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Local Wisdom-Based Science E-Worksheet with PBL Model: Efforts to Improve Critical Thinking Skills

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ABSTRAK

Saat ini, pembelajaran sains sering kali menggunakan bahan ajar konvensional yang kurang relevan dengan konteks budaya siswa, sehingga memengaruhi keterlibatan mereka dalam proses belajar. Selain itu, meskipun model PBL diketahui efektif dalam melatih keterampilan berpikir kritis, implementasinya dalam pembelajaran sains masih terbatas, terutama yang mengintegrasikan kearifan lokal sebagai bagian dari konten pembelajaran. Penelitian ini bertujuan untuk menganalisis pengaruh penggunaan LKPD elektronik berbasis potensi lokal rumah dome dengan model Problem Based Learning (PBL) untuk meningkatkan keterampilan berpikir kritis peserta didik pada pembelajaran IPA. Penelitian ini menggunakan metode pra-eksperimen dengan desain one group pretest-posttest. Sampel penelitian terdiri atas 48 peserta didik kelas VIII yang ditentukan melalui random sampling. Data dikumpulkan melalui tes, dengan analisis menggunakan Uji Wilcoxon Signed Rank. Penelitian menemukan bahwa penggunaan LKPD elektronik berbasis potensi lokal rumah dome dengan model PBL dalam pembelajaran IPA secara signifikan mampu meningkatkan kemampuan berpikir kritis , dengan nilai signifikansi yang mencapai kategori tinggi. Semua indikator keterampilan berpikir kritis mengalami peningkatan nilai pada penelitian ini. Berdasarkan hasil tersebut, pembelajaran dengan menggunakan LKPD elektronik berbasis potensi lokal dengan model PBL dapat menjadi salah satu strategi yang direkomendasikan dalam pembelajaran IPA. Implikasi penelitian ini adalah penelitian ini memberikan panduan dalam merancang dan menggunakan E-Worksheet berbasis kearifan lokal dengan model Problem-Based Learning (PBL) untuk meningkatkan keterampilan berpikir kritis siswa.

ABSTRACT

Currently, science learning often uses conventional teaching materials that are less relevant to students' cultural context, thus affecting their involvement in the learning process. In addition, although the PBL model is known to be effective in training critical thinking skills, its implementation in science learning is still limited, especially those that integrate local wisdom as part of the learning content.This research aims to analyze the effect of using electronic LKPD based on the local potential of dome houses with the Problem Based Learning (PBL) model to improve students' critical thinking skills in science learning. This research uses a pre-experimental method with a one group pretest-posttest design. The research sample consisted of 48 class VIII students who were determined through random sampling. Data was collected through tests, with analysis using the Wilcoxon Signed Rank Test. The research found that the use of electronic LKPD based on the local potential of dome houses with the PBL model in science learning was significantly able to improve critical thinking skills, with significance values reaching the high category. All indicators of critical thinking skills experienced an increase in value in this study. Based on these results, learning using electronic LKPD based on local potential with a PBL model can be one of the recommended strategies in science learning. The implications of this research are This research provides guidance in design and use E-Worksheet based on local wisdom with models Problem-Based Learning (PBL) to improve students' critical thinking skills.

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1. INTRODUCTION

Critical thinking is an important skill in 21st century learning. This skill does not stand alone but is closely related to other skills, such as metacognition, problem solving, and information literacy, which also support its formation. Learning activities that emphasize critical thinking skills include solving problems, supporting theories or statements, conducting experiments, formulating arguments, presenting interpretations, criticizing, understanding a topic in depth, or making decisions. These activities demonstrate that critical thinking is more than just reflective; it is also valid and generative (Bahtiar et al., 2020; Heard et al., 2019). Stimulating and improving critical thinking skills during the learning process is very important to improve student learning achievement. These skills play an important role in enabling students to draw conclusions based on empirical evidence and make informed decisions when faced with challenges (Hidayati et al., 2018; Sumarni & Kadarwati, 2019). Teaching critical thinking skills is very important because it equips students with the ability to analyze problems effectively. As a result, students can leverage their insights to utilize technology, gain knowledge, and design solutions to overcome everyday challenges (Faradilla et al., 2021; Widiastuti et al., 2019). The results of observations at SMP Muhammadiyah 1 Prambanan found low critical thinking skills. Students lack the initiative to ask questions, have difficulty explaining concepts in their language, are unable to determine solutions to problems, and are unable to make decisions. Interviews with teachers prove that this problem arises because students' motivation to learn has not developed. Students prefer to spend their time playing with gadgets rather than studying. This result is strengthened by the fact that learning activities are more often carried out conventionally. As a result, students become less enthusiastic when studying. This attitude arises because students feel bored with monotonous learning, such as imitating and listening to the teacher. On the other hand, students show enthusiasm when learning involves the active role of students, for example through group observation. Research in recent years supports this fact by providing a lot of important information regarding the low critical thinking abilities of students in Indonesia. Student still have difficulty in explaining, understanding questions, expressing opinions, associating information, making decisions and difficulty finding solutions to these problems (Akhdinirwanto et al., 2020; Fadilah et al., 2021). This happens because learning and learning activities have not fully focused on developing critical thinking skills (Bustami et al., 2017; Sarah & Maryono, 2020). Science learning today is still often teacher-centred, uses the lecture method, the media used is not varied, feels monotonous, and is carried out conventionally so that it provides less challenge and experience for students (E. E. Sari et al., 2019; R. Sari et al., 2020). As a result, students are used to thinking verbally and concretely, while their abstract and critical thinking skills are poorly trained. Students whose critical thinking skills are low will experience difficulties in solving problems in science learning. As a result, scientific concepts become difficult to understand, resulting in limited knowledge development and low learning outcomes. Students' critical thinking skills are influenced by various factors, including ways of thinking in solving problems and understanding each material studied (Hayati & Setiawan, 2019; Kurniawan et al., 2020).

Improving students' critical thinking skills can be done through the use of teaching materials during the learning process. One of the teaching materials that fosters critical thinking skills is e-worksheets. This is because the use of e-worksheets for learning creates a more interesting experience and facilitates better understanding of the material for students (Cullen et al., 2020; Irhasyuarna et al., 2019). Apart from utilizing teaching materials, incorporating local wisdom content into learning can also improve critical thinking skills (Deti Ratih & Rohaeti, 2020; Febri et al., 2019). The integrated use of local wisdom in the learning process encourages students to continue to strive to explore deeper knowledge, so that learning becomes more meaningful. Students' very good perceptions regarding the use of e-worksheets based on local wisdom make this teaching material able to increase students' knowledge in science learning (Fatmawati et al., 2018; Suarningtyas, 2020). Meanwhile, optimal learning outcomes can also be achieved if teachers use learning models that include active student involvement, such as the Problem Based Learning (PBL) model. Using the PBL model in science learning can improve critical thinking skills (Shofiyah et al., 2020; Tari & Rosana, 2020). Stated in their literature study that overall, the PBL model effectively encourages the acquisition of critical thinking skills. This is because the application of the PBL model in learning can foster students' critical thinking abilities by encouraging them to solve problems more wisely (Liu & Pásztor, 2020; Sartika et al., 2019). PBL learning trains students to give answers that require explanation. The PBL model helps students discover science concepts for themselves to understand these concepts better. Apart from that, PBL learning can also stimulate curiosity, motivation, perseverance, thoroughness, collaboration and communication (Febriyanti et al., 2020; Maulidya et al., 2020). There has been a lot of research on e-worksheets, local wisdom, and PBL models, but no research has been found that integrates these three aspects in science learning. This research focuses on the use of e-worksheets based on local wisdom with a PBL model to assess students' critical thinking abilities. This research aims to analyze the effect of using e-worksheets based on local dome house wisdom with the PBL model to improve students' critical thinking

skills in science learning. Through this learning, it is hoped that students will be able to improve critical thinking skills, especially in the context of science learning. The use of e-worksheets based on local wisdom with the PBL model is expected to make the learning process more exciting and increase students' interest in participating in learning activities. The aim of this research is to develop *E-Worksheet* science based on local wisdom with models *Problem-Based Learning* (PBL) which can improve students' critical thinking skills. This research aims to investigate the extent to which the integration of local wisdom in science teaching materials can make learning more relevant and meaningful for students, as well as how the application of the PBL model can encourage students to think more actively critically in solving problems. In addition, this study aims to evaluate the effectiveness of use *E-Worksheet* in increasing understanding of scientific concepts in a contextual and applicable way, as well as seeing the impact on the development of students' critical thinking skills in a learning context based on real problems that exist in their environment.

2. METHOD

This research uses a quantitative approach using pre-experimental methods. The research design applied was one group pretest-posttest design (Sugiyono, 2013). The research population was all students in class VIII of SMP Muhammadiyah 1 Prambanan. Random sampling is used as a sampling technique via lottery. This technique was chosen because it allows the data obtained to be more representative and reliable for further statistical analysis. The research sample consisted of 48 students from classes VIIIA and VIIIB. Data collection involves administering tests (Amin et al., 2017; Sugiyono, 2021). This test was carried out to assess whether there were differences in students' critical thinking abilities before and after participating in learning activities using e-worksheets based on local dome house wisdom. The test technique for measuring students' critical thinking abilities is carried out using five multiple choice questions in the pretest and posttest. These questions are valid according to experts. Indicators of critical thinking skills used include explaining, analyzing, concluding, evaluating and making decisions. These indicators are presented in Table 1.

Table 1. Indicators of Critical Thinking Skills on E-Worksheets

Critical Thinking Skills Indicator	Indicators of Critical Thinking Skills on E-Worksheets
Explain	Explain one of the sizes of an earthquake correctly.
Analyze	Distinguish between the terms seismograph and seismogram in detecting earthquakes.
Conclusion	Provide the most appropriate conclusions regarding the causes of earthquakes.
Evaluate	Evaluate the building materials used to make a house earthquake resistant.
Make a decision	Explain earthquake mitigation efforts.

The statistical analysis used in this research was the Wilcoxon Signed-Rank test. The aim of using the Wilcoxon test is to find out whether there are differences in students' critical thinking abilities when using e-worksheets based on local dome house wisdom with the PBL model in science learning. This difference can be seen by comparing the results between the pretest and posttest stages. The Wilcoxon test serves as a non-parametric alternative to the parametric paired samples t-test, especially when the assumptions of normality and homogeneity are not met. Statistical analysis was carried out using SPSS 28 software. Next, the effect size was determined to find out how meaningful the relationship was between the scores before (pretest) and after treatment (posttest).

3. RESULT AND DISCUSSION

Result

The results of data analysis found an increase in the average score from 40.4 to 61.7 between the pretest and posttest. These findings show that the use of e-worksheets based on local wisdom with the PBL model has a positive effect on improving students' critical thinking skills. The following are the results of the comparative assessment of student scores between pretest and posttest which are presented in Table 2. The students' pretest and posttest score data were then measured for normality and homogeneity as a prerequisite test before parametric testing was carried out through paired difference tests (paired sample t-test). The normality test was carried out using the Shapiro-Wilk test with a significance level of α 5%. The results of the normality test are presented in Table 3.

Table 2. Pretest and Posttest Data Analysis Results

Information	Prates	Posts
Means	40.4	61.7
Highest score	80	100
Lowest score	0	20
Standard deviation	23.9	19.3
Difference	570	372

Table 3. Normality Test

	Shapiro-Wilk		
	Statistics	df	Say.
Prates	.841	44	<,001
Posts	.842	44	<,001
trans_pretest	.836	44	<,001
trans_posttest	.810	44	<,001
A. Lilliefors Significance Correction			

Pretest and posttest significance values <0.001. A significance value of <0.05 in the normality test indicates that the data is not normally distributed. Therefore, data transformation is needed to normalize the data. However, even after the data was transformed, the significance value for the pretest and posttest remained <0.001. This means that the data in this study does not show a normal distribution. Meanwhile, the homogeneity test was carried out using Levene's Test with a significance level of α 5%. The homogeneity test results are presented in Table 4.

Table 4. Homogeneity Test

		Statistics Lives	df1	df2	Say.
Mar k	Based on Average	1.612	1	94	.207
	Based on Median	1.897	1	94	.172
	Based on Median and with adjusted df	1.897	1	90.829	.172
	Based on trimmed mean	1.733	1	94	.191

Based on the results of the homogeneity test, the significance value is 0.207. Significance >0.05 in the homogeneity test indicates that the data variance is homogeneous or that the assumptions of the homogeneity test are met. Therefore, just test the prerequisites fulfilled in the homogeneity test, even though the normality test was less than satisfactory. This means that data analysis cannot be carried out using parametric tests such as paired sample t-tests. Conversely, non-parametric tests, such as the Wilcoxon test, can serve as a replacement for the paired samples t-test. Through the Wilcoxon test, changes in scores—either increase, decrease, or no change—among students can be observed. This data is presented in Table 5. Meanwhile the Wilcoxon test results are presented in Table 6.

Table 5. Students Who Have Increased, Decreased, or No Change in Grades

		Rankings		
		N	Mean	Total Rank
pascates - prates	Negative Rating	0[A]	.00	.00
	Positive Rank	39[B]	20.00	780,00
	Tie	9[C]		
	Total	48		
A. poles < pretes				
B. positions > loans				
C. posttest = prates				

The number of students who experienced an increase in their grades was 39 people, and nine students who did not experience a change in their grades. Meanwhile, not a single student experienced a decline in grades. This shows that e-LKPD based on local dome house wisdom with the PBL model is quite suitable for use in learning.

Table 6. Wilcoxon Test Results

	Pascates - prates
WITH	-5.715[B]
Asymp. signature. (2-tail)	<0.001
A. Wilcoxon Signed Rank Test	
B. Based on negative ratings.	

The results of the Wilcoxon test are presented in Table 6, shows that Asymp. Sig (2-tailed) <0.001. A significance value below 0.05 in the Wilcoxon test means that the hypothesis is accepted, indicating that there is a disparity in pretest and posttest results in the use of e-worksheets based on local dome house wisdom with the PBL model for science learning. Next, the effect size is calculated to assess the significance of the correlation between scores before (pretest) and after treatment (posttest). Science learning in this study showed an effect size r of 0.58. Based on Cohen's classification, an effect size r with a value of ≥0.5 is included in the high category. This means that the use of e-worksheets based on local wisdom with the PBL model has a significant influence on improving students' critical thinking abilities. The test questions given to students have effectively improved critical thinking skills. Comparison of results between pretest and posttest for each indicator of critical thinking skills is presented in Table 7.

Table 7. Comparison of Pretest and Posttest Results for Each Critical Thinking Skills Indicator

Critical Thinking Skills Indicator	The number of students who answered correctly		Difference
	Prates	Posts	
Explain	14	24	21%
Analyze	19	24	10%
Conclusion	22	29	15%
Evaluate	16	31	31%
Make a decision	27	35	17%

There was an increase in the number of students who answered correctly on the posttest compared to the pretest. This increase occurred in all indicators. The highest difference in value occurred in the assessment indicator, namely 31%. Meanwhile, the lowest difference occurred in the analysis indicators, namely 10%. So, if we compare the results of the pretest and posttest, there is an increase in scores on all indicators of critical thinking abilities. These improvements are presented in Figure 2. There was an increase in values for all indicators. The highest increase in value occurred in the assessment indicator, namely 94%. Meanwhile, the lowest increase occurred in the analysis indicator, namely 26%.

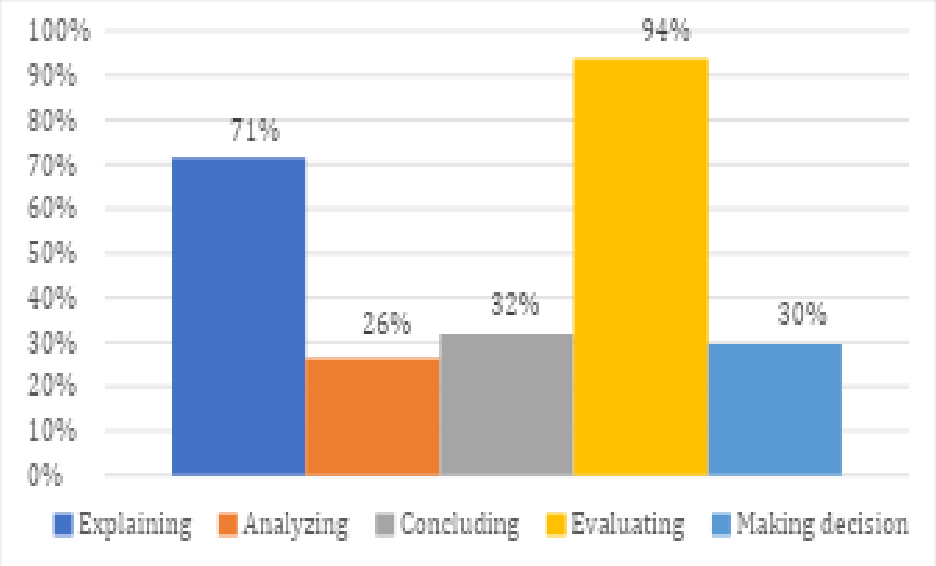

Figure 2. Increase in Value for Each Indicator of Critical Thinking Ability

Discussion

Improving critical thinking skills is essential in the 21st century. Increasing critical thinking skills can be achieved through contextual learning (Fadilla et al., 2020; Febriansyah et al., 2018). Contextual learning is very important because it allows students to connect the concepts learned with real situations in everyday life. This helps improve understanding of concepts and encourages application of knowledge in meaningful contexts for students. One of the main reasons why contextual learning is meaningful is because it can help increase students' motivation and interest in learning. When the subject matter is relevant to life, students tend to be more motivated to learn and more enthusiastic about the learning process (Fenanda et al., 2018; Ridho et al., 2020). A learning process that integrates local wisdom is one way of teaching science contextually. Natural events and phenomena that students often encounter in the surrounding environment are one learning resource that teachers can use to stimulate students' skills (Sumarni et al., 2019; Wati et al., 2021). The local wisdom of an area can be used as learning content by integrating it into teaching materials, one of which is e-worksheets. Critical thinking skills can be better trained in students when the preparation of e-worksheets is integrated with local wisdom content (Fitriana, 2018; Kemendikbudristek et al., 2020). Using appropriate learning models is also an effort to train critical thinking skills. One way is through the PBL model. This is because the application of PBL has the wisdom to help motivate students and provide learning experiences (Fernanda et al., 2020; Parno et al., 2023). According to Table 2, learning using e-worksheets based on local wisdom with the PBL model has a positive impact on improving students' critical thinking skills. This finding can be seen in the average pretest score which was initially only 40.4 to 61.7. This finding is strengthened by the results of the Wilcoxon test Table 6 which shows the Asymp value. Sig (2 tailed) is <0.001. A significance value below 0.05 in the Wilcoxon test means that there is a difference in the pretest and posttest results in the use of e-worksheets based on the local wisdom of dome houses and the PBL model.

The effect size r test of 0.58 shows that the use of e-worksheets based on local wisdom with the PBL model has a significant effect on increasing students' critical thinking skills. These findings indicate that integrating worksheets containing local wisdom into the PBL model can improve critical thinking skills. This is in line with research conducted (Mareti & Hadiyanti, 2018; Ramdiah et al., 2020). This shows that worksheets containing local wisdom can improve students' scientific reasoning abilities at a moderate level. As well as, emphasized that integrating local wisdom into worksheets can improve students' conceptual understanding (Handayani et al., 2020; Marshall & Marquire, 2019). The local wisdom contained in this research e-worksheet is that dome houses are earthquake-resistant houses in the Yogyakarta Special Region province. This local wisdom-based electronic worksheet is prepared using the PBL model, with activities including problem orientation, organizing students in groups, guiding investigations, presenting results, and analyzing and evaluating problem solving. The activities carried out by students with e-worksheet guidance are able to facilitate critical thinking skills, as evidenced by an increase in scores on the posttest, Wilcoxon test results, and effect size r test. These findings show that learning using e-worksheets with the PBL model has a significant influence on improving critical thinking skills. Utilizing e-worksheets prepared using the PBL model can help students improve critical thinking skills. This happens because worksheets prepared using the PBL model can improve metacognitive abilities and problem solving abilities (Hapsari & Suryadarma, 2020; Krisnayanti & Sujana, 2019).

Based on Figure 2The increase in the number of students who answered test questions correctly occurred in all indicators, namely explaining (71%), analyzing (26%), concluding (32%), evaluating (94%), and making decisions (30%). . This cannot be separated from the use of the PBL model in learning. The phase that contributes to improving critical thinking skills is the investigation phase. The investigation stage involves students actively seeking information to solve various problems. Students are allowed to discuss the information obtained in groups. This activity involves students in exchanging ideas. The in-depth understanding that students have regarding the local wisdom of dome houses also helps students construct their knowledge based on real experiences in everyday life. This finding is in line with research which shows that students develop high critical thinking skills when learning is carried out with local wisdom (Novitasari & Puspitawati, 2020; Ramdani et al., 2019). Apart from that, using e-worksheets as teaching materials makes it easier for students to construct their knowledge by following structured steps using scientific methods. In this process a person gains learning experience to understand the working principles of the universe through an empirical approach that can be arranged logically (Maya et al., 2019; Prasadi et al., 2020). Science involves the systematic exploration of nature, ensuring that nature includes more than the acquisition of factual knowledge, concepts, or principles; it is also a process of discovery ((Mitasari & Hidayah, 2021; Nursera et al., 2018). The critical thinking ability indicator that experienced the most significant increase was the evaluation indicator with an increase reaching 94%. Evaluating is an indicator that includes providing comments regarding the success and failure of something or an assessment of something. Students' proficiency in evaluation tasks can include a variety of skills such as presenting,

assessing performance, applying knowledge in product development, synthesizing information, and justifying their arguments based on previously acquired knowledge and information (Fitriani et al., 2002; Hakim et al., 2020). In the activity of guiding investigations with assessment indicators, students are presented with two pictures of houses made from different materials. One house is made of brick, while the other house is made of wood. Students are asked to compare the two houses based on their resistance to earthquakes. Here, students can use various sources to gather appropriate information regarding both houses. Based on these problem solving efforts, students found that wooden houses were more resistant to earthquakes than brick houses. In this case, students not only receive information, but are also able to engage in analysis and evaluation in solving a problem (Fitriana, 2018; Liu & Pásztor, 2020). Apart from that, in the results presentation activity, students can also explain why wooden houses are more earthquake resistant than brick houses. Through this activity, students can express the problems they find and discuss solutions in their groups (Fenanda et al., 2018; Mareti & Hadiyanti, 2018). Students can also explain the reasons why dome houses can be an alternative solution for earthquake-prone areas. This activity encourages students to be able to apply everyday experiences to overcome problems that exist in the real world (R. Sari et al., 2020; Sumarni et al., 2019). Meanwhile, the critical thinking indicator that experienced the lowest increase was analyzing, namely 26%. At the investigation stage of indicator analysis, students are asked to mention terms related to earthquakes. Here students mention terms including seismograph and seismogram. Some students can differentiate between the two terms, but quite a few students need help to differentiate them. Because these two terms have similar phonemes that are difficult to remember. Students tend to only read from one reading source provided by the teacher, so they don't get enough references (E. E. Sari et al., 2019; Sumarni et al., 2019). Students should learn the differences between these two terms through various learning resources. However, even though the increase in analytical skills achieved by students is lower than other indicators, the increase in scores still occurs in this indicator. Therefore, the use of e-worksheets based on local wisdom with the PBL model can improve analytical capabilities. This happens because the PBL model fosters students' analytical thinking, allowing them to solve problems effectively in various situations (Fitriana, 2018; Marshall & Marquire, 2019). This learning can train students in identifying concepts and formulating relationships between these concepts. Analytical skills support students in thinking logically and solving problems in class by examining facts or objects in depth, helping students map problems, and identifying the information needed as a basis for solving problems (Bustami et al., 2017; Handayani et al., 2020).

Comparison of the findings of this research with previous research shows significant differences in terms of the implementation of the learning model and teaching content used. Previous research, such as that conducted by researcher*Problem-Based Learning*). In this research, although improvements in critical thinking skills were found, teaching was still limited to teaching that was less contextual and did not utilize local resources. On the contrary, the findings of this study indicate that use *E-Worksheet* science based on local wisdom, combined with the PBL model, significantly improves students' critical thinking skills. The integration of local wisdom in teaching materials makes learning more relevant and interesting, so that students are more motivated to be involved in discussions and solving the problems they face. This finding is different from previous research which paid less attention to the importance of cultural context in learning, so the results of this research strengthen the argument that science education based on local context and active learning models can improve students' understanding and critical thinking skills more effectively. The implications of this research are very important in the context of developing more relevant and effective science learning. For teachers, the results of this research provide guidance in design and use *E-Worksheet* based on local wisdom with models *Problem-Based Learning* (PBL) to improve students' critical thinking skills. By utilizing local wisdom in learning, teachers can connect lesson material with students' real experiences, making learning more interesting, meaningful and easy to understand. Apart from that, the use of the PBL model allows students to be actively involved in the learning process, develop problem solving skills, and think critically and analytically. For students, the implications of this research are the development of better critical thinking skills in facing everyday challenges, because they are taught to solve problems that are relevant to their cultural and environmental context. Apart from that, learning based on local wisdom can strengthen a sense of identity and pride in one's own culture, as well as increase understanding of scientific concepts that are more applicable and contextual. For curriculum developers, this research provides a basis for integrating local values in science learning at the formal education level, which can improve the relevance and quality of education as a whole. Limitations of this research include several aspects that need to be considered. First, the research sample is limited to one particular group of schools or regions, so the results may not fully reflect the conditions of science education in other regions with different cultures or characteristics. Second, the duration of use *E-Worksheet* based on local wisdom with models *Problem-Based Learning* (PBL) is relatively short, limiting observations of the long-term impact on students' critical thinking skills. In addition, this research has not measured in depth other external

factors, such as motivational factors or students' social backgrounds, which can also influence learning effectiveness. Based on these limitations, it is recommended that further research involve a more diverse sample, both in terms of location, education level and student background, to obtain more representative results. Research also needs to extend the duration of implementation *E-Worksheet* based on local wisdom and the PBL model, to observe the long-term impact on critical thinking skills. In addition, further research is recommended to further explore other factors that can influence learning effectiveness, such as the use of technology or students' socio-cultural factors, in order to gain a more comprehensive understanding of the development of critical thinking skills in science learning.

4. CONCLUSION

Based on the data analysis carried out, it is known that science education assisted by e-worksheets based on local dome house wisdom with the PBL model improves students' critical thinking skills at SMP Muhammadiyah 1 Prambanan. This increase is statistically significant, with a significance level, which categorizes it as high. In particular, all indicators of critical thinking skills showed improvement, with the greatest improvement seen in the evaluation indicators and the least in the analysis indicators. Therefore, the use of e-worksheets based on local wisdom with the PBL model has proven to be useful in improving students' critical thinking skills. Based on the research findings, several recommendations emerged. Initially, junior high school science educators in the Special Region of Yogyakarta Province were able to incorporate the local wisdom of dome houses when teaching about the structure of the earth. Second, educators in this region can create teaching materials such as e-worksheets that integrate the local wisdom of dome houses into the science curriculum, especially when discussing topics related to the structure of the earth. Third, teachers in other regions can also incorporate the local wisdom of their region into their teaching materials.

5. REFERENCES

Akhdinirwanto, R. W., Agustini, R., & Jatmiko, B. (2020). Problem-Based Learning With Argumentation As A Hypothetical Model To Increase The Critical Thinking Skills For Junior High School Students. *Jurnal Pendidikan Ipa Indonesia*, *9*(3), 340–350. Https://Doi.Org/10.15294/Jpii.V9i3.19282.

Amin, S., Utaya, S., Bachri, S., Sumarmi, & Susilo, S. (2017). Effect Of Problem-Based Learning On Critical Thinking Skills And Environmental Attitude. *Journal For The Education Of Gifted Young Scientists*, *8*(2), 743–755. Https://Doi.Org/10.17478/Jegys.650344.

Bahtiar, B., Maimun, M., & Anggriani, B. L. (2020). Pengaruh Model Discovery Learning Melalui Kegiatan Praktikum Ipa Terpadu Terhadap Kemampuan Berpikir Kritis Siswa. *Jurnal Pendidikan Mipa*, *12*(2), 134–142. Https://Doi.Org/10.37630/Jpm.V12i2.564.

Bustami, Y., Syafruddin, D., & Afriani, R. (2017). The Implementation Of Contextual Learning To Enhance Biology Students' Critical Thinking Skills. *Jurnal Pendidikan Ipa Indonesia*, *7*(4), 451–457. Https://Doi.Org/10.15294/Jpii.V7i4.11721.

Cullen, S., Fan, J., Brugge, E., & Elga, A. (2020). Improving Analytical Reasoning And Argument Understanding: A Quasi-Experimental Field Study Of Argument Visualization. *Npj Science Of Learning*, *3*(1), 1–6. Https://Doi.Org/10.1038/S41539-018-0038-5.

Deti Ratih, P., & Rohaeti, E. (2020). Development Of Electronic Worksheet Based On Problem-Based Learning In A Course On Acid-Bases To Develop Students' Problem-Solving Ability. *Kne Social Sciences*, *3*(3), 166–176. Https://Doi.Org/10.18502/Kss.V9i8.15504.

Fadilah, N., Herlina, K., Permadi, D., & Suana, W. (2021). Development Of E-Worksheet Based On Expression Learning Model To Train Critical Thinking Skills. *Jurnal Riset Dan Kajian Pendidikan Fisika*, *10*(2), 55–63. Https://Doi.Org/10.12928/Jrkpf.V10i2.508.

Fadilla, N., Nurlaela, L., Rijanto, T., Ariyanto, S. R., Rahmah, L., & Huda, S. (2020). Effect Of Problem-Based Learning On Critical Thinking Skills. *Journal Of Physics: Conference Series*, *1810*(1), 87. Https://Doi.Org/10.1088/1742-6596/1810/1/012060.

Faradilla, Y., Afrida, I. R., & Pramono, G. W. (2021). Penerapan Model Problem Based Learning Berbantuan Mind Mapping Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas X2 Sman 1 Kencong. *Jurnal Teknologi Pendidikan*, *1*(4), 14. Https://Doi.Org/10.47134/Jtp.V1i4.93.

Fatmawati, F., Rivaldi, M., & Suhaeni, S. (2018). Development Of Electronic Student Worksheets Based Local Potential To Enhance Students' Science Learning Outcomes. *Jurnal Ipa & Pembelajaran Ipa*, *7*(1), 56–71. Https://Doi.Org/10.24815/Jipi.V7i1.29443.

Febri, A., Sajidan, & Sarwanto. (2019). Analysis Of Students' Critical Thinking Skills At Junior High School In Science Learning. *Journal Of Physics: Conference Series*, *1397*(1), 87.

Https://Doi.Org/10.1088/1742-6596/1397/1/012018.
Febriansyah, F., Herlina, K., Nyeneng, I. D. P., & Abdurrahman, A. (2018). Developing Electronic Student Worksheet (E-Worksheet) Based Project Using Fliphtml5 To Stimulate Science Process Skills During The Covid-19 Pandemic. *Insecta: Integrative Science Education And Teaching Activity Journal*, *2*(1), 59–73. Https://Doi.Org/10.21154/Insecta.V2i1.2555.
Febriyanti, D., Sjaifuddin, S., & Biru, L. T. (2020). Analisis Proses Pembelajaran Ipa Terpadu Dalam Pelaksanaan Kurikulum 2013 Di Smp Kecamatan Sumur. *Pendipa Journal Of Science Education*, *6*(1), 218–225. Https://Doi.Org/10.33369/Pendipa.6.1.218-225.
Fenanda, H. E., Herlina, K., & Abdurrahman. (2018). Practicality And Effectiveness Of E-Worksheet Based On Expression Learning Model Activities To Train Critical Thinking Skills. *Asian Journal Of Science Education*, *6*(1), 118–128. Https://Doi.Org/Https://Doi.Org/Doi.Org/10.248/Ajse.V5i2.37175.
Fernanda, A., Haryani, S., Tri Prasetya, A., & Hilmi, M. (2020). Analisis Kemampuan Berpikir Kritis Siswa Kelas Xi Pada Materi Larutan Penyangga Dengan Model Pembelajaran Predict Observe Explain. *Jurnal Inovasi Pendidikan Kimia*, *13*(1), 2326–2336. Https://Doi.Org/10.15294/Jipk.V13i1.16183.
Fitriana, A. (2018). Penerapan E-Worksheet Dengan Model Problem Based Learning Untuk Meningkatkan Kemampuan Pemecahan Masalah Peserta Didik. *Psej (Pancasakti Science Education Journal*, *8*(2), 28–40. Https://Doi.Org/10.24905/Psej.V8i2.182.
Fitriani, A., Zubaidah, S., Susilo, H., & Al Muhdhar, M. H. I. (2002). Pblpoe: A Learning Model To Enhance Students' Critical Thinking Skills And Scientific Attitudes. *International Journal Of Instruction*, *13*(2), 89–106. Https://Doi.Org/10.29333/Iji.2020.1327a.
Hakim, M. F. A., Sariyatun, S., & Sudiyanto, S. (2020). Constructing Student`S Critical Thinking Skill Through Discovery Learning Model And Contextual Teaching And Learning Model As Solution Of Problems In Learning History. *International Journal Of Multicultural And Multireligious Understanding*, *5*(4), 175. Https://Doi.Org/10.18415/Ijmmu.V5i4.240.
Handayani, N. P. S., