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The Positive Impact of E-LKPD Material on Number Patterns Based on Computational Thinking with the Malay Islamic Context on Students' Mathematical Reasoning

Angge Sapto Mubharokh[1*], Hapizah[2], Ely Susanti[3]

[1,2,3] Mathematics Education, Universitas Sriwijaya, Palembang, Indonesia
*Corresponding author: unggulsapto@gmail.com

Abstrak

Peserta didik masih kesulitan dalam menggunakan pola dan hubungan untuk menganalisis situasi matematis. Tujuan penelitian ini untuk dampak positif E-LKPD materi pola bilangan berbasis computational thinking dengan konteks islam melayu terhadap penalaran matematis peserta didik. Penelitian ini adalah penelitian desain research dengan jenis development studies yang memiliki tahapan preliminary research, prototype stage, dan summative evaluation. Teknik pengumpulan data dalam penelitian ini adalah angket, wawancara, dan tes. Adapun teknik analisis data dalam penelitian ini adalah angket dan wawancara dilakukan secara kualitatif dan tes diukur berdasarkan indikator penalaran matematis. Hasil penelitian ini adalah E-LKPD yang dikembangkan bersifat valid yang diperoleh dari hasil validasi pakar dan konfirmasi peserta didik yang memperoleh komentar dan saran. Selain itu E-LKPD yang bersifat praktis terlihat dari peserta didik memberikan respon E-LKPD. Dampak yang terjadi setelah diterapkan E-LKPD yaitu membuat peserta didik mampu menuliskan apa yang diketahui dari permasalahan, mampu menemukan pola dan menghubungkannya, hingga menentukan prosedur penyelesaian yang tepat. Simpulan penelitian menunjukkan penerapan E-LKPD berbasis computational thinking memiliki dampak terhadap kemampuan penalaran matematis peserta didik. Implikasi penelitian ini dapat meningkatkan kemampuan berpikir kritis siswa.

Kata Kunci: *Computational Thinking, E-LKPD, Konteks Islam Melayu, Penalaran Matematis*

Abstract

Learners still need help in using patterns and relationships to analyze mathematical situations. This study aimed to positively impact E-LKPD on number pattern material based on computational thinking with Malay Islamic context on students' mathematical reasoning. This research is design research with the type of development studies that have preliminary research, prototype stage, and summative evaluation stages. Data collection techniques in this research are questionnaires, interviews, and tests. The data analysis techniques in this study are questionnaires and interviews conducted qualitatively and tests measured based on mathematical reasoning indicators. The result of this research is that the E-LKPD developed is valid, obtained from expert validation and confirmation of students who get comments and suggestions. In addition, the E-LKPD, which is practical, can be seen in students responding to the E-LKPD. Applying E-LKPD allows students to write what is known from the problem, find patterns, and connect them to determine the right solution procedure. The research conclusion shows that applying E-LKPD based on computational thinking impacts students' mathematical reasoning ability. The implication of this research can improve students' critical thinking skills.

Keywords: Computational Thinking, E-LKPD, Malay Islamic Context, Mathematical Reasoning

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1. INTRODUCTION

Mathematics is one of the basic sciences that is very important in everyday life and is the basis of other sciences. The important role of mathematics in everyday life is one of the objectives of learning mathematics, to develop problem-solving abilities and train ways of thinking and reasoning in conclusion (Rahmiati et al., 2017). One of the mathematical materials that requires students to be able to connect problems in everyday life into the language of mathematics is the matter of number patterns. Number pattern material requires students to use inductive reasoning to look for mathematical relationships (Octriana et al., 2019; Spangenberg & Pithmajor, 2020). Learning mathematics is built to develop students'

creativity which can improve the ability to think, argue, and contribute to solving problems in everyday life (Asmara et al., 2019; Novera et al., 2022). Learning activities that emphasize the development of students' thinking skills and creativity are needed by elementary school students to develop their special mindset in everyday life and learning science.

