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DEVELOPMENT OF LKPD BASED ON BRAIN BASED LEARNING USING CROSSWORD PUZZLES ON THE TOPIC OF ARITHMETIC SERIES AND SEQUENCES FOR CLASS X MAS DARUL ISTIQOMAH PADANGSIDIMPUAN

PENGEMBANGAN LKPD BERBASIS *BRAIN BASED LEARNING* MENGGUNAKAN TEKA-TEKI SILANG PADA POKOK BAHASAN BARISAN DAN DERET ARITMATIKA KELAS X MAS DARUL ISTIQOMAH PADANGSIDIMPUAN

Febri Yanti Tanjung[1*], A. Naashir M.Tuah Lubis[2], Sakinah Siregar[3]
[12]Fakultas Tarbiyah dan Ilmu Keguruan, UIN SYAHADA Padangsidimpuan
Email: febriyantitanjung196@gmail.com

*email Koresponden: febriyantitanjung196@gmail.com

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Abstract

This study is motivated by the lack of use of mathematics learning tools such as student worksheets (LKPD) at MAS Darul Istiqomah Padangsidimpuan, where teacher handbooks and textbooks are more frequently used. Additionally, the students' mathematics learning outcomes, particularly in the topic of arithmetic sequences and series, are low. This study aims to assess the validity, practicality, and effectiveness of student worksheets (LKPD) based on brain-based learning (BBL) using crossword puzzles in the topic of arithmetic sequences and series for class X at MAS Darul Istiqomah Padangsidimpuan. This research is a research and development (R&D) study. The development model used in this research is the 4D model, which consists of four stages: Define, Design, Development, and Disseminate. The validation of the LKPD includes material validation, media validation, and language validation. The trial was conducted in class X-B, with a total of 19 students at MAS Darul Istiqomah Padangsidimpuan. The material experts, media experts, and language experts each consisted of 2 validators. The results of this study indicate that the developed LKPD meets the eligibility criteria, with an overall validation percentage of 87.32%, categorized as valid. The practicality of all aspects is shown by a value of 85.63%, categorized as very practical. The effectiveness is indicated by an average student learning outcome score of 71%, calculated from the overall average learning outcomes of the students, categorized as effective. Therefore, it can be concluded that the LKPD is feasible, engaging, and capable of improving student learning outcomes.

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Keywords: Arithmetic Sequences and Series, Brain Based Learning, LKPD, Crossword Puzzles

Abstrak

Penelitian ini dilatar belakangi oleh kurangnya penggunaan perangkat pembelajaran matematika seperti LKPD di sekolah tersebut, di MAS Darul Istiqomah Padangsidimpuan. lebih sering menggunakan buku pegangan guru, serta rendahnya hasil belajar matematika peserta didik khususnya pada materi limit fungsi aljabar. Penelitian ini bertujuan untuk mengetahui validitas, praktikalitas dan efektivitas lembar kerja peserta didik (LKPD) berbasis *brain based learning* (BBL) menggunakan teka-teki silang pada pokok bahasan barisan dan deret aritmatika kelas X MAS Darul Istiqomah Padangsidimpuan. Penelitian ini merupakan *research and development* (R&D). Model pengembangan yang digunakan di penelitian ini adalah 4D yang melalui empat tahap di antaranya, *Define* (pendefinisian), *design* (perancangan), *development* (pengembangan), dan *Disseminate* (penyebaran). Validasi LKPD terdiri dari validasi ahli materi, validasi media, dan validasi ahli Bahasa. Di uji coba di kelas X-B, subjek uji coba dilakukan di MAS Darul Istiqomah Padangsidimpuan yang berjumlah 19 peserta didik. Ahli materi, ahli media, dan ahli bahasa masing-masing terdiri dari 2 validator. Hasil dari penelitian ini yaitu LKPD yang dikembangkan memenuhi kriteria hasil persentase keseluruhan validasi sebesar 87,32% berada dikategori valid. kepraktisan dari seluruh aspek ditunjukkan dengan nilai 85,63% berada dikategori Praktis. Kemudian nilai efektivitas dari seluruh nilai hasil belajar peserta didik ditunjukkan dengan nilai 71% nilai ini didapat dari nilai rata-rata keseluruhan hasil belajar peserta didik dikategorikan efektif. Dengan demikian dapat dinyatan bahwa LKPD sudah layak, menarik dan mampu meningkatkan hasil belajar peserta didik.

