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Development of Illustrated E-LKPD Media to increase Students' Mathematical Logical Intelligence (Group B Study at PAUD Pembina Negeri 1 Bengkulu City)

Restri Hendayanita

Universitas Bengkulu
Bengkulu, Indonesia
restri.handayani@gmail.com*

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Abstract

This research aims to develop the media of Electronic Student Worksheets (e-LKPD) with Pictures to improve the Mathematical Logical intelligence of group B students, in PAUD Negeri Pembina 1 Bengkulu City. The lack of appropriate use of teaching media and not in accordance with the needs of students causes a lack of students' ability to analyze problem-solving. The research is a development research that adapts the ADDIE development model. There are 5 main stages in this study consisting of stages, analysis, design, development, implementation, and evaluation. The research instruments used are observations, interviews, validation sheets, and tests. The developed products were validated by a team of media experts and the material was then tested in a small group, namely ten students of group B of PAUD Pembina Negeri 1 Bengkulu City. The result of this research is a learning media product made using the Canva application which is applied using a book creator. The results of the response of group B students in a small group trial conducted on 10 students of PAUD Pembina Negeri 1 Bengkulu City, which was 80.49% (good) and the results of the educator's response, which was 96% (very good). Based on the development process starting from the validation of media and materials to the results of small group trials, it was concluded that the learning media product is very feasible and effective to use to increase intelligence.

A. Introduction

Developments in knowledge and technology have had a significant impact on the world of education, especially in focusing on the concept of Mathematics, which is an important component in the formal education curriculum (McCulloch et al., 2018). The learning process must focus on developing reasoning, critical attitudes, logic, and mathematical application skills (Maryati, 2018). Formal education requires students to master these skills so that they can apply mathematical knowledge well and meet the requirements for their development to face different situations in life.

Mathematics has a strategic position in the development of PAUD institutions, which is known as a field of cognitive development (Nasution et al., 2024). Everyone needs mathematics in today's life because it functions as a scientific thinking tool that improves skills from systematic thinking, prioritizing logic, and being critical in everything. Therefore, mastery of mathematics at the PAUD level is very important to build a strong foundation for cognitive development and critical thinking skills of students (Jayadi, 2024; Wakabayashi et al., 2020).

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High-level mathematical thinking skills are very important for students to develop in mathematics learning (Maslihah et al., 2020; Pratama, 2020). Schools must prepare students to live in the current era with high-level thinking skills such as reasoning, logic, critical and creative in the framework of problem solving (Rahim, 2023). In addition, students must also have perseverance, self-regulated learning, self-confidence, and a positive attitude towards mathematics (Febriliani, 2021). Smart and virtuous students will become productive citizens. Thus, schools must prepare students to think critically, logically, and rationally in the 21st century.

In learning mathematics at school, mathematical reasoning skills are very important (Hasanah et al., 2019; Mumu & Tanujaya, 2019). The main focus of mathematics learning is to ensure that students master these skills, which are centered on the development of deep mathematical reasoning.

Innovation is highly expected in Mathematics learning activities. This is not only aimed at mastering subject understanding, reasoning, problem solving, communication but also to improve students' mathematical disposition (Hidayatsyah et al., 2023). With this explanation, improving reasoning skills becomes the main focus in mathematics learning. Now, learning is designed to actively involve students, giving them the opportunity to think and solve problems independently, with teachers acting as facilitators. This is also due to the lack of discussion between students and fellow students and with teachers.

At this timeInteractive learning also needs to be supported by adequate learning media, such as E-LKPD Media (Hazrati & Siregar, 2023). E-LKPD can also be called Children's Worksheets (LKA) which are learning media to support learning activities. In addition, by using E-LKPD, it can provide opportunities for students to participate actively and can encourage students to explore their abilities through the process of thinking, searching, and reasoning. So by using E-LKPD, students will feel motivated during learning.

Currently, the development of 21st century technology is growing rapidly, so it can be useful in learning. Learning activities that can utilize technology are by developing LKPD into E-LKPD, so that the learning process is not limited by media (Mulyasari et al., 2022; Sariani & Suarjana, 2022). The limitations that occur can cause learning activities that are less effective and efficient, therefore innovative media such as illustrated E-LKPD are needed to improve the quality of learning.