Students still need help using patterns and relationships to analyze mathematical situations (Ariyanti & Setiawan, 2019). They have not been able to detect the regularity of a pattern or formulate a pattern from a pattern regularity (Suciyati Sartika et al., 2022). In detecting the regularity of a pattern, students always focus on number patterns with the same difference. In formulating a pattern from an orderly pattern, students always use the formula in the book to solve the problem directly and use it only by knowing the difference between each arrangement of patterns, even though the application is wrong (Ariyanti & Setiawan, 2019; Sari et al., 2018; Suciyati Sartika et al., 2022). In addition, weak mathematical reasoning skills can also be seen from The Trends in International Mathematics and Science Study (TIMSS) results in 2015, where Indonesia was ranked 44th out of 49 countries with an average score of 397. Based on the TIMSS Report 2015 results, the passing percentage of students' mathematical reasoning abilities in Indonesia, especially reasoning abilities, is 17%. It turns out that this percentage is far below the average international pass percentage, which is 30% for reasoning (Mullis et al., 2016). The cause of the weak mathematical reasoning of students, when viewed from the point of view of learning, is caused by the teaching materials used in learning that have not been able to stimulate students' mathematical reasoning, and teaching materials when learning takes place are charged to the teacher to convey to students, the lack of interest of students in learning mathematics (Sihombing, Lubis, & Ardiana, 2021; Oktaviana et al., 2021; Seno, 2014). The process of giving material also does not relate to something they are familiar with, so students find it difficult to reason because students are already familiar with procedural questions which are directly obtained using formulas, theorems, and so on (Isnaeni et al., 2018; Miswanto et al., 2019). In current learning, by utilizing the sophistication of technology, teachers can make learning more interesting and creative so that students can be actively involved (Hapizah et al., 2022; Mitha Frilia et al., 2020).

One way the teacher can actively involve students in the learning process is to use media or interesting teaching materials to help students understand the concepts presented by the teacher (Wandari et al., 2018). One of the teaching materials that can be used by teachers in the learning process is the Student Worksheet (LKPD). LKPD can be electronically called E-LKPD (Damayanti & Suniasih, 2022; Ni Putu Diah Mahendri Dewi & Agustika, 2022). Using E-LKPD will provide innovations that have a positive impact (Pangestika & Ain, 2022). The advantages of E-LKPD for teachers are that teachers will be facilitated in explaining learning material and giving assignments, as well as measuring students' abilities after learning (Nuswowati et al., 2020). For students, the advantage for students is that the E-LKPD will make it easier for students to learn because it is practical and presented in an attractive way which can increase students' interest in learning mathematics (Awe & Ende, 2019; Dini Rahma Diani, Nurhayati, 2019; Nufus et al., 2018).

In addition, in order for the E-LKPD to be designed to make it easier to stimulate mathematical reasoning to solve problems in real contexts, it is necessary to insert an approach (N. P. D. M Dewi & Agustika, 2022; Prastika & Masniladevi, 2021; Safegi et al., 2021). Within the PISA framework, computational thinking has a role in solving problems and doing mathematical reasoning (Zahid, 2020). Practical advantages of applying computational thinking include helping a person improve problem-solving, logical thinking, and analytical skills, all of which are important parts of reasoning (Hunt & Riley, 2014). Previous research states that the development of E-LKPD can facilitate students to construct their knowledge to understand concepts and train students' mathematical reasoning abilities

by solving challenging questions and requiring reasoning. The problems presented are problems that students can encounter in everyday life and can stimulate students to carry out discovery activities (A. Putra et al., 2018). However, there is an update in this research: the E-LKPD being developed will be integrated with problem-based questions in the Malay Islamic context and have stages of computational thinking expected to guide students in honing mathematical reasoning abilities. This research examines the positive impact of the E-LKPD material on number patterns based on computational thinking in the Malay Islamic context on students' mathematical reasoning. The existence of E-LKPD has validity and practicality and impacts supporting students' mathematical reasoning.

