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DEVELOPMENT OF DISCOVERY LEARNING BASED STUDENT WORKSHEET TO IMPROVE MATHEMATICAL CRITICAL THINKING SKILLS

PENGEMBANGAN LKPD BERBASIS *DISCOVERY LEARNING* UNTUK MENINGKATKAN KEMAMPUAN BERPIKIR KRITIS MATEMATIS

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ABSTRAK

Tujuan dari penelitian ini yaitu untuk mendapatkan tingkat kevalidan, kepraktisan dan keefektifan materi pembelajaran yang dikembangkan berbentuk LKPD atau Lembar Kerja Peserta Didik berlandaskan pembelajaran *discovery learning* untuk memajukan daya berpikir kritis matematis peserta didik. Penelitian ini memanfaatkan model desain pembelajaran ADDIE yang terdiri dari tahap analisis (*analysis*), perancangan (*design*), pengembangan (*development*), implementasi (*implementation*) dan evaluasi (*evaluation*). Metode penelitian yang digunakan dalam pengumpulan informasi (data) berupa tes kemampuan berpikir kritis matematis dan angket respon. Peserta didik kelas VIIA ialah subjek dalam uji lapangan luas dan peserta didik kelas VIIB subjek dalam uji lapangan terbatas. Adapun kategori yang dipenuhi dalam penelitian ini yaitu: (1) valid, berdasarkan perolehan hasil validasi oleh 3 validator (ahli media, ahli materi dan pembelajaran matematika), (2) sangat praktis, berdasarkan perolehan nilai angket respon peserta didik saat uji lapangan luas serta uji lapangan terbatas dengan rata-rata 91,35%, (3) efektif, diperoleh dari hasil tes peserta didik dengan rata-rata ketuntasan presentasi 77,08%. Maka dapat diambil kesimpulan, LKPD yang dibuat valid, sangat praktis serta efektif untuk dipakai dalam pembelajaran matematika.
Kata kunci: pengembangan LKPD; pembelajaran *discovery learning*; berpikir kritis matematis

ABSTRACT

The purpose of this study is to achieve a level of validity and, practicality and effectiveness of learning materials made in LKPD or student worksheets based on discovery learning learning to increase the mathematically critical thinking power of learners. The study utilize addie design models composed of analysis stages, design development, implementation (application) and evaluation (completion). Research ordinances or methods used in information gathering (data) of a mathematically critical and analytical ability test. Viia class learners are subject to extensive field tests and viib class learners are subject to limited field tests. As for the accepted category in this study: (1) valid, by the acquisition of validity by 3 validator (materials, media experts and mathematicians) with an overall value value of 80,81%, (2) very practical, based on the acquisition of educational responses ata wide field test and limited field tests with an average of 91.35, (3) effective, drawn from the learner's test with an average of 77.08%. Hence, the conclusion can be drawn, is that the lto which it is developed meets a valid category, is both practical and effective for use in mathematical learning
***Keywords**: LKPD development; discovery learning; mathematical critical thinking*

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PRELIMINARY

Mathematics is a subject of absolute character and always requires logic in its learning (Septian, et al., 2019). Mathematics is a subject that "can promote power (think) analytically, logically, structured, critical, innovative, and cooperative ability (Haeruman, et al., 2017). A capacity of thought that can be enhanced through math study is the critical ability of thinking ability that isa procedure that applies thinking ability, in real and direct terms to support a person in organizing, evaluating, and implementing the requirements of what he or she believes to accomplish (Atika & Zubaidah, 2016).

Critical thinking is an organized process to use rational, reflective ability to enable learners to pay attention or explain, recognize, and describe and design problem solutions (Mahmuzah, 2015). Understanding the concept of mathematics by students with critical thinking ability will be easier because critical thinking ability is one that students are required to have in mathematics (Marsitin & Sesanti, 2019). Indonesia's students have very little critical thinking ability. According to the 2018 annual programme for student attainment (PISA), Indonesia's critical thinking ability is 72 in the 78 countries participating in the survey. Thus critical thinking ability as an aspect students are required to have in order to accomplish the purpose of learning requires improvement. Teachers must plan more fun and interactive learning methods using developed media and learning resources so that the learning purposes can be accomplished (Sari & Bharata, 2017).

