Development Of E-LKPD hots questions as a medium for learning mathematics on the material of the Pythagorean theorem

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ABSTRACT

Learning in the modern era demands learning based on KBAT, literacy skills, character education, and 4C (critical, creative, collaborative, and collaborative), all of which can be achieved through the development of E-LKPD based on KBAT combined with critical thinking skills indicators. The purpose of this study is to produce an E-LKPD product using KBAT-based questions, to determine whether the KBAT-based E-LKPD is suitable for the material of the Pythagoras theorem, and to determine the student's reaction to the created KBAT-based E-LKPD. . This refers to the ADDIE model. This study involves eighth grade students of SMP N 2 Utara Province who are the subject of this study and the object of this study is E-LKPD using KBAT based questions. Student questionnaires and confirmation sheets were used in this study. This study obtained the results which are: (1) The feasibility of E-LKPD using KBAT-based questions by media experts is in the feasible category (80.00) and material experts are also in the feasible category (77.5); and (2) Student response to E-LKPD using KBAT-based questions is in the good category with an average of 81.1%. Thus, this study shows that E-LKPD using KBAT-based questions can be used as media in the learning and teaching process.

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INTRODUCTION

Mathematics is the field that studies structure, space, quantity, and change. Mathematics is very important for human life. Mathematics has evolved since it was discovered. Mathematics continues to develop because mathematics is very important for things related to human life. Therefore, for students, the name "queen of science" is not necessarily beautiful. Students believe that learning mathematics especially at the primary school level is very difficult (Pasaribu, 2020). Mathematics can also help students become critical, rational, logical and

confident people. Therefore, from an early age, having strong math skills is very important (Afifah & Arisca Dewi, 2022).

In line with the facts of observation at SMP Negeri 2 Rantau Selatan, the problem faced is that the indicators used in mathematics learning are still focused on memory and understanding. The questions given are not in the form of solutions to problems, so students do not want to check the questions before giving answers, especially those related to the Pythagoras theorem. This causes them to lose their thinking skills. The inaccuracy of the model used by teachers during the learning process is one of the factors that cause low student motivation and learning outcomes. To encourage students to participate actively in the learning process, teachers only use conventional learning methods, namely lectures and assignments (Sagala & Hasibuan, 2023). Almost everyone is aware that many teachers always practice and even use the lecture method in their learning process. There is actually nothing wrong with this method; however, some subjects and classroom conditions cannot be used with this method (Kurniasih & Sani, 2023).

If we want to improve students' thinking skills, we must find other ways to foster their interest in learning. Teachers can focus more of their attention on engaging their students and helping slow learners if needed. This is because basic skills and knowledge, also known as teaching materials, have been prepared before students enter the classroom, so the learning process can be used for more important and meaningful activities (Kokasih, 2023). Educational resources will activate and make it easier for students to understand the material. Of these, there is one way that is more helpful and facilitates learning activities, which is LKPD which allows students to interact well with the teacher. This can improve their thinking skills by increasing their activities (Fitria et al., 2020). LKPD aims to increase the activity of students' cognitive processes and help them solve problems (Fitriana et al., 2024).

Printed Learner's Worksheets (LKPD) are still often used, but not as effective in the digital age. If android is used as an interactive learning media, advantages will arise especially in the midst of the current pandemic. Android-based interactive learning media is expected to help students remain independent during the student-centered learning process. Qualified LKPD can help students develop knowledge and learning goals (Umbaryati, 2021). It is also expected to increase students' interest in mathematics (Novelina Santoso et al., 2022). On the other hand, it is acknowledged that the development of technology and communication have an influence on the field of education (RatheSswari, 2023). Therefore, in line with the progress of science and technology and to increase students' interest in mathematics, a more innovative LKPD, which can be accessed online or known as E-LKPD. to integrate digital technology and improve critical thinking, teaching materials in learning can be made in a modern way, which is by using digital technology such as lesson summaries, practice questions and case investigations. Electronic Learning Worksheets (E-LKPD) is an ideal teaching material solution (Mahmudah & Bahtiar, 2022). Therefore, we need E-LKPD that can help teachers and students in optimizing learning (Tur Rosidah et al., 2021).