E-Illustrated LKPD is a student activity sheet designed by utilizing electronics such as computers, notebooks, smartphones and other electronic devices, so that the use of Illustrated E-LKPD can be done anywhere and without having to spend a lot of money and can be used according to the electronic devices owned by each student (Farman et al., 2021; Sariani & Suarjana, 2022). Illustrated E-LKPD has several advantages, namely: (1) Students can explore materials and questions from various directions; (2) Students can use their devices to learn other than playing games; (3) Students can find new and interesting ways to learn; (4) The presentation of the material is able to attract students' interest in learning. With this convenience, it has a positive impact on the learning process. The use of Illustrated E-LKPD can influence students' learning activities to be more interesting, interactive, and provide opportunities for students to practice and encourage children to learn.

Based on initial observations at PAUD Negeri Pembina 1, researchers obtained information from class teachers that LKPD has been implemented in the learning process as a support for student learning in hard copy form. The LKPD used is quite interesting, but in terms of appearance and content, it can still be developed further, such as equipped with pictures, texts and learning reference videos. In addition, students are still manual in working on their questions, for example, they still print files sent by their teachers and then work on them and photograph them to be sent back as an assignment assessment. This is considered inefficient, because it takes a lot of time. Based on this, it is necessary to develop Illustrated E-LKPD which is able to provide assistance to students and teachers in carrying out the learning and assessment process. In addition to developing teaching media, it is also necessary to provide stimulation so that students can think critically, one of which is by using Illustrated E-LKPD based on Logical-Mathematical intelligence. This intelligence is very useful in learning to solve math problems. So that later students have the ability to solve problems mathematically. Where this ability is included in one of the eight types of intelligence, namely Logical-Mathematical intelligence. In addition, this intelligence also includes the ability to think based on a fact that has been observed previously and vice versa, thinking based on the rules of fact, the ability to understand and analyze patterns with numbers using reasoning skills to solve a problem. Each ability that students have is different, some learn autodidactically through references, some learn by taking formal education at school.

Therefore, things are needed that can stimulate students' thinking patterns. One of them is by developing learning tools in the form of E-LKPD. This platform is not only attractive in appearance, but also easy to

use. With the features provided by Liveworksheets, teachers can develop interactive and interesting illustrated LKPD for students. As a result, the use of Liveworksheets can increase student engagement and motivation in the learning process.

Based on the problems above, the researcher wants to develop a LKPD that can facilitate learning, where the LKPD developed is in the form of Illustrated E-LKPD assisted by Liveworksheets. The researcher hopes that by using the developed Illustrated E-LKPD, it can determine the Logical-Mathematical intelligence possessed by students in solving problems related to logical mathematical calculations. Illustrated E-LKPD is also expected to facilitate teachers in assessing learning.

B. Research Methods

This study uses the R&D method with the ADDIE development model which stands for Analyze, Design, Development, Implementation, and Evaluation. The ADDIE research and development model developed by Branch, (2009) can be described as follows:

Figure 1. ADDIE Development Model

Population and Sampling

The sampling method used in this study is non-probability random sampling, namely convenience sampling. According to Hartono (2004), convenience sampling is sampling that is done by choosing samples freely according to the researcher's wishes. This sampling method was chosen to facilitate the implementation of the thesis on the grounds that the population of internet users is very large. In addition, it is also difficult to create a real sampling framework because the list of internet users is very difficult to obtain. The selection of the convenience sampling method is based on the availability of elements and the ease of obtaining them, in other words the sample is taken because the sample is in the right place and at the right time. Based on the minimum sample determination in this study, it is 10 Group B students at PAUD Negeri Pembina 1, Bengkulu City. To avoid unfilled questionnaires. Or errors in filling them out, the researcher increased the number of samples to 20 respondents.

Research Time

This research will be carried out at PAUD Negeri Pembina 1 Bengkulu, which is located at Jl. Serayu No. 22 BTN Padang Harapan, Gading Cempaka District, Bengkulu City. For the product trial location, students are also at PAUD Pembina NegerI 1 Bengkulu City. While the implementation time will be carried out in the even semester of the 2023/2024 academic year.