Kata Kunci: Barisan dan Deret Aritmatika, *Brain Based Learning*, LKPD, Teka-Teki Silang

1. INTRODUCTION

Education is an important activity that cannot be separated from human life.[1] Education is also a process of humanizing humans as a whole which is more institutionalized in a cultural context.[2] All educational activities are solely aimed at realizing the goals of education.[3] Thus, schools as a component of education have a great responsibility to improve the quality of optimal learning for each subject, including mathematics. Mathematics is one of the basic sciences that plays an important role in helping to develop human thinking abilities

Mathematics is one of the subjects that must be studied at every level of education.[4] According to the results of an international study conducted by the Program for International

[1] A. Naashir M. Tuah Lubis, "The Ability to Solve Mathematical Problems through Realistic Mathematics Learning Based on Ethnomathematics," *Mathematics and Science Education International Seminar (MASEIS)*, 2021, hlm. 4.

[2] Lelya Hilda, "Pembelajaran Berbasis Saintifik dan Multikultural dalam Menghadapi Era Masyarakat Ekonomi Asean (MEA)," April 28, 2020, hlm. 8, https://doi.org/10.31219/osf.io/zgxn7.

[3] Abd Rahman Bp et al., "Pengertian Pendidikan, Ilmu Pendidikan Dan Unsur-Unsur Pendidikan," *Al Urwatul Wutsqa: Kajian Pendidikan Islam*, June 2022, hlm. 6.

[4] A Naashir M. Tuah Lubis, Sakinah Siregar, *"Students' Thinking Characteristics in Concepts Understanding on Basic Statistics Courses That Reviewed From The Extended Level Triad ++*," *Jurnal Ilmu-Ilmu Pendidikan Dan Sains* 12 (June 2024) hlm. 104.

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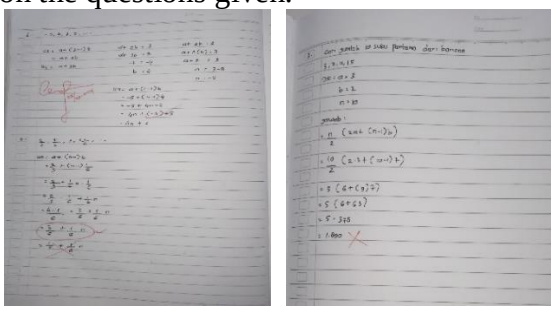
Student Assessment (PISA), it was stated that the results of the PISA study in 2022 showed that Indonesia's mathematics ranking was ranked 66 out of 81 countries, and the average Indonesian mathematics literacy score was 366 and these results indicate that the mathematics literacy of students in Indonesia based on international studies is still relatively low.[5]

Mathematics learning should be attached to real concepts with students, because it can be used as an interesting learning resource. Based on the results of initial observations conducted by researchers by providing 3 questions about arithmetic sequences and series in the form of essays to students to get an overview of students' mathematics learning outcomes. Through the analysis of students' answers, it was found that there were still many students who could not complete their assignments properly, where 15 out of 21 students or 75% of students were unable to work on the questions given.