2. METHODS

This research is design research with the type of development studies (Akker et al., 2006). Development studies have three stages: preliminary research, prototype stage, and summative evaluation. The preliminary research stage consists of context and problem analysis, literature review, and development of a theoretical framework for design activities. The Prototype stage is where the E-LKPD development activities are carried out, which are still in the form of prototypes through trial activities which are carried out repeatedly. During this process, a formative evaluation will be carried out to improve the quality of the E-LKPD to obtain an E-LKPD that has validity and practicality. The formative evaluation stage used in this study is the formative evaluation stage in design research Tessmer (1993), consisting of self-evaluation, expert review, one-to-one evaluation, small group, and field test stages. The summative evaluation stage was carried out to determine whether the E-LKPD that was applied impacted students' mathematical reasoning abilities. In the summative evaluation, an evaluation will be carried out by conducting a test, and the test results will be measured based on the student's mathematical reasoning indicators.

The subjects of this study were eighth-grade students at SMP Negeri 17 Palembang, with three subjects in the one-to-one evaluation stage. Six people are in the small group stage, and six are in the field test stage. There are 30 people. In addition, experts as research subjects at the expert review stage consisting of 2 subject matter experts, 2 product experts, and two teachers. Data collection techniques used in this study were questionnaires, interviews, and tests. The questionnaire used is a validation questionnaire and a student response questionnaire. A validation questionnaire is used to obtain information about the validity of the E-LKPD based on assessments from material, product, and teacher experts. Student response questionnaires were used to see the practicality of the developed E-LKPD. Interviews were used to determine the initial problems that had to be investigated and to gather information from teachers regarding using E-LKPD in mathematics learning. In addition, tests are used to see the E-LKPD's impact on students' mathematical reasoning abilities. The tests used are pretest and post-test. The data obtained from the interviews were analyzed using the stages of reduction, display, and conclusion. The questionnaire consisting of validation sheets and student response questionnaires was analyzed using the validation sheet stages, reading all the comments and suggestions the validator gave, summarizing the validation results as a reference for product revision, and drawing conclusions with the feasibility category. Student response questionnaires, counting the number of positive answers, confirming negative answers as a reference for revision, and revising as a practical reference. The data obtained from the student's test results were then checked for answers according to the scoring rubric and analyzed descriptively to see the impact of the E-LKPD on students' mathematical reasoning abilities. The test results obtained will be analyzed based on the indicators of students' mathematical reasoning abilities shown in Table 1.

Table 1. Mathematical Reasoning Abilities

Indicator	Descriptor
Make a guess	Students can write down possible temporary answers and present information obtained from the problems given so that they can determine the steps to be taken to solve them.
Finding patterns or characteristics of mathematical phenomena to make generalizations	Students can analyze problems using patterns and relationships that have been understood.
Draw logical conclusions	Students can make a new correct statement based on a series of completion processes that have been taken before.

3. RESULTS AND DISCUSSION

Result

Computational thinking-based E-LKPD development research in Malay Islam uses a design research flow with the type of development studies consisting of preliminary research, prototype stage, and summative evaluation stages. The preliminary research stage includes the initial analysis carried out by material analysis, literature review, and the developing of a theoretical framework for design activities. The results of the material analysis showed that students had difficulties in number pattern material, namely that students had not been able to detect the regularity of a pattern and formulate a pattern from the regularity of patterns and had not been able to connect the problems of everyday life into the language of mathematics. Then when viewed from the learning of mathematics, the results show a lack of understanding of the students' concepts and are fixated on the examples given. Based on these problems, the development of the E-LKPD was carried out to increase students' interest because the E-LKPD can present a learning innovation that can make students enthusiastic about learning. In addition, E-LKPD can present illustrations of problems and interactive work to attract students' attention to learning. Then computational thinking is inserted in every existing problem activity to help students hone their mathematical reasoning skills because the steps involved in computational thinking are certainly related to mathematical reasoning abilities. The existence of a Malay Islamic context presents something they are familiar with so that they can easily understand the existing subject matter.

In the second stage, after designing the activity, the E-LKPD was designed as an initial E-LKPD based on computational thinking in Malay Islam, starting with making flowcharts and storyboards. The flowchart and storyboard results are poured into an E-LKPD, which can be run on various platforms, such as PCs and Androids. In this case, the initial version of the E-LKPD that has been designed is ready to be tested at the Prototype Stage. The results of the flowchart and storyboard are shown in Figure 1.

