di Martapura kelas VII pada semester ganjil tahun pelajaran 2023/2024. Penelitian ini menggunakan jenis penelitian pengembangan (Research and Development) dengan menggunakan model ADDIE tetapi peneliti hanya menggunakan tiga tahap yaitu Analysis, Design dan Development. Validitas lembar kerja e-LKPD interaktif diperiksa melalui 3 faktor yaitu konstruk, isi dan bahasa yang terdapat pada lembar validasi pada tahap *Expert Review* dan masukan atau komentar dari hasil percobaan pada tahap *One to One*. Kepraktisan E-LKPD interaktif didasarkan pada hasil perhitungan angket yang diberikan pada tahap *Small Group.* Hasil penelitian menunjukkan bahwa pengembangan E-LKPD Interaktif mempunyai validitas sebesar 95,3125% dengan kriteria sangat valid dan persentase kepraktisan sebesar 86,25% yang tergolong sangat praktis.

Kata kunci: Pengembangan, E-LKPD Interaktif, *Computational Thinking*, Bilangan Bulat

INTRODUCTION

Education has always been used as a foundation for making changes and updates in the field of technology in accordance with the demands of developments in science and technology (Utomo et al., 2021). In the 4.0 era, one way to support the learning process is information technology. Learning media that can be accessed via mobile devices include cellphones, laptops and tablets which are used as new alternative tools because they make it easier for users to access them anywhere and anytime (Nabilla et al., 2022).

In the field of education, technology has an important influence on science, where in science students are taught about natural phenomena and facts and with this technology, humans use technology to apply this knowledge (Maritsa et al., 2021). Education has always been used as a foundation for making changes and updates in the field of technology in accordance with the demands of scientific and technological developments (Utomo et al., 2021). In the 4.0 era, one way to support the learning process is information technology, namely with learning media that can be accessed via mobile devices, including cellphones, laptops and tablets which are used as new alternative tools because they can facilitate users by being accessible anywhere and anytime (Nabilla et al., 2022) With technology, students can be more active in participating in learning (Rahman & Hapizah, 2021). Entering today with the advancement of worldwide technology has affected various aspects of life in the fields of politics, economics, culture, art and even education (Muhammad et al., 2017).

This is a real challenge for teachers and students to use technology in education (Lapitan et al., 2021). Teachers must be able to take advantage of technological developments by developing or finding new innovations that can support and facilitate students in interactive learning activities so that they can increase motivation and enthusiasm for learning. Students can play an active role in learning activities (Anggraeni et al., 2021). Moreover, students now must be prepared to face the challenges of the 21st century which is full of challenges and competition (U. Khasanah & Herina, 2019). One of the abilities that students need in the 21st century is *Computational Thinking (CT)* as said by (Azmi & Ummah, 2021) Computational Thinking (CT) is something that is very necessary in mathematics.

However, student's computational thinking abilities are still relatively low (Lestari & Roesdiana, 2023). In line with what (Marchelin et al., 2022) said that most secondary school students still have low computational thinking skills. Then (Supiarmo, Turmudi, et al., 2021) also said that students' computational thinking skills are still low and need attention. In addition, based on the results of research conducted by (Kamil et al., 2021)

said that 64% of students' computational thinking skills still need attention. In line with research conducted by (Jamalludin et al., 2022 that 67% of students still do not have good computational thinking skills, especially on integers.

As stated by (Rara et al., 2022) that the process of mathematics learning process in Indonesia has not been oriented towards computational thinking skills. Then the results of (Sa'diyyah et al., 2021) which say that student computational thinking skills are still low and need to be improved. One way to improve computational thinking skills is by providing problem solving questions (Sa'adah et al., 2023). Computational thinking is an approach to problem solving abilities (Nasiba, 2022. Research conducted by (Setiana, 2018) also shows that computational thinking skills can be developed with problem solving. Then the results of (Supiarmo, Mardhiyatirrahmah, et al., 2021) research show that the optimal computational thinking process can be used in solving problems through the steps of statements, instructions, reminders, directions and encouragement.