Electronic Student Worksheet (E-LKPD) is an electronic book and multimedia technology that provides insights as teaching material in a shorter and more flexible way. It is hoped that students will better understand the lesson by using E-LKPD in this learning (Khotimah et al., 2022). E-LKPD can be easily accessed via PC, laptop, or smartphone. This data is supported by

images and videos, and students can directly answer E-LKPD questions without having to enter an active link to a Google form or the like. The results of the student's E-LKPD work will be sent automatically to the educator's email (Zahroh & Yuliani, 2021). In order to improve students' creativity and critical intelligence, E-LKPD must be designed with Higher Order Thinking Skills (HOTS), learn to analyze problems from various points of view, and improve systematic thinking skills.

In the 2013 curriculum, HOTS is the cognitive ability that is the focus. By implementing learning tools that use HOTS-based questions, it is projected that students will master good skills and knowledge (Sidiq et al., 2021). Schools should teach students not only to understand the material but also to learn new skills. HOTS is one of the skills that must be taught (Jailani et al., 2017). Higher order thinking skills (HOTS) are skills that students need to have (Dinni, 2018). Students must have critical thinking skills to face the challenges of the twenty-first century world. Critical thinking is a systematic and purposeful process used in mental activities such as solving problems, making decisions, persuading, analyzing assumptions, and conducting scientific research (Helmawati, 2023). Therefore, it is a challenge for educators to implement learning based on higher order thinking skills (HOTS) based learning (Firma Kholifahtus et al., 2021).

The aim of this study is to improve students' understanding and motivation in learning mathematics at the first secondary school level through the innovation of learning methods.

Specifically, this study aims to identify the problems encountered in current mathematics learning, develop and implement the Learning Participant Sheet (LKPD) based on digital technology or E-LKDP, as well as evaluate the effectiveness of using E-LKPD in improving students' critical thinking. cognitive skills and abilities. This research also aims to encourage the application of learning based on Higher Order Thinking Skills (HOTS) into the curriculum as an attempt to face the challenges of the 21st century.

METHOD

Research and development (R&D) methods, also known as research to develop products or improve them, are used in this study. R&D is a very useful way or approach to improve practice. Moreover, R&D is a systematic approach used to generate new knowledge, solve problems, or develop products, processes, or services (Rachman et al., 2024). Research with the ADDIE model, which consists of five steps, is used in this research and development: analysis, planning, design, development, implementation, and evaluation (Sari & Susilowibowo, 2022).

The researcher used the ADDIE model because this model has the advantage of being organized in its working stage, which is not applied randomly, which is considered suitable for the development of E-LKPD mathematics using Higher Order Thinking Skill (HOTS) based on the subject questions of the Pythagorean subject. Theorem. The following diagram shows the stages in the ADDIE model or process that will be applied in this study.
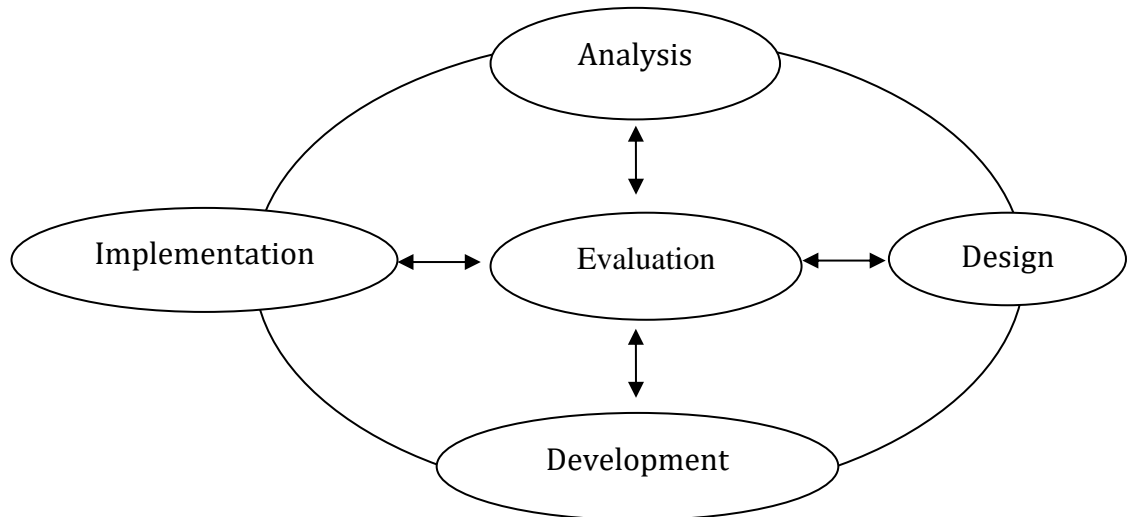
Figure 1. ADDIE Model Schema