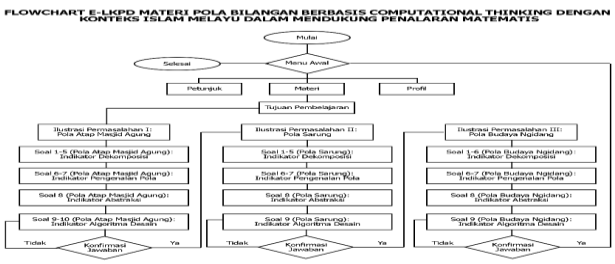
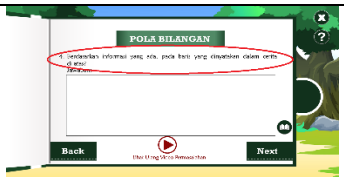


Figure 1. E-LKPD Flowchart

At the Prototype Stage, a formative evaluation flow will be carried out to improve the quality of the E-LKPD to obtain an E-LKPD that has validity and practicality. The formative evaluation follows the Tessmer flow, consisting of self-evaluations, expert reviews, one-to-one evaluations, small groups, and field tests. At the self-evaluation stage, collecting information from several references (books and journals) and summarizing it into one note as material for checking obvious errors (visible errors) in the E-LKPD from the results of checking so that the errors or errors found in the E-LKPD are obtained. In the second problem (sarong pattern) and third (Ningdang culture pattern), there is a video illustration narrative that can make it difficult for students to understand the meaning of the problem and add supporting information to the problem. There are errors in several conditions in the E-LKPD application, the video pause button does not appear and adjusts the volume on the question menu, the section repeats the question illustration, there is the text that is not fully visible, and the answer column, there are several special characters that cannot be input—added Basic Competency menu after conducting revisions at the self-evaluation stage and producing the prototype so that the E-LKPD material on number patterns based on computational thinking with the Malay Islamic context can be tried at the expert review stage and one-to-one evaluation.

At the expert review and one-to-one evaluation stages, the activities evaluated the E-LKPD material on computational thinking-based number patterns in Malay Islam with experts. The selected expert is then given a validation sheet to provide comments and suggestions after the expert uses the E-LKPD. In addition, the researcher determined students as research subjects in a one-to-one evaluation. Next, the researcher invites students to evaluate the E-LKPD that has been developed in turn. The results of the comments and suggestions at the expert review and one-to-one evaluation stages are used for product revision, so several things need to be improved in the E-LKPD material on computational thinking-based number patterns in the context of Malay Islam. The things that need to be improved at the expert review and one-to-one evaluation stages are shown in Table 2.

Table 2. Revision Results in the Expert Review & One-to-One Evaluation Stage

Before Revision	After Revision
 Sentences on questions before revision	 It corrects sentences in questions that need clarification and is easier to understand in problems 1 and 2.
No revision There are no questions that make students think that a good quality sarong has a different number of motifs.	 It adds questions that make students think that a good quality sarong has a different number of motifs.

Before Revision	After Revision
No revision	
There is no information about a shingle roof and how many rows of roof tiles the mosque has.	Added information about shingle roofs for additional knowledge for students and the number of rows of mosque tiles on the help button.
No revision	
Information about the characteristics of a good-quality sarong can only be seen in the illustrated video implicitly.	I have added information in pictures and characteristics regarding good-quality sheaths on the help button.
	
There is information that provides answers in the help menu.	Omitting information that provides an answer in the help menu.
No revision	
No pop-ups are ending the application, and warning text pop-ups for each question.	Added an application exit button in the form of a pop-up ending the application and warning text in the form of a pop-up on each question.
	
The symbols on the next and back buttons have a double meaning.	It fixed the symbol on the button according to its function.
	
The application background only has a forest background without any relation to the Malay Islamic theme.	Customize the background with the Malay Islamic theme.

After conducting revisions at the expert review and one-to-one stages to produce a second prototype, the E-LKPD material on number patterns based on computational thinking in the Malay Islamic context is ready to be tried at the small group stage. At the small group stage, the researcher conducted interviews with students. From the results of the interviews, two students had used game-type math learning applications but had never learned to use the E-LKPD. In addition, in terms of subject matter, all students have studied number pattern material and still remember the material. Furthermore, the researchers conducted a trial of the E-LKPD to prove whether there were any obstacles to its use. Then the researcher also gave the students a questionnaire sheet to see students' responses to the E-LKPD material on computational thinking-based number patterns within Malay Islam. The results of the questionnaire at the field test stage can be seen in Table 3.

Table 3. Questionnaire Results at the Small Group Stage

No.	Question	Yes	No
1	The appearance of the E-LKPD is interesting to me.	6	0
2	Studying using the E-LKPD makes me feel energized and more active.	6	0
3	Learning by using the E-LKPD makes me happy.	6	0
4	The sentences used in the E-LKPD are easy to understand.	6	0
5	I can understand learning material more easily through the E-LKPD.	5	1
6	I can understand the subject matter problems by explaining the illustrated videos in the E-LKPD.	6	0
7	I can understand the subject matter contained in the E-LKPD on my own.	5	1
8	I like working on questions from subject matter problems using the E-LKPD.	6	0
9	The instructions for using the E-LKPD are easy for me to understand.	6	0
10	Learning using the E-LKPD is interesting because it is easy to learn.	6	0

In addition, there are comments given by students on the questionnaire sheet. There is question number 7 on the sheath problem, which is difficult to understand. Learning with the E-LKPD feels exciting with an interesting illustration background, and when pressing the return button, the students' answers are lost. Based on the data obtained above, there are areas for improvement in the E-LKPD material for computational thinking-based number patterns within Malay Islam, so it needs to be revised. Following are the results of the revision at the small group stage, which can be seen in Table 4.

After conducting revisions at the small group stage, the E-LKPD material on number patterns based on computational thinking with the Malay Islamic context of the third prototype is ready to proceed to trials at the field test stage to confirm the revision results to obtain a practical E-LKPD. At the field test stage, the teacher will become an instructor in implementing the E-LKPD in the learning process. The activities carried out by the researcher were during the learning process carried out by the teacher by implementing the E-LKPD. The researcher made observations of the activities carried out by students and teachers. While observing these activities, the teacher was able to implement them easily. In addition, students can understand what instructions are conveyed by the teacher. Students are enthusiastic and tend to be more active with applying the E-LKPD in learning. After completing the learning process, give questionnaires to students to obtain information related to the use of the E-LKPD that is being developed. The following is the questionnaire data at the field test stage that has been obtained, which can be seen in Table 5.

Table 4. Results of the Revision at the Small Group Stage

Before Revision	After Revision
	
Question number 7 on the sheath problem before repair	Improved question number 7 on the sheath problem to make it easier to understand.
	
When pressing back, the answers that have been filled in disappear.	Added a feature to save answers that students have typed.

Table 5. The Results of the Questionnaire at the Field Test Stage

No.	Question	Yes	No
1	The appearance of the E-LKPD is interesting to me	27	3
2	Studying using the E-LKPD makes me feel less bored and less lazy to study	30	0
3	I think the sentences used in the E-LKPD are easy to understand	28	2
4	I can understand the material contained in the learning E-LKPD	30	0
5	I can understand the subject matter with daily problems, which are supplemented by an illustrative video explanation in the E-LKPD	30	0
6	I can understand the subject matter contained in the E-LKPD on my own	30	0
7	With the E-LKPD it makes learning easier to understand	30	0
8	The instructions for using the E-LKPD are easy for me to understand	30	0
9	In my opinion, learning using the E-LKPD is interesting because it is easy to learn	30	0

Based on the results obtained from the questionnaire sheet at the field test stage, no difficulties or errors were found in the E-LKPD. In this study, the E-LKPD that has been developed and implemented fulfills the practical category, so the E-LKPD material on number patterns based on computational thinking in Malay Islam has been completed for its development stage and is practical. The summative evaluation stage in this study was evaluated by carrying out tests, namely the pretest, and post-test, to see whether the E-LKPD had an impact in supporting students' mathematical reasoning. The questions used as tests are the same. The pretest results obtained from question number 1, when viewed based on indicators of mathematical reasoning, show that 16 students could solve the questions correctly, and 14 were wrong in drawing logical conclusions.

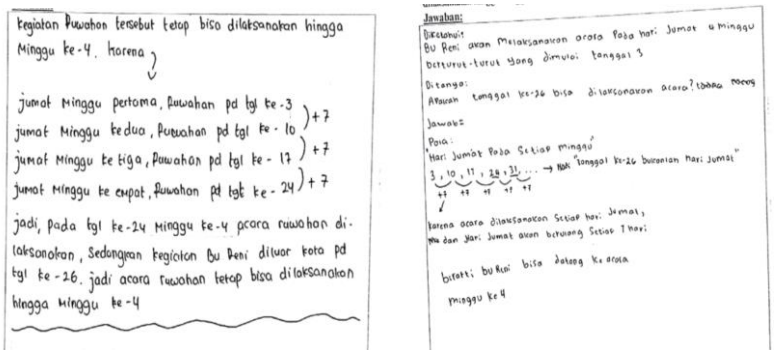


Figure 2. Students' Pretest Answers were Correct in Question Number 1

Based on Figure 2, these students can understand the questions well, estimate the completion process correctly, and write down what is known in the questions to conclude answers. These students are also able to associate known patterns to look for the next pattern so that they can solve the problem. Students also do the right calculations in each process of completion.

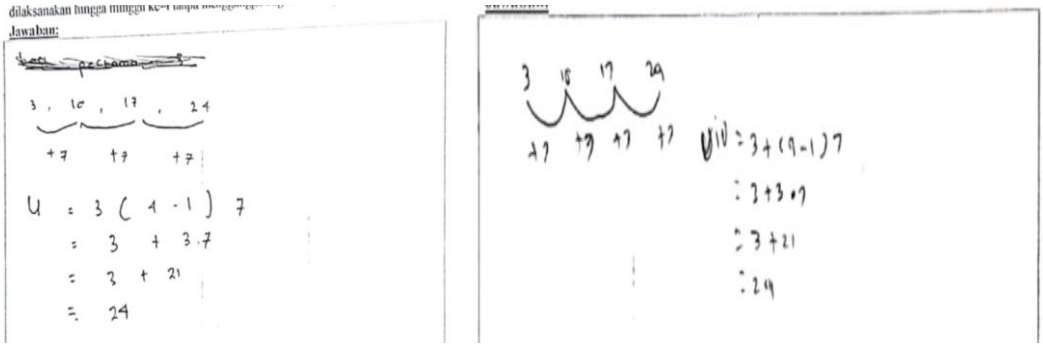


Figure 3. Students' Pretest Answers were Wrong in Question Number 1

In addition, it can be seen in Figure 3, which shows that students are less able to draw logical conclusions. Errors in drawing logical conclusions are caused by students needing to understand the purpose of the problem, and students are only fixated on the pattern of a sequence of numbers. Then the post-test results obtained from question number 1, when viewed based on indicators of mathematical reasoning, show that 27 students could solve the questions correctly, and only three students needed to be corrected in drawing logical conclusions.

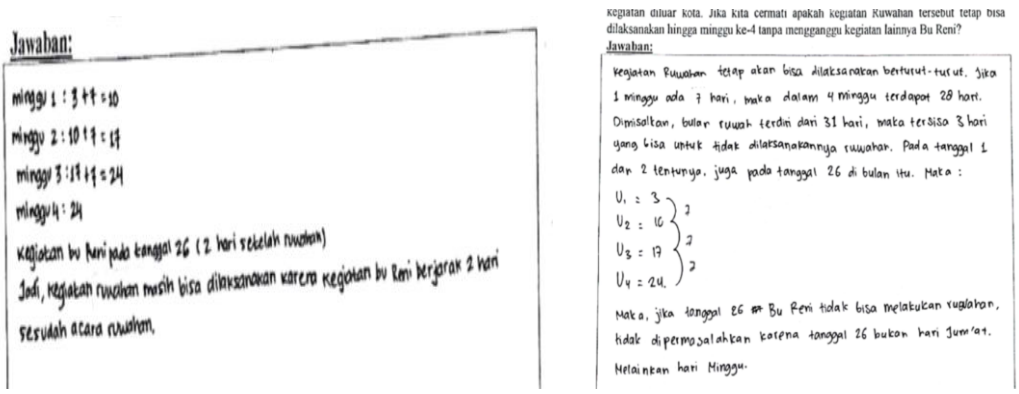


Figure 4. The Students' Post-Test Answers were Correct in Question Number 1

Based on Figure 4, it can be seen that the results of the post-test showed that students experienced an increase where at the time of the pretest, there were only 16 students who were able to solve the questions well based on the reasoning indicators to 27 students who were able to solve the questions during the post-test. It shows that after implementing the E-LKPD, computational thinking-based number pattern material makes students understand the problem better and solve it in stages until they can solve it correctly. In question number 2, which is a matter of mathematical reasoning on the matter of number patterns of a sequence of object configurations, it was found that the results of the students' pretest showed that only seven students could solve the problem correctly. Twenty-three students needed to be corrected in finding a pattern.

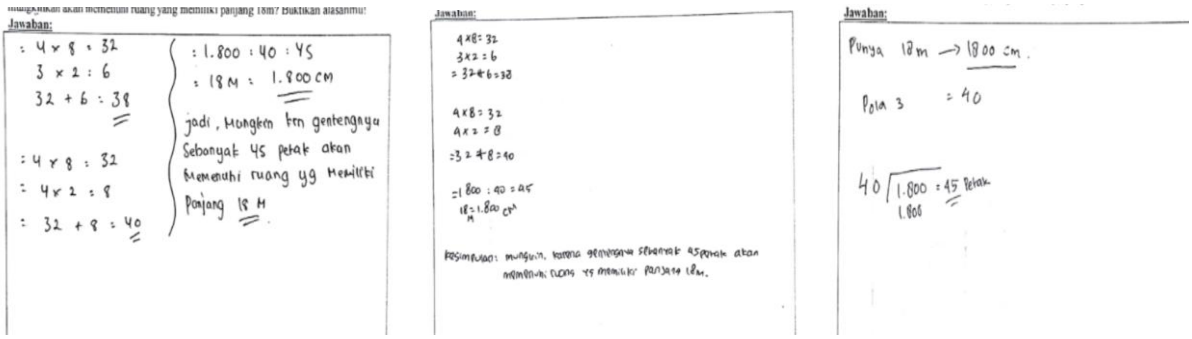


Figure 5. Students' Pretest Answers were Wrong in Question Number 2

Based on Figure 5, These students are less able to solve the number pattern problem of an object configuration. It is caused by students being unable to understand the problem properly, not being able to estimate the right process, determine patterns and relate them to analyze mathematical situations to obtain the right solution. Then the post-test results obtained from question number 2, when reviewed based on indicators of mathematical reasoning, showed that 24 students could solve the questions correctly, and six students were wrong in finding a pattern and drawing logical conclusions.