Research Procedures

This research uses the Research and Development (RnD) development method. According to Sugiyono (2015: 405) in developing the ADDIE research method there are five development steps, namely:

1. Analysis Stage

The purpose of this stage is to determine the initial needs in developing this learning media. In this study, a needs analysis is needed, such as the following: (1) User Needs Analysis, (2) Content analysis, and (3) Hardware and Software Needs Analysis. Needs analysis is needed in determining who the user subjects are for this Electronic Student Worksheet (E-LKPD) learning media. The users here are group B students of PAUD Negeri Pembina 1, Bengkulu City. The user subjects can be used as a reference as a guideline for developing Electronic Student Worksheet media or called E-LKPD with pictures, namely determining the appearance and ease of use that are appropriate to the age of the user. Content analysis is related to the

contents of the E-LKPD with pictures media, namely material that is relevant to the Basic competencies that have been set. Finally, hardware and software analysis is carried out to determine the needs that will be used for development. After that, determine the device that will be used to run the application, namely a laptop, smartphone with an Android operating system.

Analyze the needs and identify the problems that are the reasons for developing this illustrated E-LKPD. After identifying the problems, at this stage the researcher collects the information and data needed, namely by analyzing the curriculum to determine the themes and sub-themes to be developed and analyzing the Core Competencies and Basic Competencies to be developed. For more details, it is stated in the RPPH and RPPM (attached).

The analysis was conducted using structured interviews with PAUD educators at schools that will or are being researched regarding what learning media have been used, what difficulties are obstacles in implementing learning, how children's interests are in plants. After that is done, it can be continued by determining the objectives because this step is to formulate the development of media needed by children to overcome problems that arise as encountered during the initial observation and then analyze the child because it is to find out the child's character.

Based on the results of learning observations and interviews at PAUD Pembina Negeri 1, Bengkuu City, that generally activities related to logical mathematical intelligence, children's interest in Mathematics is still low and the learning process becomes boring because the learning media does not attract children's interest. And sometimes it tends to coloring activities and playing activities without reading, writing and arithmetic activities.

Based on the results of this analysis, it is then used as a guideline in developing learning media to improve the logical mathematical intelligence of group B students. The development of illustrated E-LKPD media is intended to improve the learning process. This also makes it easier for educators in learning activities in the classroom.

Meanwhile, the results of teacher interviews include:

a. Teachers really need supporting media such as electronic media to improve logical mathematical intelligence because teachers do not have time to develop it themselves.
b. Teachers do not have innovative learning media.

Based on the results of the teacher interviews, the researcher felt the need to develop electronic learning media to improve the logical mathematical intelligence of students in group B.PAUD Pembina Negeri 1, Bengkulu City.

2. Design Stage

At the product design stage, it will go through several stages as follows:

a. Setting Material/Theme

The materials used in this study are adjusted to the Core Competencies and Basic Competencies that have been established, namely as explained in the KI and KD tables below:

KI.1 Spiritual Attitude	KI. 2. Social Attitudes
K.D. 1.1 Believing in the existence of God through His creation	KD. 2.8 Have behavior that reflects independence

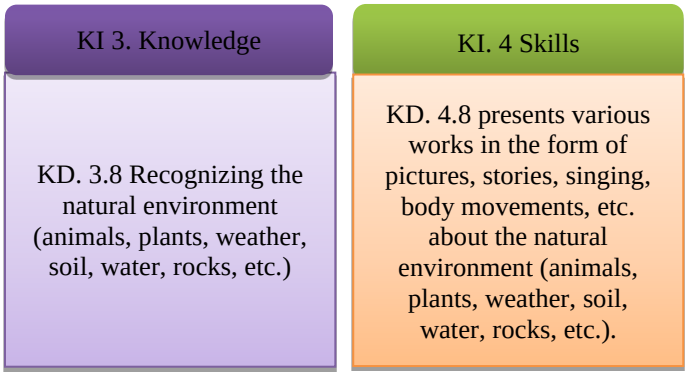

Figure 2. Analysis of KI and KD

b. Developing illustrated E-LKPD products

The development developed by researchers is oriented to improve the logical mathematical intelligence of group B students of PAUD Negeri PEMBINA 1, Bengkulu City. Where the Illustrated E-LKPD media is developed and adjusted to the material to be delivered to students.

c. Making an illustrated E-LKPD design

The next stage is the stage of creating the design of the learning media that will be developed. The steps that will be taken are to determine the outline of the elements contained in the learning media. Then create a flowchart that describes the sequence and structure of the learning media, then continue to create a storyboard that includes a template design plan and also materials. This storyboard will be used as a guideline in creating learning media products. After creating the storyboard, an interface display can be created or called an interface design.

The media is designed based on 1 theme, 3 sub-themes, namely Fruit plants, Flower plants, Vegetable plants. This teaching media is not only applied in the media application but also printed to be used as a usage guide intended for teachers and parents with A4 size and the E-LKPD media sheet has 33 pages.

Teaching media design, such as:

1) Themes and subthemes. With the development of concept maps from the theme and subthemes of fruit plants, flowers, vegetables, and trees.
2) Analysis of Core Competencies (KI) and Basic Competencies (KD) curriculum.
3) Developing sub-themes into concept maps.
4) Create a daily learning plan (RPP).
5) Formulate learning objectives
6) Developing Materials based on Themes, KI, KD and RPP that are developed
7) Formulate practice questions.

At this stage, the researcher also designed the illustrated E-LKPD media that will be poured into the next stage. The steps taken by the researcher were to develop a flowchart and storyboard. Here are the steps:

a. Developing a flowchart

Flowchart or flow diagram is a diagram that describes the work process of developing illustrated E-LKPD media for 5-6 year olds, group B. The flowchart was developed with the aim of describing the workflow of E-LKPD media. E-LKPD media product flowchart.

b. Developing a storyboard

Storyboard is a guideline/description to facilitate the process of creating media products. Storyboard functions to describe the contents of the flowchart into the form of illustrated E-LKPD media.

After analyzing the problems and needs, the next step is to create an illustrated E-LKPD design. The design that will be created will be adjusted to the design plan for students and then further developed. The design was created using Liveworksheets, where previously the illustrated E-LKPD media framework was created using the Canva website and then changed to Portable Document Format (PDF) which contains the cover, development field identity, illustrated E-LKPD title, learning instructions, learning objectives, learning materials, illustrations, learning videos, practice questions, and learning reference links. From the

framework created in the form of PDF, it will later be inputted and edited again in Liveworksheets, according to needs. So that the output produced at this stage is in the form of an illustrated E-LKPD design framework using Liveworksheets which can be used as a learning reference for students so that it can motivate students and is relevant to the learning competencies used.

Figure 3. Initial Electronic-LKPD cover and written questions design

3. Development

At this stage, the aim is to develop electronic-based learning media products in student worksheets that are able to improve the logical mathematical intelligence of group B students.

a. Development of learning media with liveworksheets.

Researchers continue to create media based on previously created storyboards and designs. Illustration displays, instructions for use and liveworksheets are adjusted to the theme and sub-themes according to KI & KD. Furthermore, the content display is processed using the Canva application, to implement it into an application that can be operated via Android.

b. Developing research instruments

The research instruments used at this stage are media expert and material expert validation instruments, student assessment sheet instruments for limited trials and assessment instruments or posttests on illustrated E-LKPD media to improve the logical mathematical intelligence of students in groups with the theme of Plants and sub-themes of Fruit, Flowers, Vegetables, and Trees.

c. Validation of data collection instruments

The data collection instrument that has been developed was validated by an instrument validator consisting of a media expert lecturer, a material expert lecturer, two (2) PAUD group B teachers, and group B students of PAUD Negeri Pembina 1, Bengkulu City. The validation results and suggestions and comments provided will be used to improve the E-LKPD learning media to improve the logical-mathematical intelligence of group B students.

d. Revision 1

Validation data obtained from media experts and material experts are used as a reference for improving the illustrated E-LKPD learning media that was developed.

e. Limited trial

The results of the revisions from media experts and material experts were then subjected to limited trials aimed at identifying product limitations. The data obtained were responses from students and recorded in observation assessments, so revision II was carried out.

f. Revision II

The results of data obtained from limited trials are used as revision material and the final revised results of the illustrated E-LKPD learning media developed will be used at the implementation stage, namely the large-scale test.