One of the materials that can examine mathematical problem solving skills is integers because in integer material students are required to solve problems related to several integers and integer counting operations (Rio & Pujiastuti, 2020). Integer material is very important because it can support students in carrying out the problem solving process (Melindarwati & Munandar, 2022). Because with this material students are required to be able to complete the problem solving process because they are faced with problems related to integers and operations on integers that must be resolved (Parulian et al., 2019).

However, integers are still one of the materials that students find difficult to learn because integer material is abstract so that it has an impact on the low learning outcomes of students who do not reach the minimum score of more than 50% (Arifuddin & Ar-rosyid, 2017). One of the causes of difficulties experienced by students in integer material is that the supporting books and learning tools that students have are still lacking (Mandasari & Rosalina, 2021). The teacher only utilizes printed books as learning media so that many students have low scores on whole number material (Nuryati et al., 2021). Teachers should be able to make learning integers more fun by providing contexts (Muslimin et al., 2020). Or it can also use media so that it can create cooperation between students in whole number material (Aris et al., 2017).

One way that can be done is by providing students with teaching materials to help with the learning process (Hardi et al., 2023). Student Worksheets are one of the teaching materials that can make it easier for students to understand the material they are studying, which can be used as a guide to solving problems and encourage students in the thinking

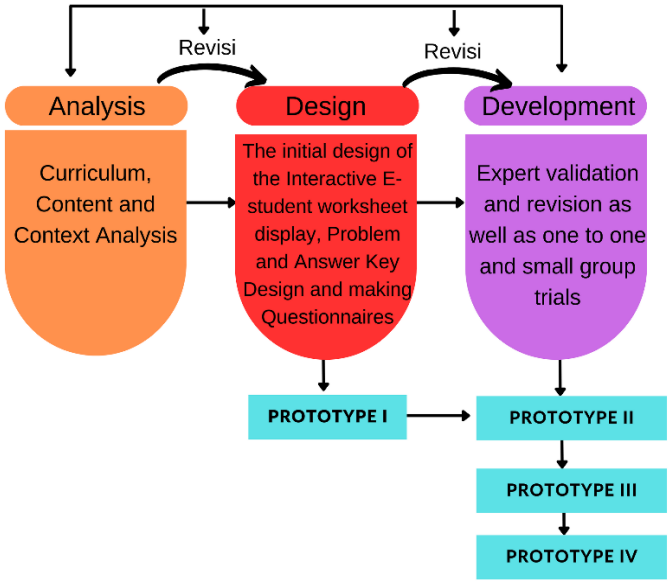
process, making it easier for students to solve the problems given (Rewatus et al., 2020). Student worksheet is able to make the learning process more systematic (Anggraeini et al., 2022). In the era of Industrial Revolution 4.0 learning applied in the learning process, teaching staff must be able to develop digital-based teaching materials that can be used by students anywhere and at any time (Ramadhani & Fitri, 2020). This digital teaching material is an innovative form of conventional teaching material in general which makes students more enthusiastic because there are pictures, music and others that make students more enthusiastic (Indariani et al., 2019). One of the digital teaching materials is E-Student Worksheet. E-Student Worksheet is a student worksheet that was developed with various innovations, namely by utilizing electronic media as a learning medium that can support the learning process (Syafruddin et al., 2022). E-student worksheet can encourage students to be actively involved with the material discussed, and students get direct experience so they are not limited to mere knowledge (Rahayu, 2018). E-student worksheet also acts as an interactive facility and has easy access and contributes to student independence (Dewi et al., 2022). According to (Fukuda, 2020) CT abilities can be improved through interactive multimedia-based teaching materials.