A simpler medium or learning source is a learner's worksheet that can be made with a method consistent with the saintific approach, one of which is learning learning, so that students can be prepared to develop their own information according to the 2013 curriculum standard (Rachmawati et al., 2019). LKPD or student work sheet is a composite work that students must accomplish. The work is typically a procedure for the performance of task and must be clearly a basic competence reached (Septian et al., 2019). In line with the definition presented by Umbaryati (2016), which reveals that the LKS or LKPD can be a medium that provides ease in learning preparation, thereby creating effective relationships between learners and educators, capable of promoting both learner's performance and learning activity.

After observation and interview with a math teacher at SMPN 2 Boleng, it was known that the teaching material used only in the form of a publisher's package book was used, using no such thing as LKPD or LKS. In use, the package book is also underrated because many learners with learning value have not yet reached KKM or the minimum requirement, with established KKM unit as 65. It can be known from the acquisition of the daily review of learners, where 61% of students with the average learning result scores are under 65. Furthermore, it was also found that the learning method used by SMPN 2 Boleng teachers during the math learning process WAS the lecture method, the teacher-centered learning. The result of the interview, it is also known that learners still have difficulty understanding comparisons. Learners are struggling and are not used to resolving the story by considering some of the procedures of interpretation, analysis, evaluation and deduction.

The problem can be solved by student worksheet with a new invention, i.a. based on discovery learning, made by teachers themselves. Much is done by educators both in terms of both material delivery and a good selection of methods during learning activities to achieve satisfying math in order to achieve the purpose of learning (Khodijah, et al., 2020). To achieve the goal of learning, a model to use in class is the discovery learning model (Farib et al., 2019). As suggested by Nugrahaeni et al., (2017) discovery learning as one of the learning models that can train and advance critical thinking power gives students many opportunities to think and to find opinions through study exercises.

Some related research carried out Sari & Bharata (2017), is about developing idon-based incubation guides to advance critical thinking power of learners. From these results, it concludes that the LKPD developed is very valid, very practical, and very effective in advancing learners' critical thinking ability during the mathematical learning process. Another study is carried out by Irmawati (2019) about the development of problem worksheets to improve learners' critical thinking ability. From this description it is concluded that the lto which it is developed is worthy to be applied to mathematical learning.

Unlike previous weaver, the study reviewed lto discover learning to enhance learners' critical, mathematical ability to think highly in innovative and creative learning. It positions learners as subjects of learning according to presented presented heretical learning. From the description comes a study on " Development Of Discovery Learning Based Student Worksheet To Improve Mathematical Critical Thingking Skills of students at SMP Negeri 2 Boleng".

METHOD

The model used in development or researcch and developmentt (R&D) is addie's design model composed of analysis levels (analysis), design (design), development (development), implementation (application) and evaluation (application). Where this model comes to the final step of evaluation. The first stage is the analysis stage. What is done is analysis of the need for the teaching materials that educators use to support learning activities, the learning characteristic analysis and the basic competence and competence attainment indicator analysis that the mimicry of comparison materials in student worksheet to match that of competence analysis.

The next step is design. In these, student worksheet framework is prepared, determines the system of discovery learning with which to project, stimulus, statements, information collection, information processing, verification and generalization then develop research instruments. The third stage of the ADDIE model is the development stage. The design of the earlier stage was realized at this stage. It is validated by 3 validator to get input for repairs. The revision is implemented according to input and Suggestions from the 3rd validator to perfect the lack of the student worksheet developed.

At the implementation stage, the developed design results are implemented to learners or diuretics in class. Application made on class vii SMPN 2 Boleng. Response efforts are spread to learners to get designed LKPD-use practicality after a trial process is completed. The test of critical thinking ability is then carried out with 4 items of description in order to know the minimum percentage of critical thinking ability as well as the result. Recent revision of the LKPD was conducted by researchers at the evaluation stage. The process of revision is done according to the suggestion, input or comment generated by the student response or math teacher notes.

Based on the above exposure, the sintak of development research can be presented on figure 1.