Picture 1. Observation Results

Based on these problems, researchers argue that there needs to be a solution to the existing weaknesses. One of the learning media that can facilitate learning is student worksheets (LKPD). According to Prastowo, student worksheets (LKPD) are printed teaching materials in the form of sheets of paper containing material, summaries, and instructions for implementing learning tasks that must be done by students referring to the basic competencies that must be achieved by students.[6] The preparation of LKPD can be integrated with various types of learning models, one of which is brain-based learning. As a theory, brain-based learning is a learning model that is in line with the natural way the brain works during the learning process. This approach provides space for students to think freely, in a supportive environment, and is filled with stimuli that can trigger students to think creatively.[7]It is important for researchers to develop LKPD based on brain based learning using crossword puzzles on the topic of arithmetic sequences and series for class X MAS Darul Istiqomah Padangsidimpuan. The formulation of the problem in this study is: 1) how is the validity of LKPD based on brain based learning using crossword puzzles on the topic of arithmetic sequences and series for class X MAS Darul Istiqomah Padangsidimpuan?; 2) how is the practicality of LKPD based on brain based learning using crossword puzzles on the topic of arithmetic sequences and series for class X MAS Darul Istiqomah Padangsidimpuan?; 3) how is the effectiveness of LKPD based on brain based

[5] Tasya Natalia, "Skor Matematika-Membaca Pelajar RI Salah Satu Terendah Di Dunia," *CNBC Indonesia*, February 1, 2024.

[6] Ahmad Nizar Rangkuti, *Pendidikan Matematika Realistik Pendekatan Alternatif dalam Pembelajaran Matematika*, (Bandung: Cipustaka Media, 2019), hlm. 13.

[7] Didik Rezki Suryani, "Pengembangan Modul Matematika Berbasis Pendekatan Pembelajaran Saintifik Di SMP Negeri 8 Padangsidimpuan," 2023, hlm. 3.

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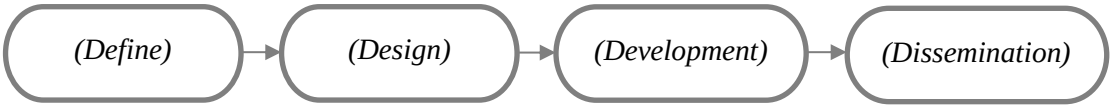
learning using crossword puzzles on the topic of arithmetic sequences and series for class X MAS Darul Istiqomah Padangsidimpuan?

2. RESEARCH METHOD

This research was conducted at MAS Darul Istiqomah Padangsidimpuan located on Jl. Abror/ Pulo Bauk, Huta Padang Pijorkoling. Padangsidimpuan Tenggara District, Padangsidimpuan City. This research was conducted in the even semester of the 2024/2025 academic year on the material of arithmetic sequences and series. The subjects in this study were 19 students of MAS Darul Istiqomah Padangsidimpuan class X-B.

The type of research used is the type of research and development or Research and Development (R&D). The type of development carried out using the 4-D model consists of 4 main stages, namely Define, Design, Development, and Disseminate. The following stages will be used in the form of a chart which can be explained as follows:



Picture 2. 4D Model Learning Device Development Chart

3. RESULTS AND DISCUSSION

The development of Brain Based Learning-based LKPD in this study uses the Research and Development (R&D) method with a 4-D development model. In line with the research conducted by Muthia Marda Rani & Ali Asmar with the title of the development of Brain Based Learning (BBL) based student worksheets on the material of two-variable linear equation systems for class VIII of junior high school, this study aims to develop Brain Based Learning (BBL) based student worksheets on one of the mathematical materials, namely two-variable linear equation systems that meet the criteria of valid, effective and practical for class VIII of junior high school. The model used in this study is the plomp development model. Based on the results of the validity analysis, the validity percentage is 88.75% with a very valid category. Meanwhile, the results of the practicality test obtained a percentage of 88.54% with a very practical category. Based on the results obtained, it can be concluded that the Brain Based Learning based student worksheet on the material of two-variable linear equation systems for class VIII of junior high school is valid and practical.[8]

The purpose of this study is to produce valid, practical and effective Brain Based Learning-based mathematics LKPD.