The development stage is the process of realizing a previously prepared product design into reality. At this stage, it can be done with the initial product development process, including product content that creates planned illustrations and compiles materials that have been obtained and included in the guidebook.

4. Implementation Stage.

This fourth stage is the implementation stage, where the learning media has been revised from the limited trial applied, tested and implemented to group B students of PAUD Negeri Pembina 1, Bengkulu City. The test aims to determine the learning media developed which can then be used to determine the feasibility of the illustrated E-LKPD learning media to improve the logical-mathematical intelligence of group B students.

5. Evaluation Stage

*Evaluation*is an activity to assess whether each step of the activity and the product made is in accordance with the specifications. The evaluation aims to determine the quality of the product, both before and after implementation. The results are analyzed and evaluated to determine the quality, value of benefits, and feasibility of the learning media.

A brief flow diagram of the product development procedure can be seen in Figure 4 below:

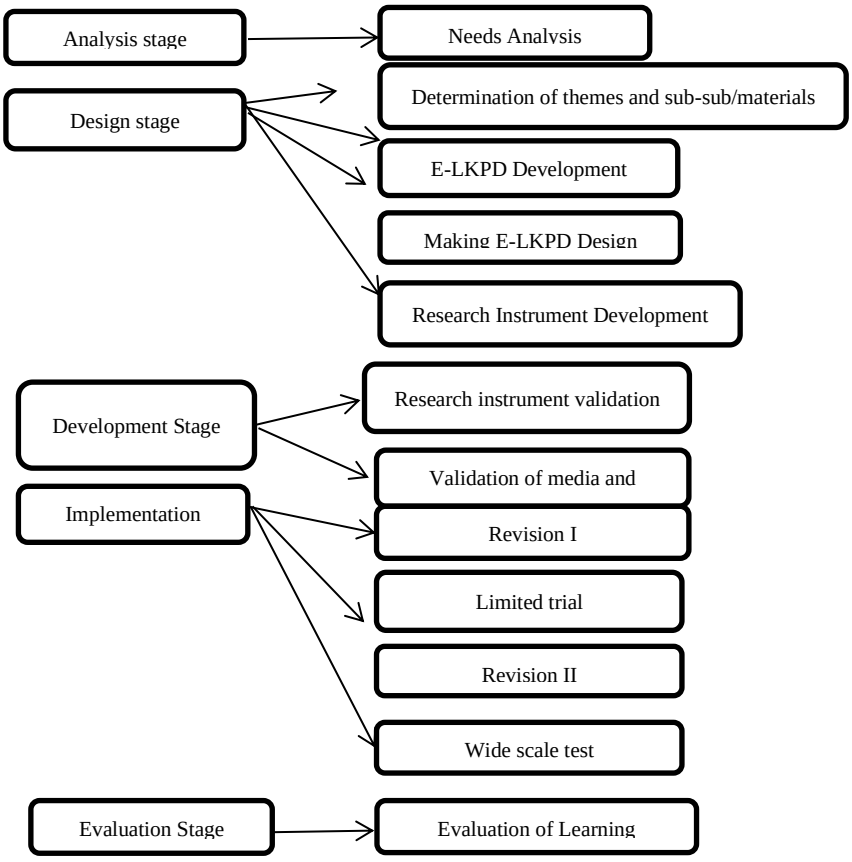

Figure 4. Flowchart of Product Development Procedures

Product Trial Design

The product trials conducted in this study aim to obtain data related to product quality and to determine the effectiveness of the product being developed.

1. Expert Validation

Validation test conducted by two lecturers, namely media experts and material experts. The purpose of this validation test is to provide an assessment of learning media with the book creator application with the help of the Canva application.

2. Limited Trial

It was conducted to determine the quality of the product based on the assessment of 10 students from Group B of PAUD Negeri Pembina 1, Bengkulu City, and to determine the logical-mathematical intelligence of the application of illustrated E-LKPD learning media.

3. Large Scale Trial

The large-scale test will be conducted on a larger scale, namely after passing the product revision stage and the product developed is considered feasible, then the product is applied to Mathematics learning in particular. The purpose of the large-scale test is to determine the E-LKPD illustrated learning media developed to improve the logical mathematical intelligence of group B students. The research design used is pretest and posttest.

Based on the minimum sample determination in this study, it is 10 people. To avoid unfilled questionnaires. Or errors in filling them out, the researcher increased the number of samples to 20 respondents.

Table 1. Assessment criteria before implementing E-LKPD media

Rated Aspect	Score	Presentation
BB	1	0 – 30 %
MB	2	31 - 50 %
BSH	3	51 – 75%
BSB	4	76 – 100 %

Product Trial Results

1. Implementation

The trial involved two classes from group B, namely B1 and B2, with a total of 2 educators and 20 students. The implementation was carried out between February-March 2024. After observation, a pretest was conducted in both classes to assess students' initial competencies before the implementation of the Illustrated E-LKPD product based on logical mathematical intelligence. The application of the media was carried out twice a week in each class. After implementation, the researcher collected data on the competencies of students aged 5-6 years for analysis, in order to evaluate the effectiveness of the product in improving logical mathematical intelligence.

Table 2. Pretest and Posttest Result Data

Results	Student Competence			
	Pre-test		*Post Test*	
	B1	**B2**	**B1**	**B2**
Number of children	10	10	10	10
Maximum Value	29	29	36	35
Minimum Value	27	25	32	31
Total Score	279	270	340	322

The collected data is converted into a scale of 0-100 to calculate the N-Gain value. This step aims to assess the effectiveness of the development of Illustrated E-LKPD that focuses on logical-mathematical intelligence.

Table 3. Data on Students' Pretest and Posttest Results

Description					
		Group		Statistics	Std. Error
NGain_Percent	B1	Mean		7,6130	2.45955
		95% Confidence Interval for Mean	Lower Bound	2,0491	
			Upper Bound	13,1769	
		5% Trimmed Mean		7,8908	
		Median		8,3333	
		Variance		60,494	
		Std. Deviation		7,77779	
		Minimum		8.82	
		Maximum		19.05	
		Range		27.87	
		Interquartile Range		9.40	
		Skewness		-,874	,687
		Kurtosis		1,411	1,334
	B2	Mean		7,4217	2.65635
		95% Confidence Interval for Mean	Lower Bound	1.4126	
			Upper Bound	13,4308	
		5% Trimmed Mean		7,9938	
		Median		10,0000	
		Variance		70,562	
		Std. Deviation		8,40010	
		Minimum		12.12	
		Maximum		20.67	
		Range		28.79	
		Interquartile Range		9.58	
		Skewness		-1,531	,687
		Kurtosis		2,661	1,334

The results of the pretest and posttest showed variations in scores between classes B1 and B2. For class B1, the minimum score obtained was 8.82, while the maximum score reached 19.05. In class B2, the minimum score was 12.12 and the maximum score was 20.67.

2. Feasibility test

a. Normality Test

To assess whether the distribution of data in a group or variable is normally distributed, a normality test is needed. This test is useful for determining whether the data that has been collected comes from a normally distributed population. Based on data calculations, the results of the analysis can show whether the data follows a normal distribution or not.

Table 4. Control Class Normality Test

Statistics	Variable 1
N Sample	10
Mean	34.00
Standard Deviation	1,247
Df	10
KS Sig	0.200
Normal	

From the table above, it can be concluded that the significant value of the normality test of the control class is 0.200. If we look at the decision above, the significant value of 0.200 > 0.05 means that the data is normally distributed.

Table 5. Normality Test of Experimental Class

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		10
Normal Parametersa,b	Mean	,0000000
	Std. Deviation	4.47937027
Most Extreme Differences	Absolute	,202
	Positive	,202
	Negative	-,149
Test Statistics		,202
Asymp. Sig. (2-tailed)		,200c,d

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. This is a lower bound of the true significance.

Based on the SPSS output table, it is known that the significance value of 0.200 is greater than 0.05. So according to the basis for decision making in the Kolomogorov-Smirnov normality test above, it can be concluded that the data is normally distributed. Thus, the assumption or requirement of normality has been met.