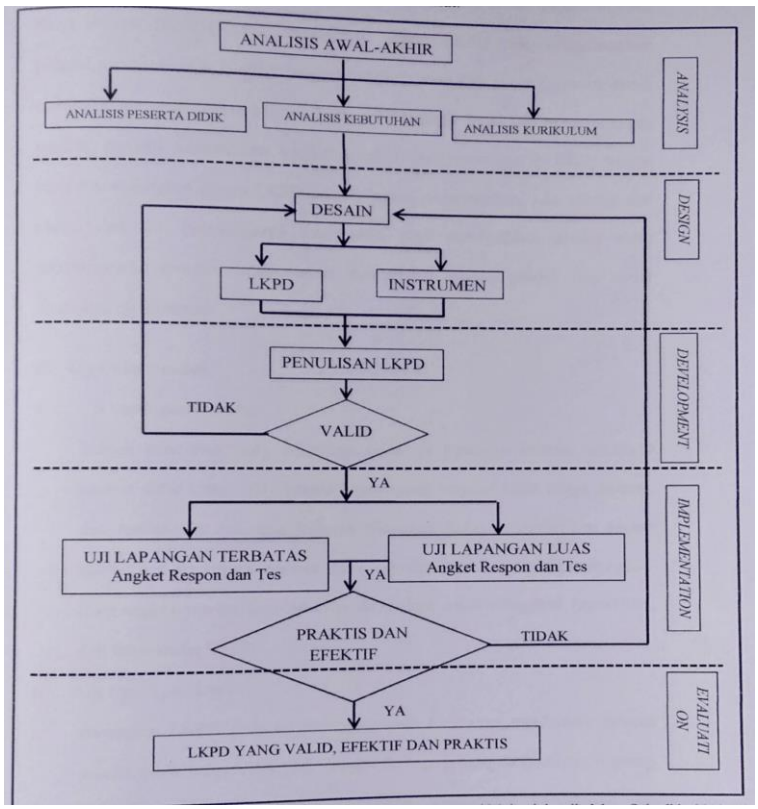


Figure 1. LKPD Development Procedure Diagram

The study employs the type of qualitative data acquired from responses, Suggestions and input from media experts, materials experts, math teachers and learners, and quantitative data known from the validation of LKPD by 3 validator, the assessments of student responses and critical cognitive test results of learners. The research instrument used consists of two kinds of nontest instruments consisting of a validation sheet from media experts, materials experts and mathematicians used to test the valification and adaptability of learners. The test instrument used is the test of the critical thinking ability given to know the effectiveness of learning using LKPD that is developed in promoting critical thinking ability. LKPD be said valid and practical if the validation of 3 validator reaches a minimum with valid and practical categories or 61% interval 61%. The student work sheet percentage is said to be effective if the average percentage of critical thought capability tests are in a moderate category or interval "71% $\bar{S}$<86%".

RESULT AND DISCUSSION

The student worksheet design is adjusted according to analysis done. Student worksheet design is adapted to the steps of discovery learning. The form of material delivery in LKPD that is adapted to the discovery learning flow is as follows:

1. Stimulation

This activity is intended to stimulate basic capabilities or to grow learners' initial plans for problem solving materials. This section presents mathematical problems in everyday life in picture form. The picture presents the problem of comparisons of age, weight in objects, the comparison of many pencils and the introduction of many animals to the building of comparative materials. Here is the stimulus activity form on the LKPD as in figure 2.

Figure 2. Stimulation

2. Statement (Problem Identification)

This activity consists of situations or contextual mathematical problems that are consistent with materials obtained to build understanding of learners to habitually encounter problems. The picture presented the problem of the comparison of many men to many women. The problem identification activity in LKPD is in figure 3.

Figure 3. Problem Identification

3. Data Collection

This data gathering activity has a purpose to further the students' information about the material given to the igrant. The mathematical information of the Ike consists of concepts and equations used in perfecting a comparative problem. This data-collection activity on the LKPD is in figure 4.