1. Define

The definition stage consists of two steps, namely: initial-final analysis, student analysis which can be described as below.

a. Initial-Final Analysis

Based on the results of the researcher's observations at MAS Darul Istiqomah Padangsidimpuan, the researcher found that the main problem that needs to be considered in learning is that students are less active and less focused in following the

[8] Muthia Marda Rani Ali Asmar, "Pengembangan Lembar Kerja Peserta Didik Berbasis Brain Based Learning Pada Materi Sistem Persamaan Linear Dua Variabel Untuk Kelas VIII SMP," *JurnalEdukasidanPenelitianMatematika* 12, no. 1 (March 2023).

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lesson, even though the teacher has tried to involve students in learning. This causes a lack of understanding and low learning outcomes for students.

b. Student Analysis

Based on interviews with several class X students at MAS Darul Istiqomah Padangsidimpuan, the researcher found that each student has different learning characteristics. Some students have more dominant intelligence in mathematics, while others are more intelligent in religion. Students who have visual intelligence, for example, will be more interested and motivated to learn mathematics if the questions given have visual elements that support their way of thinking. The same applies to students with other intelligences.

2. Design

Stage After the definition stage in the define stage, the researcher then carries out the design, namely media selection, format selection and making an initial design according to the selected format. Furthermore, the media format used in LKPD is a format that refers to general, only the content of the material is inserted on each LKPD sheet according to the competency achievement indicators owned. The initial design of LKPD based on brain-based learning is in accordance with the specified format. The following is a description of the initial design stage of the learning device to be developed.

LKPD design based on brain based learning	**information**
	**Cover**, the cover of the LKPD is designed with the title "Student Worksheet based on brain-based learning of arithmetic sequences and series". In the lower right corner there is information about the class, school level. In the upper left corner there is information about the author's institute of origin. While below there is a box to fill in student information.
	**Foreword**, in this section there is an expression of gratitude and thanks from the author for completing the LKPD based on brain-based learning as well as the author's hopes for the LKPD.

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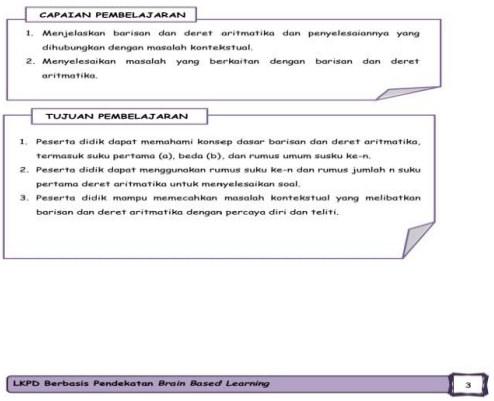
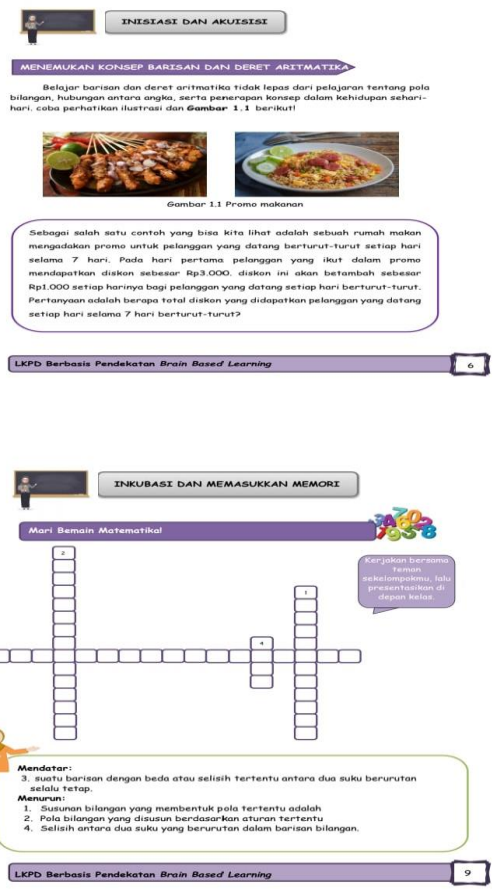
	**Learning Achievements and Learning Objectives**, this section contains the final behavior that is expected to be obtained by each student from the learning process they have taken on the material on arithmetic sequences and series using LKPD based on brain-based learning.
	**Main Material,** this section contains brief explanations in the form of definitions and formulas regarding a number of materials that will be discussed in the LKPD along with examples of questions. **Group Assignments**, in this section there are questions made in the form of crossword puzzles with the hope that students will be interested and enthusiastic about working on group assignments.