In the first stage, the analysis stage, needs are assessed, problems are identified, and objectives for the high-order thinking skill-based student worksheet have been set. The design is done by considering the manufacturing order of E-LKPD. Basic competence (KD), measurement of competence achievement, training questions, and material content are the five elements that make up this sequence. The materials used in E-LKPD need to meet the basic competencies (KD) that will be achieved in the learning objectives through the use of training questions based on Higher Order Thinking skills (HOTS). Input and suggestions obtained from material and media expert validation tests are used to make revisions during the development phase. The purpose of verification by this team of experts is to ensure that the E-LKPD that will be tested by students meets the standards. At the implementation stage, the E-LKPD that has been designed as such in the design stage is delivered or used. The evaluation stage, the final stage of the product development process, is based on the results of student evaluations and verifiers of the developed product.

The subjects used in this study are eighth grade students of SMP N 2 Selatan Region and the object of this study is E-LKPD using HOTS-based questions about the phytagoras theorem. Two types of data checks are carried out: verification data checks by experts (material experts and media experts), data analysis of E-LKPD product trials through questionnaires to the students who are the subjects. Data obtained from expert validation was used to measure the quality of E-LKPD using a Likert scale. Table 1 shows the items with four answer options.

Table 1. Likert Scale Validity Category

SKOR			
1	2	3	4
Very unsuitable	Not suitable	Suitable	Very suitable

(Satiti et al., 2021)

Further, formulas are used to analyze data collected with data collection tools, namely:

$$\bar{X} = \frac{\sum X}{N} \; x \; 100$$

Description:
$\bar{x}$ = The average score of the assessment from the expert
$\sum x$ = Number of scores obtained from the expert
N = Number of all questions
So that the HOTS-based E-LKPD category is in the following table.

Table 2. Quality Criteria of E-LKPD by Experts

No.	Value	Category	Decision Expression
1.	$81{,}25 < x \leq 100$	Very decent	If E-LKPD can be used as a teaching material to teach students, because all the evaluated elements have no shortcomings and are very suitable.
2.	$62{,}50 < x \leq 81{,}24$	Feasible	Although there are some shortcomings and the E-LKPD product needs to be improved, all the items evaluated are appropriate.
3.	$43{,}75 < x \leq 62{,}49$	Less feasible	If all the things or items in the evaluated element are not suitable, the product has some deficiencies or many deficiencies, for which improvement is required to be used as an E-LKPD.
4.	$25{,}00 < x \leq 43{,}74$	Not feasible	Justification is required so that the product can be used as an E-LKPD if each component is judged to be deficient and unsuitable.
5.	$81{,}25 < x \leq 100$	Very decent	If E-LKPD can be used as a teaching material to teach students, because all the evaluated elements have no shortcomings and are very suitable.
6.	$62{,}50 < x \leq 81{,}24$	Feasible	Although there are some shortcomings and the E-LKPD product needs to be improved, all the items evaluated are appropriate.

The method used to examine data from a product test or trial is to use a questionnaire that can measure student responses. The results of student feedback are evaluated by involving the formula:

$$P = \frac{\sum x}{\sum xi} \times 100$$

Description:
P = Percentage of Feasibility
$\sum x$ = Total score of student answers
$\sum xi$ = Total score of the highest answer

To analyze the reaction results, the following are used:

Table 3. Student Response Qualification

No.	Percentage (%)	Learner Response Evaluation Method
1.	80 -100	Good
2.	60 -79	Good Enough
3.	40 -59	Not Good
4.	0 -39	Very Not Good

RESULTS AND DISCUSSION

This study was conducted at SMP N 2 South Region of Labuhanbatu. Before conducting the study, the researcher visited the school directly to assess the condition and conditions of the school. This study will obtain E-LKPD educational products using HOTS-based questions to be tested by students. Analysis (analysis), design (design), development (development), implementation (implementation), and evaluation are the five steps in the ADDIE model used for this study.

1. Analysis Stage

The results of preliminary observations made by the researcher at SMP N 2 Rantau Utara Labuhanbatu show that the E-LKPD used in the school is still in the form of paper collected from mathematics textbooks and is still LOTS-based. Due to lack of time, teachers could not fully develop E-LKPD using HOTS-based questions to create a new E-LKPD according to the curriculum.

2. Design Stage

After the analysis is completed, the next step is to design the E-LKPD. This stage includes two things: designing the instrument and systematically designing the E-LKPD
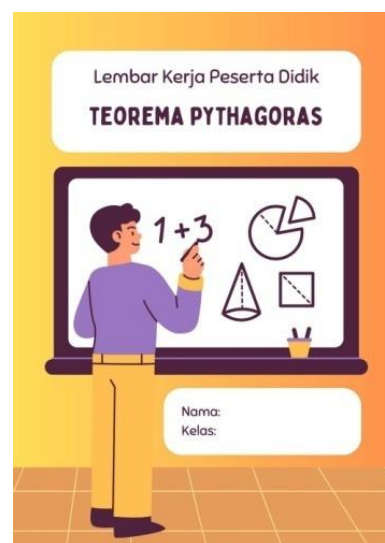

Figure 2. E-LKPD Cover Visualization

Figure 3. Visualization of LKPD Content

Figure 4. Visualization of HOTS Problem

3. Development Stage
Furthermore, at this stage, the development of E-LKPD is carried out which is evaluated by a team of expert lecturers. This stage is conducted in order to obtain the E-LKPD product that has been reviewed based on input from the validator. E-LKPD eligibility criteria are assessed using graphic elements, content, presentation and language. The media expert was the first to correct the lack of media to be displayed, the media expert gave an average score of 65.7 because there were several aspects that needed to be checked, namely the inappropriate color design of the pictures, the unattractive cover design, and the inappropriate layout of the text and images on E-LKPD After being reviewed at the next meeting, the media expert gave an average score of 80.0 in the category $62.50 < x \leq 81.24$ to be suitable for use.

Table 4. Media Expert Validation Criteria

Assessment Aspect	Indicator	Score 1	2	3	4
Cover format	1. LKPD cover has a clear focus point.			√	
Cover Type	2. The background color is the contrast and color of the LKPD title.				√
	3. LKPD's typeface is suitable for LKPD's content.			√	
Cover Explanation	4. Illustrations are very interesting because they display clear or concrete objects and not abstract ones that can be easily understood.			√	
Structure of LKPD Content	5. The content layout of the LKPD is uniform between the front page, subject or content, and the last page, which includes similar or equivalent chapter headings.			√	
	6. The print area and margins are proportional to the content of the LKPD.			√	
Typical Content of LKPD	7. The typeface used is easy to use and easy to read.				√
Overview of LKPD Content	8. The overall picture is appropriate, attractive, and creative.			√	
Text Structure	9. Creates well-proportioned and normal-sized paragraphs (text layout).			√	
LKPD Size	10. LKPD sizes meet ISO standards, with a tolerance of 5-20 mm. A4 (210 x 297 mm), A5 (148 x 210 mm) and B5 (182 x 257 mm) are all suitable paper sizes.			√	

Next, the material expert rechecked the writing of words that were too difficult for students to understand, the validator gave an average score of 77.5 with a good category of $62.50 < x \leq 81.24$. This means that the material in e-LKPD is eligible to be used in e-lKPD since the verifier has already been declared valid (Syafi'i et al., 2018). E-LKPD based on HOTS questions on the material of the phytagoras theorem can be continued at the next stage after verification, review, and signature of validity.

Table 5. Material Validation Criteria

Assessment Criteria	Indicator	Score 1	2	3	4
Content Suitability	1. Compatibility of study materials with CP and KD.				√
	2. Deeper material			√	
	3. The quality of the description of the learning materials offered.			√	
	4. The LKPD is combined with practice exams tailored to competency achievement metrics.			√	
Appropriateness of Presentation	5. Content presentation				
	6. Cultivate thinking skills.			√	
	7. Suitability in promoting learning interaction.			√	
Language	8. Accuracy of EYD used.			√	
Content Suitability	9. Use of simple and effective language.			√	
	10. The variety of sentence meanings in LKPD			√	

4. Implementation Stage

The experiment was carried out directly to eighth grade students of SMP N 2 South Rantau Selatan, a total of 31 students using questionnaires at this stage of implementation. The results of the E-LKPD trial based on the student response questionnaire can be seen in Table 6.

Table 6. Average Percentage of Student Evaluations

No.	Assessment Indicator	Percentage of Answers (%)	Criteria
1.	Are the materials used in E-LKPD easy to understand and follow the learning indicators?	87	Good
2.	Are the E-LKPD questions clear and easy to understand?	80	Good
3.	Is the language used for E-LKPD effective?	77	Good enough
4.	Is it possible to increase motivation and curiosity through the implementation of this E-LKPD?	83	Good
5.	Is the presentation of E-LKPD interesting and encouraging?	90	Good
6.	Does this E-LKPD help you solve problems in Pythagorean theorem material?	77	Good enough
7.	Does this E-LKPD add to your knowledge of the Pythagorean theorem material?	74	Good enough
	Average	81,1	Good

In conclusion, Table 6 shows the average percentage of student evaluations of 81.1% is in the good category, showing that E-LKPD can be used in learning.

5. Evaluation Stage

At the final stage of this ADDIE, the evaluation of the feasibility of HOTS-based E-LKPD on the material of the Pythagoras theorem was made based on the verification results and student responses. The researcher found that this measure of feasibility shows that E-LKPD is suitable to be applied in learning.

Based on the results of the five levels that have been completed, students show improvement in learning outcomes. The use of HOTS on E-LKPD that is used in learning to train students' high-level thinking skills such as critical thinking, creative thinking, reflective thinking, and problem solving. In the development of E-LKPD pay attention to the design of the message so that the media produced is

very interesting to students. Previous research findings also reveal that media delivered with interest will help increase learning motivation (Handayani & Amirullah, 2019). Furthermore, other studies have confirmed that the development of Electronic Worksheets has valid, practical and meaningful results (Marian & Suparman, 2019).

HOTS-based E-LKPD has also conducted practical tests, which were obtained based on student responses to electronic learning sheets used in learning. Rantauprapat obtained a practicality percentage of E-LKPD based on HOTS of 81.1% in the good category, showing that E-LKPD can be used in learning. Based on the percentage of practicality above, it can be concluded that the HOTS-based E-LKPD developed is practically used in teaching.

CONCLUSIONS AND SUGGESTIONS

Based on the results and interpretation, it can be concluded that the development of E-LKPD or electronic student worksheets based on Higher Order Thinking Skills (HOTS) for the learning of the Pythagorean theorem material in secondary school grade VII N 2 Rantauprapat is effectively used in mathematics. learning. This is supported by evaluations by media experts and material experts who show an average qualification percentage of 80.00 and 77.5 respectively. Next, student feedback shows an average of 81.1% can use this E-LKPD for teaching and learning activities.

Further studies also need to evaluate the long-term effects of using E-LKPD on students' critical thinking skills and learning outcomes. In addition, the next researcher can compare conventional learning methods with E-LKPD and involve other variables such as learning motivation and student survival to get a more comprehensive picture of the effects of E-LKPD.

REFERENCES

Afifah, A., & Arisca Dewi, P. (2022). Pengembangan media e-komik untuk meningkatkan pemahaman konsep matematika siswa. *Jurnal Axioma : Jurnal Matematika Dan Pembelajaran*, *7*(1), 24–34. https://doi.org/10.56013/axi.v7i1.1194

Dinni, H. N. (2018). HOTS (High Order Thinking Skills) dan kaitannya dengan kemampuan literasi matematika. *PRISMA, Prosiding Seminar Nasional Matematika*, *1*, 170–176. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/19597

Fitria, A., Wijaya, M., & Danial, M. (2020). Pengembangan lembar kerja peserta didik (LKPD) berbasis high order thinking skill (HOTS). *Pendidikan Kimia PPs UNM*, *3*(2), 163–171. http://www.nber.org/papers/w16019

Fitriana, E., Putra, E. D., & Murtinasari, F. (2024). Pengembangan lembar kerja peserta didik (LKPD) berbasis etnomatematika: Pengembangan. *Jurnal Axioma: Jurnal …*, *9*(1). https://ejurnal.uij.ac.id/index.php/AXI/article/view/2299%0Ahttps://ejurnal.uij.ac.id/index.php/AXI/article/download/2299/1710

Handayani, S. L., & Amirullah, G. (2019). Meningkatkan pemahaman guru sekolah dasar melalui pelatihan penyusunan rencana pelaksanaan pembelajaran berbasis literasi, 4C, PPK dan HOTS. *Jurnal SOLMA*, *8*(1), 14. https://doi.org/10.29405/solma.v8i1.2949

Helmawati. (2023). *Pembelajaran dan penilaian berbasis HOTS* (P. Latifah (ed.); 1st ed.). PT. REMAJA ROSDAKARYA.

Jailani, J., Sugiman, S., & Apino, E. (2017). Implementing the problem-based learning in order to improve the

students' HOTS and characters. Jurnal Riset Pendidikan Matematika, 4(2), 247. https://doi.org/10.21831/jrpm.v4i2.17674g the problem-ba. *Jurnal Riset Pendidikan Matematika*, *4*(2), 247.

Kholifahtus, Y., F., Agustiningsih, & Aguk Wardoyo, A. (2021). Pengembangan lembar kerja peserta didik elektronik (E-LKPD) berbasis higher order thinking skill (HOTS) materi magnet. *Pedagogia: Jurnal Ilmiah Pendidikan Dasar Indonesia*, *5*(2), 143–151. https://doi.org/10.52217/pedagogia.v5i1.1205

Khotimah, K., Istinganah, S., Umardiyah, F., & Nasrulloh, M. F. (2022). Pengembangan E-LKPD matematika berbasis HOTS pada materi bangun ruang prisma dan limas SMP kelas VIII. *JoEMS (Journal of Education and Management Studies)*, *5*(5), 48–57. https://doi.org/10.32764/joems.v5i5.799

Kokasih, E. (2023). *Pengembangan bahan ajar* (B. sari Fatmawati (ed.); 1st ed.). PT. Bumi Aksara.

Kurniasih, I., & Sani, B. (2023). *Ragam pengembangan model pembelajaran untuk peningkatan profesionalitas guru* (A. Jay (ed.); 5th ed.). Kata Pena.

Mahmudah, M., & Bahtiar, M. D. (2022). Pengembangan E-LKPD berbasis higher order thinking skills pada mata pelajaran akuntansi keuangan sebagai upaya meningkatkan berpikir kritis peserta didik. *Jurnal Pendidikan Akuntansi (JPAK)*, *10*(1), 80–93. https://doi.org/10.26740/jpak.v10n1.p80-93

Marian, F., & Suparman. (2019). Design of student worksheet based on discovery learning to improve the ability of mathematics reasoning students of class VII junior high school. *Journal of Physics: Conference Series*, *1306*(1). https://doi.org/10.1088/1742-6596/1306/1/012036

Pasaribu, L. H. (2020). Pengaruh motivasi, minat belajar dan lingkungan terhadap prestasi belajar matematika siswa. *JURNAL MathEdu (Mathematic Education Journal)*, *3*(2), 106–108. https://www.journal.ipts.ac.id/index.php/MathEdu/article/view/1680%0Ahttps://www.journal.ipts.ac.id/index.php/MathEdu/article/download/1680/949

Rachman, A., Yochanan, E., Ilham Samanlangi, A., & Purnomo, H. (2024). *Metode penelitian kuantitatif, kualitatif dan R&D* (Issue Januari).

RatheSswari, K. (2023). Information communication technology in education: bringing innovation in classroom. *Ganeshman Darpan*, *8*(1), 96–110. https://doi.org/10.3126/gd.v8i1.57335

Sagala, P. R. B., & Hasibuan, L. R. (2023). Pengaruh model pembelajaran snowball throwing terhadap motivasi dan hasil belajar siswa pada kurikulum merdeka belajar. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(1), 1417. https://doi.org/10.24127/ajpm.v12i1.7014

Santoso, A. N., Salsabila, E., & Haeruman, L. D. (2022). Pengembangan media pembelajaran interaktif berbasis android dengan model discovery learning pada materi teorema Pythagoras kelas VIII SMP Negeri 20 Jakarta. *Jurnal Riset Pembelajaran Matematika Sekolah*, *6*(2), 39–50. https://doi.org/10.21009/jrpms.062.06

Sari, E. N., & Susilowibowo, J. (2022). Pengembangan E-LKPD berbasis HOTS pada mata pelajaran praktikum akuntansi lembaga kelas XI semester 2. *Edukatif : Jurnal Ilmu Pendidikan*, *4*(3), 4469–4483. https://doi.org/10.31004/edukatif.v4i3.2709

Satiti, W. S., Khotimah, K., & Rosyid, M. A.

(2021). Pengembangan LKPD materi kubus dan balok menggunakan konteks pribadi untuk peserta didik kelas VIII. *Exact Papers in Compilation*, *3*(3). http://ojs.unwaha.ac.id/index.php/epic/article/view/569/271

Sidiq, Y., Ishartono, N., Desstya, A., Prayitno, H. J., Anif, S., & Hidayat, M. L. (2021). Improving elementary school students' critical thinking skill in science through HOTS-based science questions: A quasi-experimental study. *Jurnal Pendidikan IPA Indonesia*, *10*(3), 378–386. https://doi.org/10.15294/JPII.V10I3.30891

Syafi'i, A., Marfiyanto, T., & Rodiyah, S. K. (2018). Studi tentang prestasi belajar siswa dalam berbagai aspek dan faktor yang mempengaruhi. *Jurnal Komunikasi Pendidikan*, *2*(2), 115. https://doi.org/10.32585/jkp.v2i2.114

Tur Rosidah, C., Sulistyawati, I., Achmad Fanani, A., & Pramulia, P. (2021). Lembar kerja peserta didik (LKPD) pembelajaran tematik berbasis tik: ppm bagi guru SD Hang Tuah X Sedati. *BERNAS: Jurnal Pengabdian Kepada Masyarakat*, *2*(3), 660–666. https://doi.org/10.31949/jb.v2i3.1319

Umbaryati. (2021). Pentingnya LKPD pada pendekatan scientific pembelajaran matematika pentingnya LKPD pada pendekatan scientific pembelajaran matematika umbaryati. *Prisma*, 218–221.

Zahroh, D. A., & Yuliani. (2021). The development of scientific literacy based E-LKPD to train student's critical thinking skills in growth and development materials. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, *10*(3), 605–616.