Another cause that makes students have difficulty in solving whole number operation problems is that students do not understand the concept of whole numbers contextually, resulting in students having difficulty solving addition and subtraction problems of positive whole numbers and negative whole numbers (Mulyani et al., 2018). To overcome this, the use of context in the E-LKPD can be done. Using context makes math learning more meaningful for students (Kurniawan & Susanti, 2021). Mubharokh et al. (2022) said that the use of context can make it easier for students to understand and remember what they learn. In this case, the researcher chose the context of traditional games. The use of traditional game contexts can help students understand concepts through real activities that are simulated into a fun game (Martines et al., 2023).

RESEARCH METHOD

This research is a design research type of development studies which aims to produce interactive Electronic Student Worksheets (E-student worksheet) on integer material to support valid and practical computational thinking abilities. The subjects in this research are nine students of class VII in the odd semester of the 2023/2024 academic year. Subject selection uses a purposive sampling technique, where selection is based on recommendations from the teacher and on the availability of students. The data collection techniques used were questionnaires and interviews.

The interactive E-student worksheet development procedure used in this research refers to the ADDIE development model but only uses the Analysis, Design, Development stages. The flow of this research development model is as shown in **Picture 1** below



Picture 1. Diagram development of ADDIE

Analysis Stage

At this stage, a needs analysis will be carried out in developing interactive E-student worksheet as the basis for formulating the learning that is carried out. Analyze the curriculum used, namely curriculum Merdeka and then review the literature on the learning material used, namely integers and analyze the abilities of students who will be tested with different abilities ranging from low, medium and high.

Design Stage

After analyzing, in this second stage is the design or in other words, the researcher prepares the E-LKPD design or referred to as prototype 1 using Canva which consists of two problems of integers material using the context of traditional games in the form of marbles and rubber bands. Then create questions for each problem that help direct students to use computational thinking skills. Then at this stage a validation sheet is also designed to be given to the validator during the expert review and a practicality questionnaire to be given when conducting small groups.

Development Stage

At this stage, create an interactive E-student worksheet with an initial design created directly through the Canva application. Canva can create a variety of attractive designs (Tanjung & Faiza, 2019). Canva also has many interesting designs, can include videos that attract students' attention, and can be accessed for free (Kurniasari et al., 2022; Pelangi, 2020; Serevina & Hamidah, 2022). The questions that have been created will be included in the design. After completing the design, the E-student worksheet that will be used is converted into a link that can be accessed by electronic devices using their respective browsers. The design used is based on expert review and revision of prototype I using a validation sheet which will be analyzed using a Linkert scale with the scale in **Table 1**.

Table 1. Evaluation category validation sheet

Skor	Validity Score
4	Very good
3	Good
2	Enough
1	Less Good

Next, a calculation of the values obtained through the validation data sheet is carried out to check whether the E-student worksheet is valid or not through the equation:

$$\text{valid } \textit{skor} = \frac{\text{total score obtained}}{\text{maksimal skor}} \times 100\%$$

(Akbar, 2013)

The validity value that has been obtained is to determine the level of validity of the E-student worksheet which has been validated through the validity requirements described in Table 2.

Table 2. Validity criteria

Validity Level	Validity Criteria
82% - 100%	Very Valid
63% - 81%	Valid
44% - 62%	Invalid
25% - 43%	Not Valid

(Sugiyono, 2017)

Furthermore, revisions will be made based on suggestions and criticisms from ASM validators who are experts in computational thinking, MWA validators who are experts in the field of learning media and FV validators who are experts in the field of language using instruments adapted from (Mubharokh et al., 2023) resulting in prototype II. The interactive E-student worksheet trial was carried out one to one with 3 students, each of them representing low, medium, and high abilities based on their learning outcomes in the researcher's environment at the same school with the aim of finding out and seeing the parts of the questions and interactive activities that needed to be revised. Trials are carried out directly with students and students' comments on the interactive E-student worksheet will be improved so that it is possible to produce prototype III.

Next, a small group trial will be carried out on 6 people from the same school who are grouped heterogeneously and then divided into two groups. In the small group, students were given a practicality questionnaire adapted from (Mubharokh et al., 2023) with seven positive statements and three negative statements to see the practicality of the product that has been developed and small discusion is also held to find out if there are difficulties experienced when usin E-student worksheet.

Table 3. Practically questionnaire

No	Question	Responses			
		SS	S	TS	STS
1.	The color display of Interactive E-student worksheet is very interisting				
2.	The size of the video displayed on the Interactive E-student worksheet is appropriate				
3.	Learning that has been done using E-student worksheet makes me more understand				
4.	The sentences used in the E-student worksheet are easy to understand				
5.	The Interactive E-student worksheet instructions are clear so that it makes it easier for me to solve the problems given				
6.	The Interactive E-student worksheet can be accessed anywhere by using a cellphone				
7.	The Interactive E-student worksheet motivate me to study while at school				
8.	The interactive E-student worksheet cannot motivate me to study outside of school hours				
9.	The Interactive E-student worksheet does not make me want to solve the problem				
10.	The Interactive E-student worksheet display is boring				

The results of this small group trial will be used as an evaluation. If revisions are still found, it will produce prototype IV. The questionnaire sheets were analyzed using a Linkert scale with practicality requirements as in **Table 4** and **Table 5.**

Table 4. Likert scale statement format

Attitude Statement	Skor	
	Positif	Negatif
Strongly Agree (SS)	4	1
Agree (S)	3	2
Disagree (TS)	2	3
Strongly Disagree (STS)	1	4

Table 5. Practicality criteria

Achievement Level	Information
$84\% \leq N_a \leq 100\%$	Very Practical
$68\% \leq N_a \leq 84\%$	Practical
$52\% \leq N_a \leq 68\%$	Less Practical
$36\% \leq N_a \leq 52\%$	Impractical
$20\% \leq N_a \leq 36\%$	Very Impractical

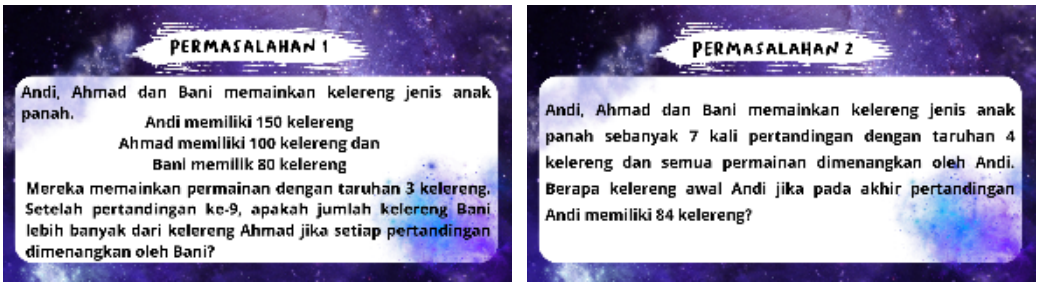
RESULT AND DISCUSSION

Analysis Stage

The first stage of this research is the analysis stage. Researchers conducted an analysis of needs analysis, curriculum analysis, namely the learning outcomes on integer material are students can apply arithmetic operations on real numbers and provide estimates / estimates in solving problems, student analysis and material analysis. Needs analysis is carried out by observing during the learning process in order to find what is needed. Student analysis to understand the capabilities of the students who want to be studied. The author conducted an analysis on class VII students. From the results of interviews with teachers, the results showed that students' computational thinking abilities were still low. Then the teacher provides suggestions for determining students who will be subjects at the one to one and small group stages. Then the author analyzes the curriculum used, namely the Kurikulum Merdeka. Then finally, material analysis, after discussing with the teacher, it was found that the material to be used was integers about addition and subtraction using the context of the traditional game of marbles and then for multiplication and division using the context of the traditional game of rubber bands.

Design Stage

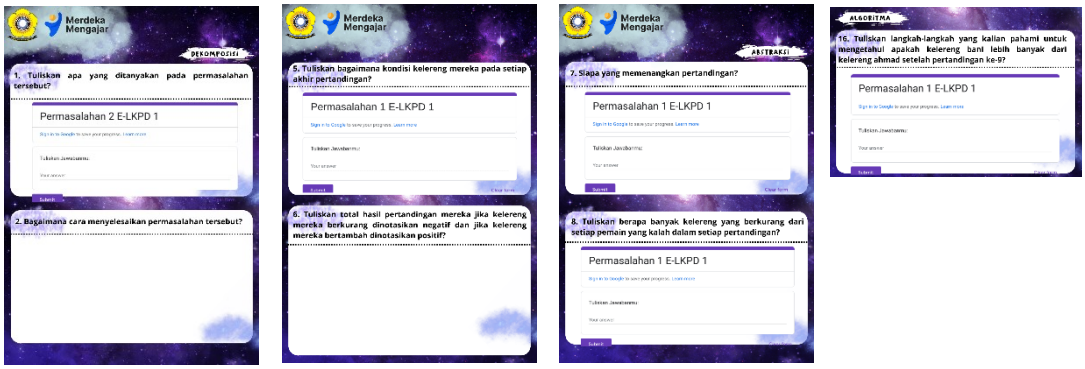
At this stage, researchers begin to design the questions that will be used in the E-student worksheet that will be developed. The researcher created problems with material of adding and subtracting integers using the context of traditional Marbles games and multiplying and dividing integers using the context of traditional South Sumatran Rubber Band games to make it easier for students to understand the problems as shown in Picture 2. As stated by (Putri et al., 2023) by using a context that students understand, students can be better able to answer the questions given. After that, the researcher designed an interactive E-student worksheet using Canva. Researchers design any pages on Canva that will be used in research.



Picture 2 Problems in interactive e-student worksheet

The problems above include non-routine questions that students rarely encounter. This question also requires students to understand the problem which includes what is known and what is being asked, then develop a solution plan, carry out the solution and conclude the results of the answer, where the steps above help students to master computational thinking skills. The following are the results of Prototype I that was created:

Picture 3a. *Prototype* I



Picture 3b. *Prototype* I

Development Stage

At this stage, several stages are carried out to test the validity of the product being developed, namely Expert Review, One to One and Small Group. From the results of prototype I, validation will be carried out with the validator. The validation sheet contains 23 questions consisting of content, construct and language. The following are the results of the E-student worksheet validation from expert review in Table 6.

Table 6a. Validation result from *expert review*

No	Aspect	Indicator	Percentage
1	Contents	Interactive e-student worksheets created according to Learning Outcomes	100%
		Interactive e-student worksheet created in accordance with Learning Outcomes, Learning Objectives Flow	100%
		Suitability of problems in E-student worksheets with Integer material	95,83%
		The problems in the E-student worksheet lead to computational thinking abilities	95,83%
		Provisions and completeness of the problems contained in the interactive E-student worksheet	100%
		Problems on E-student worksheets can be used to train students to break down problems into sub-problems	100%
		Problems on E-student worksheets can be used to train students to use previous knowledge that is useful for solving problems	100%
		Problems on E-student worksheets can be used to train students to select important information needed to solve problems	83,33%
		Problems on E-student worksheets can be used to train students to solve problems systematically	100%

Table 6b. Validation result from *expert review*

No	Aspect	Indicator	Percentage
2	Construct	Questions number 1 – 3 are the stages of the decomposition indicator	100%
		Questions number 4 – 6 are the pattern recognition indicator stages	95,83%
		Questions number 7 – 13 are the abstraction indicator stages	83,33%
		Questions number 14 – 15 are the algorithm indicator stages	95,83%
		The order of the E-student worksheet question structure is appropriate according to the computational thinking indicator stages	91,67%
		Select contrasting text so it is easy to read	95,83%
		Choose a contrasting background so it is easy to read	100%
		The interactive E-student worksheet design has an appearance that is attractive to read	100%
		The interactive E-student worksheet design has an attractive appearance for learning	100%
		Easy for users to access E-student worksheets	91,67%
3	Language	Use of language that complies with Enhanced Spelling (EYD) V5	91,67%
		The sentence structure contained in the E-student worksheet is clear	91,67%
		The sentences used in the E-student worksheet are clear	91,67%
		The sentences used in the E-student worksheet are easy to understand	87,5%
		The punctuation used in the E-student worksheet is correct	95,83%
		Average percentage	95,3125%

Based on the validation above, an average percentage of validity was obtained of 95.3125%, which shows that the interactive E-student worksheet is quite valid but needs to be revised based on comments and suggestions from the validator. In line with the result of research by (Putri et al., 2022) with a validity of 84,9%, (Meriza et al., 2022) with a validity of 84,9%, also (Rulyansah & Sholihati, 2018) with a validity of 92,15%. This is in line with what (I. Khasanah & Agung, 2019) said which states that the aspect of validity itself is a product that determines the quality of the learning device created where this aspect is seen from the material on the device. The following are comments and suggestions from validators regarding this interactive E-student worksheet with comments and suggestions in **Table 7.**

Table 7. Comments and suggestions along with revision Ddecisions

Validator	Comments/Suggestions	Revision Decision
Validator A (Expert in Computation-al Thinking)	The column for answering is too small	One page is created for one question
	There are too many problems on each E-student worksheet so students don't have time to answer them	One E-student worksheet creates one problem
	There are several questions that have the same meaning	Delete one of the questions that has the same meaning
	Added an interactive number line that students can try	Create a number line using the Geogebra application then add it to the E-student worksheet page
Validator B (Expert in the field of learning media)	Adding content to make it more varied	The problem with E-student worksheets is that they use rubber band content
	There is no need to add indicator information for each question	Removed indicator information on each question
Validator C (Expert in languages)	Improve vocabulary so that it is easier for students to understand	Correct some vocabulary that is difficult for students to understand
	Added instructions to the interactive number line	Added instructions to the interactive number line

Based on suggestions and comments from validators, revisions were made to prototype I as follows:

Table 8a. Revisi from *expert review*

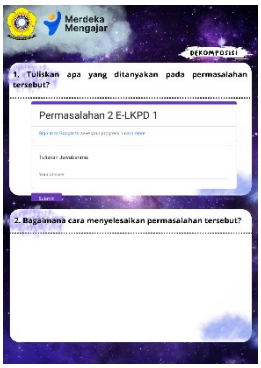
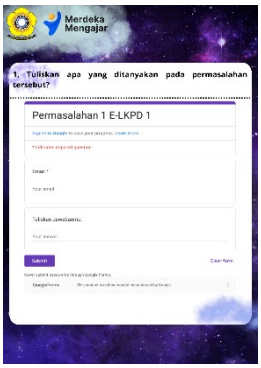
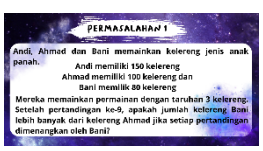
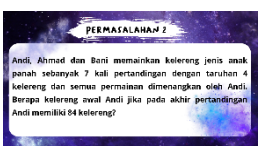
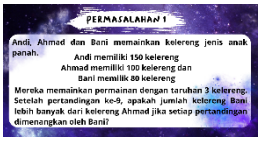
No	Before Revision	After Revision
1	The column for answering is too small 	One page is created for one question 
2	There are too many problems on each E-student worksheet so students don't have time to answer them  	One E-student worksheet creates one problem 