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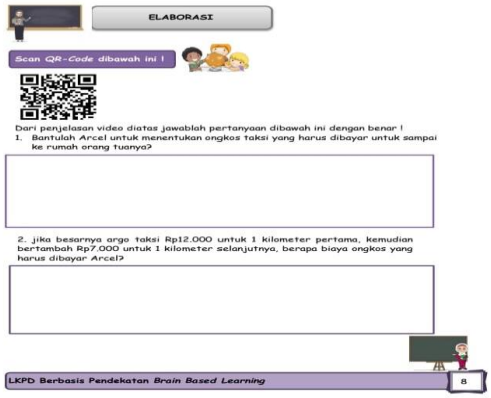	**Independent Assignment,** in this section there are questions to hone students' reasoning skills, which are made in the form of videos with students having to scan the available QR code.

3. Development stage

At this stage, the validation process is carried out against material, media, and language experts. This instrument aims to determine the validity of the development of learning devices based on Brain Based Learning to improve students' mathematics learning outcomes. The following validators of the product development of learning devices based on Brain Based Learning in this study can be seen in the following table.

a) Validation by material experts

Validation was carried out by 2 material experts, Lecturer at UIN Syahada Padangsidimpuan and Mathematics Teacher at MAS Darul Istiqomah Padangsidimpuan. In general, the validation results data by material experts can be seen in the following table.

No.	Assessment Aspects	Score Per Aspect	Total Score	Score Per Aspect	Total Score
		Validator 1		Validator 2	
1.	Content/Material	17	20	17	20
2.	Presentation	16	20	15	20
Total Score		33	40	32	40
Persentation		82,5 %		80 %	
Average Percentage		81, 25 %			
Category		Very Valid			

Table 1. Results of Validation by Material Experts

Based on the table above, the results of the validation of the material in the LKPD based on brain-based learning by validator 1 with a percentage of 82.5% and validator 2 with a percentage of 80% so that an average percentage of 81.25% was obtained which is a very valid category.

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b) Validation Results Data by Media Experts

Table 2. Validation Results by Media Experts

No.	Assessment Aspects	Score	
		Validator 1	Validator 2
1.	The illustration on the cover depicts the title of the LKPD	5	5
2.	Use of letter variations that are not excessive	5	4
3.	The color of the writing on the LKPD contrasts with the background color.	5	5
4.	The use of color in LKPD does not interfere with the delivery of the material.	5	5
5.	The hierarchy of titles is clear, consistent and proportional.	5	4
6.	The instructions in the LKPD are easy to understand	5	5
7.	Appropriate placement of layout elements	4	4
8.	The text is clearly legible	5	5
9.	The images presented are clear and the color combinations are attractive.	5	5
Total score		**44**	**42**
Percentage		**97 %**	**93 %**
Average percentage		**95 %**	
Category		**Very Valid**	

Validation was carried out by 2 media experts, namely Didik Rezki Suryani, M.Pd (Lecturer at UIN Syahada Padangsidimpuan) and Sabrina Sitompul, S.Pd (Mathematics Teacher at MAS Darul Istiqomah Padangsidimpuan). In general, the validation data by media experts can be seen in the following.