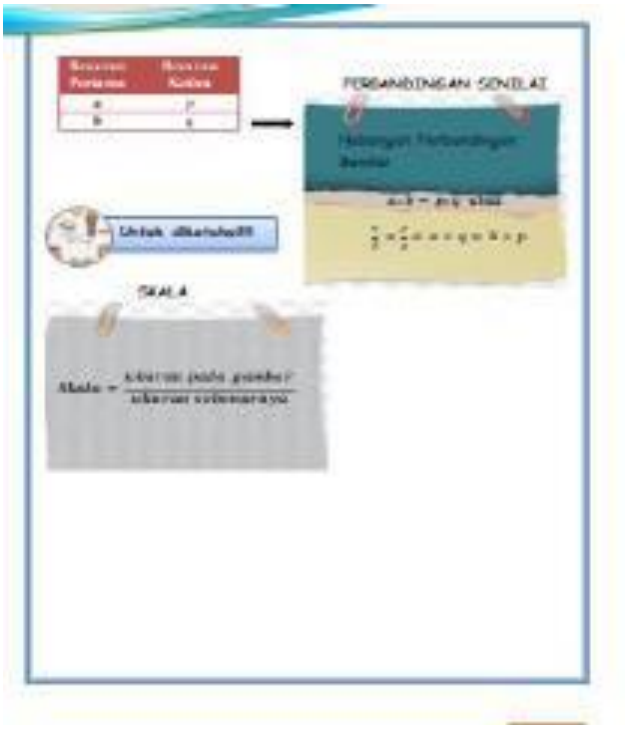


Figure 4. Data Collection

4. Data Processing

The problem associated with the problem identification activity is then treated to data-processing activities by referring to the mathematical information provided to the data-collection activities. In this activity, learners gain a new understanding of the material learned. This data processing activity on the linkage is in figure 5.

Figure 5. Data Processing

5. Proof

In this section the learners will outline or explain ways to resolve the situation or the mathematics of the results of the data-processing activities that their truthfulness will prove by discussing. The view of this section on the LKPD is in figure 6.

Figure 6. Proof

6. Conclusion

In this section, learners draw conclusions based on their own understanding after studying the material given to the student worksheet. The view of this section on the LKPD is in figure 7.

Figure 7. Conclusion

The design was then validated by the three validator to know the level of validan. Scholars are the validator selected to give an assessment of the lto products developed from the feasibility of content, presentation and language. The median expert was one of the validator to give an appraisal of the lon developed from the media aspect. Mathematicians are the validator to give an assessment of the lgiven developed from the aspect of learning. Here are the validation results sheets of the three validator.