Table 8b. Revisi from *expert review*

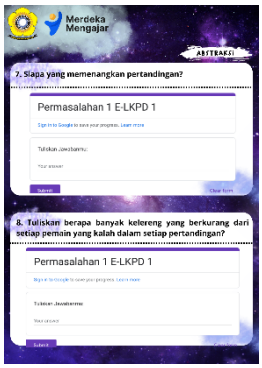
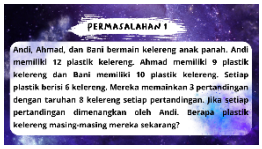
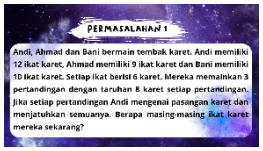
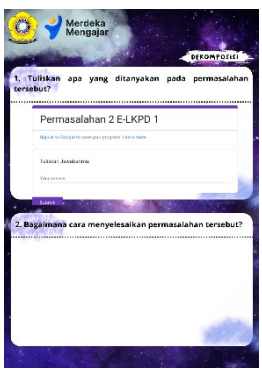
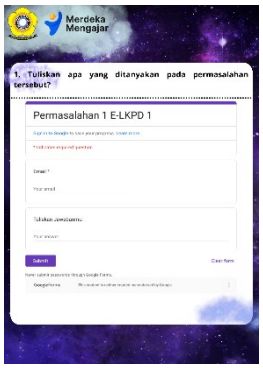
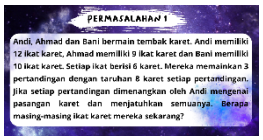
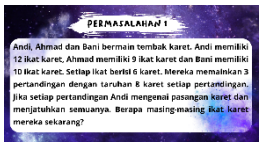
No	Before Revision	After Revision
3	There are several questions that have the same meaning 	Delete one of the questions that has the same meaning
4	Added an interactive number line that students can try	Create a number line using the Geogebra application then add it to the E-student worksheet page 
5	Adding content to make it more varied 	The problem in E-student worksheet 2 uses rubber band content 
6	There is no need to add indicator information for each question 	Removed indicator information on each question 

Table 8c. Revisi from *expert eeview*

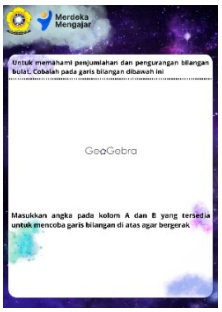
No	Before Revision	After Revision
7	Improve vocabulary so that it is easier for students to understand 	Correct some vocabulary that is difficult for students to understand 
8	Added instructions to the interactive number line 	Added instructions to the interactive number line 

Based on the results of discussions and revisions that have been carried out, the results at this stage are called prototype II. Apart from being tested in an expert review, the prototype II that was obtained was tested on 3 students to see the validity of the interactive E-student worksheet that had been developed. These students who have been selected based on suggestions from teachers and student availability. The following are the overall results of observations of the difficulties experienced by students in working on E-student worksheet at the one to one stage along with the revision decisions taken by the author.

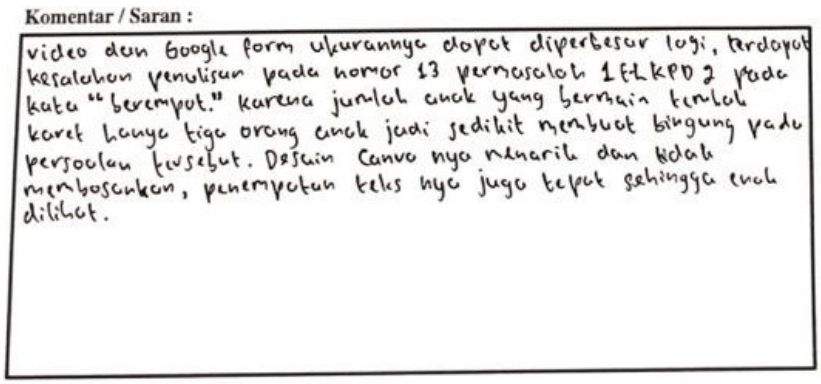
Table 9a. Student Difficulties and Revision Decisions

No	Student Difficulties	Revision Decision
1	Students do not understand question number 2 on the E-student worksheet	Still maintained
2	Students do not understand question number 5 on the E-student worksheet 	Question fixed 

Table 9b. Student Difficulties and Revision Decisions

No	Student Difficulties	Revision Decision
3	Students are confused by the available number lines 	Clarify instructions on the number line 

Apart from seeing the difficulties experienced by students when working on E-student worksheet. Researchers also provide comment/suggestion sheets to students to provide their comments and suggestions. As in the following image:



Picture 4. Coment in one to one stage

The revised results from one to one were called prototype III which was then tested in small groups which were divided into 2 groups, each group consisting of 3 students who have been grouped heterogeneously. This small group trial aims to see the practicality of the interactive E-student worksheet that has been developed. After students work on the E-student worksheet, students are asked to write comments/suggestions on the E-student worksheet given. The results of the comments/suggestions provided will be used by researchers as consideration for making revisions. Apart from filling in comments/suggestions, students are also given a practicality questionnaire which aims to see the practicality of the E-student worksheet that has been developed. The questionnaire contained 10 statements and was filled in individually by students with an average

percentage of 86.25% which was included in the very practical category, then the result of this obtained prototype IV. In line with the result of research by (Putri et al., 2022) with a practicality result of 89%, (Meriza et al., 2022) with a practicality result of 83,75%, also (Rulyansah & Sholihati, 2018) with a practicality result of 88,35%. As stated by (Milala et al., 2021) practicality refers to the condition of learning media developed by users, both students and teachers, so that the learning carried out is meaningful, interesting, fun and useful for students and increases creativity in learning. The results of calculating the results of the practicality questionnaire are in **Table 10**.

Table 10. Practicality questionnaire results

No	Practicality Indicator	Percentage	Criteria
1	The color display on the E-student worksheet is very attractive	87,5%	Strongly Practical
2	The video size displayed on the E-student worksheet is appropriate	79,17%	Practical
3	The learning that has been done using the E-student worksheet has made me understand more	87,5%	Strongly Practical
4	The sentences used in the E-student worksheet are easy to understand	75%	Practical
5	The E-student worksheet instructions are clear, making it easier for me to solve the problems given	87,5%	Strongly Practical
6	E-student worksheets can be accessed anywhere using a mobile phone	83,33%	Strongly Practical
7	E-student worksheets motivate me to study while at school	83,33%	Strongly Practical
8	E-student worksheets cannot motivate me to study outside school hours	91,67%	Strongly Practical
9	The e-student worksheet provided did not make me want to solve the problem	95,83%	Strongly Practical
10	The interactive E-student worksheet display is boring	91,67%	Strongly Practical
	Average percentage	86,25%	86,25%

CONCLUSION

Based on the development stage, it can be concluded that the interactive E-student worksheet that has been developed can be categorized as a valid product. This validity can be seen from the results of validation by 3 validators in terms of context, construct and language with an average percentage of validity of 95.3125%, which means that the E-student worksheet developed is quite valid but needs to be revised based on comments and suggestions. In addition, the validity of this interactive E-student worksheet is also seen from the learning process at the one to one stage where students do not have any difficulties and there are not many problems found. The interactive E-student worksheet

that has been developed can be categorized as a practical product that can be seen from the practicality questionnaire which was filled out by students at the small group stage with an average percentage of 86.25% and was categorized as very practical. Apart from that, this practicality can also be seen from discussions with subject after using interactive E-student worksheet along with comments and suggestions from subjects at the small group stage. Future researchers can develop interactive E-LKPD using other materials and can conduct further trials at the implementation stage in order to get the effect of using the developed E-LPKD.

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