Based on the table above, the results of the Media validation on LKPD based on brain-based learning by validator 1 with a percentage of 97% and validator 2 with a percentage of 93% so that an average percentage of 95% was obtained which is a very valid category.

c) Validation Data by Language Experts

Table 3. Validation Results by Language Experts

No.	Assessment Aspects	Score	
		Validator 1	Validator 2
1.	Appropriate size and type of letters	5	4
2.	Spacing size conformity	4	4

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3.	Conformity with good and correct Indonesian language rules	4	4
4.	Use of various types of letters that are not excessive	5	4
5.	Clarity of sentence structure	4	3
6.	Simplicity of sentence structure	4	4
7.	Sentences are easy to understand	5	4
8.	Doesn't give rise to double meanings	5	5
9.	Commutative	4	4
10.	Interactiva	4	4
11.	Reads well	5	5
12.	Suitability to the level of thinking of students	4	4
13.	Clarity of instructions and directions	5	5
14.	Clarity in providing information	4	4
Total Score		**62**	**58**
Percentage		**88,57 %**	**82,85 %**
Average Percentage		**85,71 %**	
Category		**Very Valid**	

Validation was carried out by 2 language experts, namely Dr. Erna Ikawati, M.Pd (Indonesian Language Lecturer) and Rosanti Rangkuti, S.Pd (Indonesian Language Teacher, MAS Darul Istiqomah Padangsidimpuan).

In general, the validation data by language experts can be seen below. Based on the table above, the results of language validation on LKPD based on brain-based learning by validator 1 with a percentage of 88.57% and validator 2 with a percentage of 82.85% so that an average percentage of 85.71% was obtained which is a very valid category.

Based on the data above, information on validation of LKPD based on brain-based learning from experts was obtained as follows:

Table 4. LKPD Validation Results by Experts

No.	validator	Percentage	Category
1.	Materials Expert	81,25%	Very Valid
2.	Media Expert	95%	Very Valid
3.	Linguist	85,71%	Very Valid
Average Percentage		**87,32 %**	**Very Valid**

Based on the table above, the average percentage of validation of brain-based learning-based LKPD is 87.32% with a very valid category. Thus, brain-based learning-based LKPD meets the criteria of very valid and is suitable for use in the classroom.

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4. Dissemination Stage

The dissemination stage is the final stage of this research and development process. This stage aims to disseminate or publish the mathematics teaching materials that have been created. The dissemination stage is carried out on a limited basis to Mathematics teachers at MAS Darul Istiqomah Padangsidimpuan. Brain-based LKPD is given to Mathematics teachers at MAS Darul Istiqomah Padangsidimpuan in printed form and files.

PRODUCT TRIAL

The trial of brain-based learning-based LKPD was conducted in one class, namely class X-B MAS Darul Istiqomah Padangsidimpuan in the even semester. There were 19 students in class X-B. The trial of brain-based learning-based LKPD was conducted to determine the level of practicality and effectiveness of brain-based learning-based LKPD.

The results of the brain-based learning-based LKPD trial that have been implemented are as follows.

1) Analysis of Practicality Results Data

The practicality data of the brain-based learning-based LKPD that was developed was taken from the results of the analysis of teacher and student response questionnaires. The following is a description of the results of the analysis of teacher and student response questionnaire data.

a) Teacher Response Questionnaire Results Data

Table 6. Teacher Response Questionnaire

Assessment aspect	Item number	Score
Convenience	1	3
	4	4
	5	3
	6	4
	11	4
Interest	7	4
Language	2	3
	3	4
Material	12	5
	13	5
Usefulness	8	4
	9	5
	10	4
	14	4
Total score		**56**
Percentage		**80%**
category		**Practical**

Based on the table above, the results of the teacher's response obtained a score of 56 with a percentage of 80% which is a practical category.