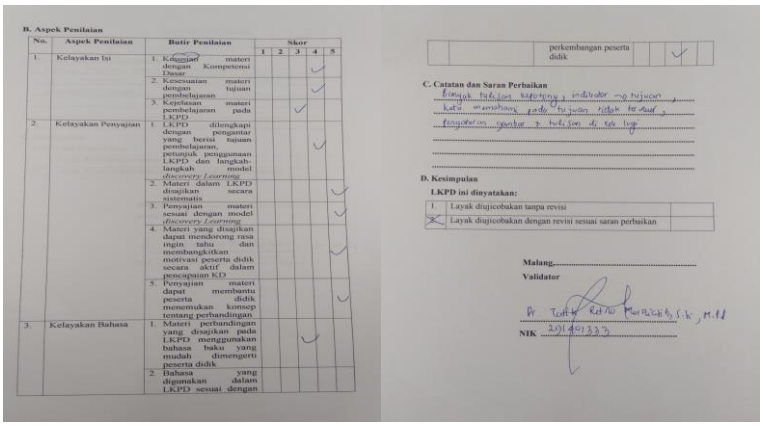


Figure 8. Material Expert Validation Sheet

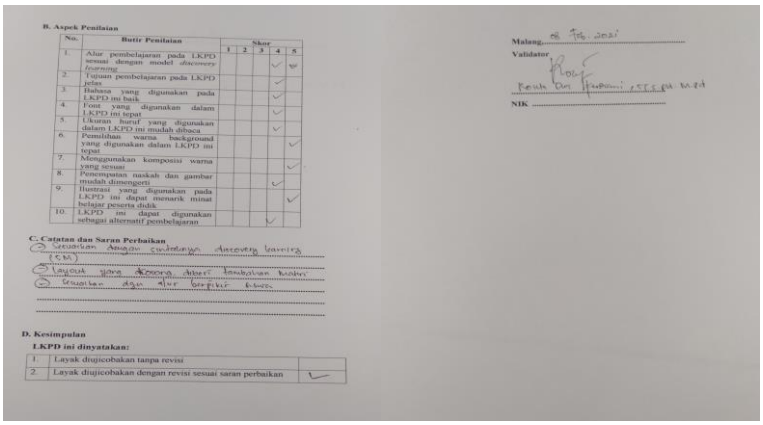


Figure 9. Media Expert Validation Sheet

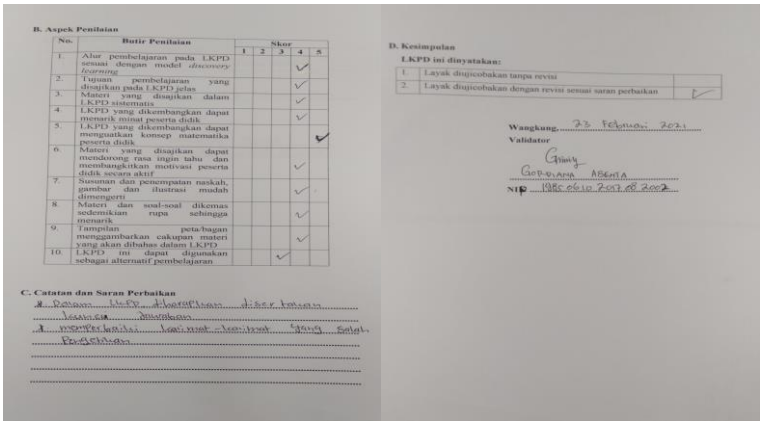


Figure 10. Learning Expert Validation Sheet

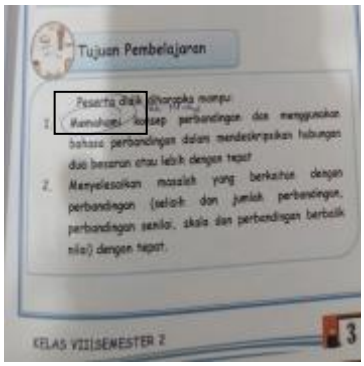
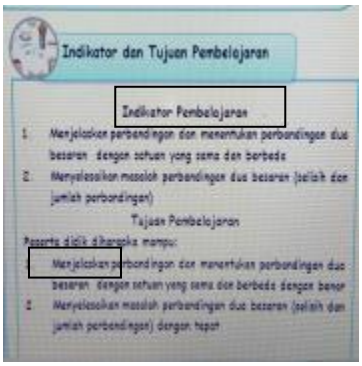
The recapitulation of student worksheet validation results by 3 validators is given in table 1.

Table 1. LKPD Expert Validation Recapitulation

Validator	Average	Criteria
Media Expert	86%	Valid
Material Expert	76,44%	Valid
Learning Expert	80%	Valid

From exposure to data on table 1, the conclusion could be reached that the lto developed is valid for testing on learning. After validation process, the design with methods developed is a revision process according to the Suggestions and input from validator before the lit is implemented in class or tested by class participants vii SMPN 2 Boleng. The results of the revision of Italy and the repair are shown in the following table 2.

Table 2. Student Worksheet View Before and After Revision

No.	Before Revision	After Revision
1.		
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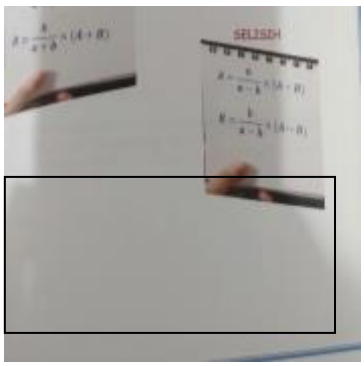
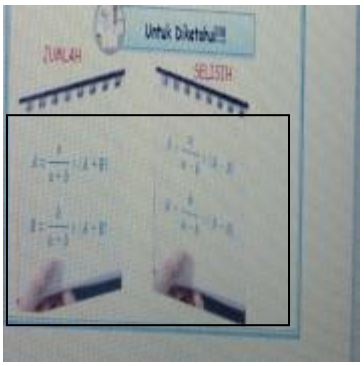
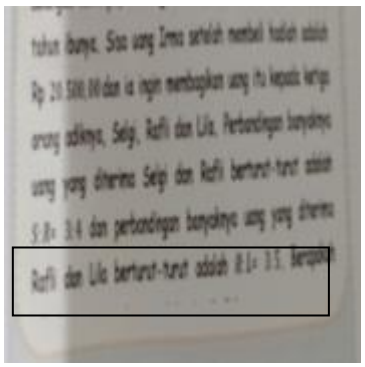
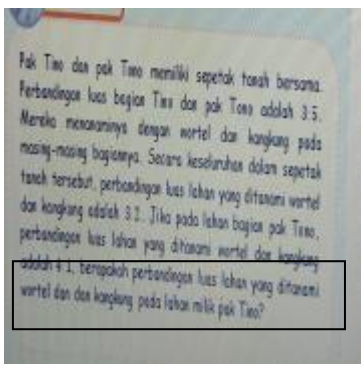
3.		
4.		

No.	Before Revision	After Revision
5.	There is no competency test answer key	
6.		

From table 2 it is explained that picture number 1 in the table is an additional learning indicator and an understanding change to explain to the purpose of learning. In image number 2 is a page addition to answering the problem of the action. come observe before entering the activation. come ask. In image number 3 there is an addition to the blank space. On picture number 4 an improvement on the truncated text. On image number 5 is a key addition to a previously unenclosed competency test answer activity. In image number 6 there isa misspelled "problem" on the application of the LKPD.

After revision, the lungi is ready for a test run for the viib class learners first as a limited field test subject. Each learner is given a response plan to achieve the level of impractical effectiveness and a critical thought capacity test to know the effectiveness of lto which itis developed. The input and Suggestions of limited field studies are revised first, after which the iis ready to be tested back to viia class learners as a wide field test subject. Implement a trial process based on the discovery learning stage. Researchers are spreading responses to learners in order to achieve the practicality of lto developed and critical thought ability tests to know l. The recapitulation of test and angket responses by the time a limited field test is shown in table 3 and 4.

Table 3. Limited Field Student Test Results

Name	Total Score	Mark
AN	28	87,5
AKV	28	87,5
EPA	30	93,75
MFEN	20	62,5
MMJ	28	87,5
MLPS	22	68,75
SAR	18	56,25
WWE	24	75
YJ	24	75
Average ($\bar{S}$)		77,08%

From the data exposure in table 3 shows that 8 of the 9 learners obtained ≥ 65. Thus the percentage of sharpness that the viib classes obtained on limited field tests was 77.08%. Because of the percentage of sharp above 70%, the critical thinking ability of field test learners is limited to the "moderate" category, hence the conclusion that effective inproportion is used in math study to advance the mathematics critical thinking power of learners.

Table 4. The Results of the Student Response Questionnaire for the Field Test are Limited

Aspect	Total Score	Score Percentage	Criteria
Language	84	93,33%	Very Practical
Presentation	279	88,57%	Very Practical
Condition	119	88,14%	Very Practical
Average (P)		90,01%	Very Practical

At table 4 above is obtained, the average percentage of learners' assessments of lanywhen a limited field test is 90.01% with a "very practical" category, it can be concluded that the into-comparison developed can be used in the math study.

Based on limited field trials, the lto get Suggestions from learners. The Suggestions obtained can be seen on the following table 5.

Table 5. Student Worksheet Suggestion on Limited Field Test

Suggestion	Revision
There are still a few typos	Correct the writing thats is wrong in typing into the correct writing

After conducting limited field trials and making revisions, further analysis was given on the large field. Response efforts are spread to learners to know the practicality of lhad-to-use use and critical thought ability tests to know leffectiveness. The recapitulation

of test and angket responses by the extensive field test participants is enclosed at table 6 and 7.

Table 6. Wide Field Student Test Results

Name	Total Score	Mark
ABB	26	81,25
AYE	24	75
DS	18	56,25
EJ	30	93,75
FMSB	26	81,25
GFO	28	87,5
HDTN	24	75
HMAB	28	87,5
HS	22	68,75
JNV	26	81,25
MAR	30	93,75
MEL	28	87,5
MMSE	18	56,25
VH	26	81,25
VMO	28	87,5
WSC	28	87,5
YJC	30	93,75
YMS	26	81,25
YKN	24	75
YRPD	30	93,75
Average ($\bar{S}$)		81,25%

Table 7. The Results of the Student Response Questionnaire for the Field Test are Wide

Aspect	Total Score	Score Percentage	Criteria
Language	184	92%	Very Practical
Presentation	654	93,42%	Very Practical
Condition	278	92,6%	Very Practical
Average (P)		92,67%	Very Practical

From exposure to the data on table 6, came the data that 18 of the 20 learners obtained results on sixty-65. Thus the percentage of brightness that the viia class obtained on a broad field test was 81.25%. Since the percentage of intelligence above 80%, the critical thinking ability of learners meets the "moderate" category, it can be drawn to the conclusion that an effective comparison was made in mathematical learning to advance the mathematically critical thinking ability of learners. From table 7's data exposure on table 7 obtained, average percentage of assessments on lgiven on wider field tests are 92.67% in the "highly practical" category, it can be concluded that the lto comparison made can be used in math study.