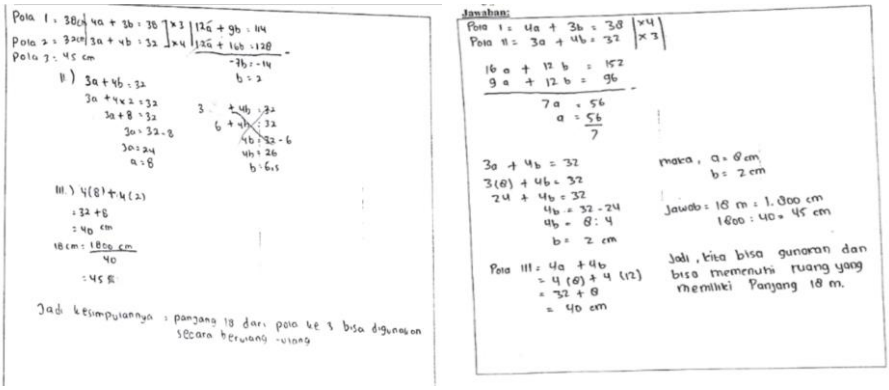


Figure 6. The Students' Post-Test Answers Were Correct in Question Number 2

Based on Figure 6, it can be seen that the results of the post-test showed that students experienced an increase; at the time of the pretest, there were only seven students who were able to solve the questions well based on the reasoning indicators to 24 students who were able to solve the questions during the post-test. After implementing the E-LKPD, computational thinking-based number pattern material allows students to write down what is known from the problem, find patterns, and connect them to determine the appropriate solution procedure.

Discussions

Based on the results of this study, the validity of the E-LKPD was shown based on the results of product validation carried out by experts at the expert review stage and confirming students at the one-to-one evaluation stage to get truly valid results. Good Student Worksheets must be constructively appropriate to students' development level, using simple, clear, and uncomplicated sentence structures. In addition, pedagogically, a good worksheet must emphasize the problem-solving process. Besides that, adding pop-ups to continue the questions was done to convince students with the answers they wrote (Adawiyah et al., 2021; Idayanti & Sujana, 2022). One of the criteria for a good application, of course, has a function as something that can be used easily and has a good appearance (Syaputra & Silalahi, 2017). Practicality can be seen from the convenience of students in operating, student interest, and its function as a medium. The E-LKPD that has been developed and implemented fulfills the practical category. The practicality of the E-LKPD was obtained after going through the formative evaluation stage, which showed that students gave responses that were easy to use, attractive, able to understand the material, and made students enthusiastic about learning increasing. Using E-LKPD helps students more easily understand the concept of the material being taught (G. Y. M. A. Putra et al., 2021; Sariani & Suarjana, 2022). E-LKPD can be an alternative as an interactive and interesting teaching material used in learning mathematics (Yanti et al., 2020).

The Impact of E-LKPD in Supporting Mathematical Reasoning that occurred after implementing the E-LKPD material on computational thinking-based number patterns in the Malay Islamic context, this study conducted tests before and after using the E-LKPD. The test results showed that in the matter of number patterns from a number sequence, it was seen that the students experienced an increase. At the time of the pretest, there were only 16 students who were able to solve the problems well. If viewed from the results of the pretest, there are difficulties for students solving the number pattern problem of an object configuration, namely, students who need help to draw logical conclusions. Errors in drawing logical conclusions are caused by students needing to understand the purpose of the problem, and students are only fixated on the pattern of a sequence of numbers. With the implementation of the E-LKPD, computational thinking-based number pattern material makes students understand the problem better and solve it in stages until they can solve it correctly. The E-LKPD material on number patterns based on computational thinking allows students to write down what is known from the problem, find patterns, and connect them to determine the appropriate solution procedure.

The visible results of applying computational thinking-based E-LKPD impact students' mathematical reasoning abilities. This finding is reinforced by previous research stating that computational thinking is a cognitive process involving reasoning where problems are solved and artifacts, procedures, and systems are better understood (Csizmadia et al., 2015). Interactive E-LKPD material for introducing flat shapes based on ethnomathematics for first-grade elementary school students is feasible and valid (Prayoga et al., 2022). Liveworksheet-based interactive regular and irregular polygonal E-LKPD is feasible to improve learning outcomes of fourth-grade elementary school students (Nirmayani, 2022; Prastika & Masniladevi, 2021). The impact that occurs after the application of the E-LKPD on number pattern material based on computational thinking in the Malay Islamic context in supporting mathematical reasoning is to make students able to write down what is known from the problem, able to find patterns and connect them, to determine the appropriate solution procedure.

4. CONCLUSION

The developed E-LKPD is valid. In addition, the developed E-LKPD is practical after the formative evaluation stage, which shows that students give easy-to-use, attractive responses, can understand the material, and increase students enthusiasm for learning. The implications of this research can improve students' critical thinking skills.

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