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b) Data on Student Response Questionnaire Results

Table 7. Student Response Questionnaire

Assessment aspect	Item number	Score
Convenience	1	85
	3	83
	4	82
	5	83
	6	80
Interest	14	84
Language	2	83
	3	80
Material	9	81
	10	83
Usefulness	7	83
	11	82
	12	81
	13	80
Total score		**1.150**
Average score		**63,8**
Percentage		**91,26 %**
Category		**Very Practical**

Based on the table above, the results of the student responses obtained an average score of 63.8 with a percentage of 91.26% which is a very practical category. Based on the data above, the following information was obtained from the teacher and student response questionnaire results:

No.	Response questionnaire	percentage	Category
1.	Teacher	80%	Very practical
2.	Student	91,26%	Very practical
Average score		85,63%	Very practical

Based on the table above, the average percentage of teacher and student questionnaire responses to the practicality of brain-based learning-based LKPD is 85.63% with a very practical category. Thus, brain-based learning-based LKPD meets the criteria of very practical.

2) Analysis of Effectiveness Results Data

The effectiveness data of the brain-based learning (BBL)-based LKPD developed was taken from the N-Gain Test of the results of the analysis of students' pretest and posttest scores. The following is a description of the results of the analysis of students' pretest and posttest scores.

Table 8. Student Learning Outcomes during the pretest and posttest

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No.	Respondent	*pretest*	*Posttest*	Post-pre	Skor ideal-pre	*N-Gain Score*	Category
1.	AK	40	100	60	60	1	Medium
2.	AZH	60	100	40	40	1	Medium
3.	DSR	7	40	33	95	0,34	Height
4.	HSH	32	75	43	70	0,61	Height
5.	IBN	60	80	20	40	0,5	Height
6.	MNDH	47	81	34	53	0,64	Height
7.	NPRN	40	75	35	60	0,58	Height
8.	NLT	24	100	76	75	1	Medium
9.	PS	40	80	40	60	0,66	Height
10.	PPA	40	80	40	60	0,66	Height
11.	RNS	60	100	40	40	1	Medium
12.	RD	40	80	40	60	0,66	Height
13.	S	60	100	40	40	1	Medium
14.	S	20	65	45	80	0,56	Height
15.	SMN	20	80	60	80	0,75	Medium
16.	SR	34	65	31	70	0,44	Height
17.	TSN	44	80	36	55	0,65	Height
18.	WS	20	80	60	80	0,75	Medium
19.	ZA	60	91	31	40	0,77	Medium
Total		**748**	**1552**			**13,57**	
Average		**39**	**82**			**0,71**	Medium

Based on table 8, the N-Gain Score value is 0.71 with a moderate category, meaning that there is an intrease in student learning outcomes with an N-Gain Percent of 70% which is an effective category. Thus, the use of LKPD based on brain-based learning meets the effective criteria.

4. CONCLUSION

Here are some conclusions that can be drawn from the results of this Research and Development, including:

1. Valid criteria are seen based on the results of the validation data analysis from the validators, including the independent mathematics curriculum teaching module with a percentage of 85.5% which is a very valid category, LKPD based on brain-based learning with an average percentage of 81.25% is a very valid category, namely from material experts a percentage of 81.25% is a very valid category, from media experts a percentage of 95% is a very valid category and from language experts a percentage of 85.71% is a very valid category. Thus, LKPD based on brain-based learning and its supporting instruments meet the valid criteria.
2. Practical criteria are seen based on the results of the analysis of teacher and student response questionnaire data on LKPD based on brain-based learning. The results of teacher responses obtained a percentage of 80% which is a practical category and student responses obtained a percentage of 91.26% which is a very practical category so that an

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average percentage of 85.63% is a very practical category. Thus, LKPD based on brain based learning (BBL) meets the practical criteria.

3. Effective criteria are seen based on the results of the analysis of students' pretest-posttest data so that an N-Gain Score of 0.71 is obtained with a moderate category and an N-Gain Percent of 71% is an effective category. Thus, LKPD based on brain based learning meets the effective criteria.

5. REFERENCES

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