C. Results and Discussion

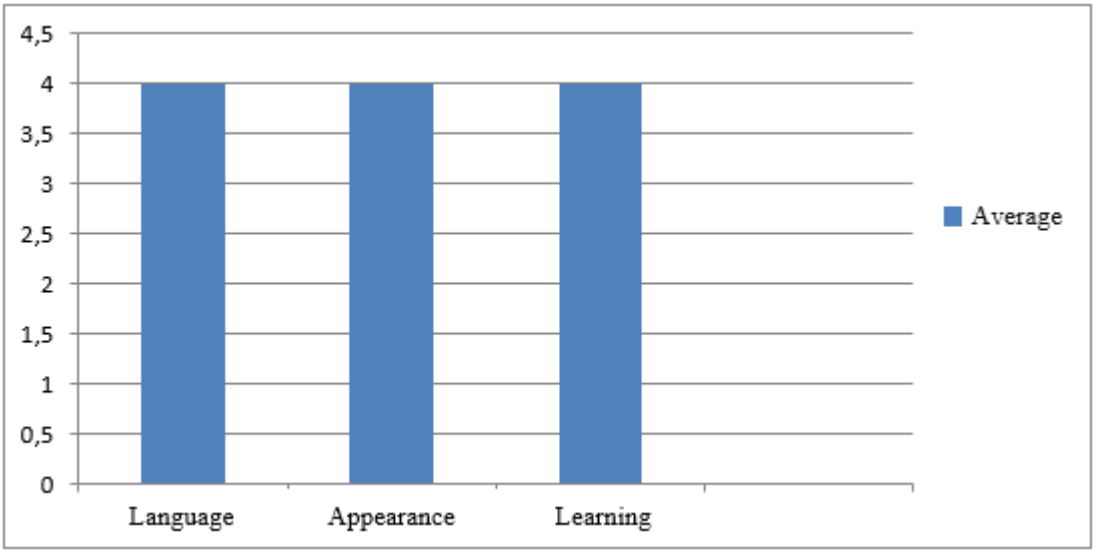

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Table 6. User Validation Results (Educators) Use of E-LKPD Media

No	Rated aspect	Average score results	Assessment Category
1	Content suitability	4	Very Worth It
2	Presentation of Material	3.96	Very Worth It
3	Linguistics	4	Very Worth It
4	Appearance	4	Very Worth It
5	Learning	3.9	Very Worth It
Total Average Score Rating		3.97	Very Worth It

After analyzing the school's needs, the researcher then evaluated the applicable PAUD curriculum to determine Core Competencies and Basic Competencies (KI & KD) as well as relevant themes and subthemes. The Illustrated E-LKPD Media developed refers to the material that has been determined and is stated in the Daily Learning Implementation Plan (RPPH).

Figure 5. Results of Illustrated E-LKPD Media Products After Revision

Implications as a consequence of the development of illustrated E-LKPD Learning Media, namely:

1. The development of the Illustrated E-LKPD learning media can improve the Logical Mathematical Intelligence of Group B students at PAUD Pembina Negeri 1, Bengkulu City. This means that teachers can use this learning media in the learning process in class group B. Aspects that can improve the Logical Mathematical Intelligence of Group B students are: 1) Attracting students' interests and talents, 2) Making students think critically, 3) Can help children solve everyday problems, 4) Ease for children to understand the material, 5) The media design is attractive.
2. This illustrated E-LKPD media is worthy of improving children's logical mathematical intelligence according to the results of research conducted by researchers. E-LKPD media can be used by teachers widely in learning in PAUD, because of the ease of media design and the advantages it has and the completeness of its supporting facilities. Illustrated E-LKPD
3. Media *E*-Illustrated LKPD effective to improve Mathematical Logic intelligence Group B students at PAUD Pembina Negeri 1, Bengkulu City

This research also has limitations, namely:

1. The development of illustrated E-LKPD media is still in the form of simple learning media, using limited features.
2. The material used is further explored, so that students have better knowledge and skills.
3. Technology is still inadequate to test effectiveness.

D. Conclusion

The E-LKPD media to improve mathematical logical intelligence in PAUD of Bengkulu city which was developed is categorized as very feasible, namely meeting the aspects of the appropriateness of content, appropriateness of material, media appearance and learning program. The E-LKPD media developed is also very effective as a learning medium for increasing Mathematical Logic intelligence. This has been proven using the t-test, with the results showing a significant difference between the pre-test and post-test of children's intelligence in each class.

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