From exposure to the data on table 6, came the data that 18 of the 20 learners obtained results on sixty-65. Thus the percentage of brightness that the viia class obtained on a broad field test was 81.25%. Since the percentage of intelligence above 80%, the critical thinking ability of learners meets the "moderate" category, it can be drawn to the conclusion that an effective comparison was made in mathematical learning to advance the mathematically critical thinking ability of learners. From table 7's data exposure on table 7 obtained, average percentage of assessments on lgiven on wider field tests are 92.67% in the "highly practical" category, it can be concluded that the lto comparison made can be used in math study.

The results of the test of the learner's critical thinking ability were obtained to determine the level of ldeveloped. Learners are fully assessments if the individual value of learning is more than or equal to the minimum minimum requirement (KKM) that applies at the 65-point school of SMPN 2 Boleng. The lsion percentage is said to be effective if the average percentage of critical thought capability tests of learners is at moderate levels Based on data exposure at table 3 and 6, it can be seen that the percentage of increase in critical thought scores of learners in limited field tests is increasing in large field tests. The average result of the critical think ability test of learners on a limited and wide field test is 79.16% and far above the value of KKM, with established KKM is 65. Thus the critical thinking ability of learners using the lto developed is enhanced“.

The results acquired on this study are the product of lbased discovery learning with a degree of clarity, practicality and good effectiveness. The products may give learners an increased ability to solve mathematical problems that are presented using critical cognitive indicators and help educators to be more creative at designing media or other mathematical sources. In doing so, the time and expense required in this research is considerable for maximum results. Because of the constraints of the technology at the research site, researchers cannot immediately revise the wrongs found in the field during a limited field test before being tested back on the large field. However, the level of propriety and lgiven effectiveness that are developed fall into good categories.

The level of keand lbased learniing discovery acquired from the validation of materials' experts of 76.44% in valid categories, media experts of 86% with valid categories and 80% in valid mathematicians by 80% in valid categories. This results in equivalent to research done by Mahjatia, et al., (2020) that teaching lis valid based on expert validation. Salvation and recognition come from the three - aspect results of that assessment: In accordance with the valid 2.83 value value on the average, the lcome is in

accordance with effective learning principles, the construction aspect with 3.00 on average in valid categories, the language used in lmi according to the Indonesian code, and the technical aspect is acquired at 3.00 on a valid, valid, lslated in accordance with the correct code of writing. Similar research is done by Gustin et al, (2020) about the development of LKPD the effect of RME. It is valid results from an agreement performed by two validates with a valiant level and an ilion come from the four aspects of assessment: According to the question of whether or not there will be no problem. It may be concluded that the blown lint is well presented and is thus recommended for use in mathematical study.

The average percentage of learners' responses to know the degree of practicality, with a limited field test of 90.01% with a very practical category and an extensive field test of 92.67% by the highly practical category. The results equate with research carried out by Patricia, et al., (2018) that lbased discovery learning is made capable of directing learners through direct activities to discover concepts, such as carrying out tests and data that enable learners to be passionate and actively involved in learning. Learners delight in learning and do not tire of learning. It is the lon-based discovery learning that is developed that makes it easier for learners to learn the material. This is in accordance with research conducted by Safitri, et al., (2020) that lwith the discovery learning model developed meets a practical category acquired from 4,74 educators and 4.47 student council figures. The average score obtained was 4.61 in the highly practical category. So it may be drawn to the conclusion that the lint made is natural to apply to comparative matter.

The ltalk-level effectiveness is known from the test results of the critical ability of learners as field tests are limited and field tests are large. In limited field tests, critical aptitude tests with a value-65 achievement of 8 out of 9 learners and in extensive field tests, 18 out of 20 learners with an illustrative 65 score attainment. The average test results of 4 items on the subject of description tests on limited field tests are 76.38% with moderate categories and the average test results on extensive field tests are 81.25% moderate. Therefore, the conclusion to which lmade is effective for use in advancing critical thinking ability in comparative matter. This results in an equivalent to research carried out by Zulmi & Akhlis (2020), that lkon on discovery learning developed meets the worthy criteria seen from the acquisition of preetest value and the posttest on the experimental class of n-gain preetest and posttest by 0.44, and in the experiment classes gained n-gain preetest and posttest by 0.51. This suggests that learning is not without the application of the lesion, so it can be drawn to the conclusion that the made lint is effective

for use during the process of mathematical learning and thus can train critical thinking ability participants are educated.

CONCLUSION

From observation on results of research and discussion came a conclusion that a product of a learner's work sheet developed meets a valid category, it is perfectly practical and effective for use in math study. Suggestions for other researchers, in outlining maths it is best to develop an ion more compatible with the character of learners.

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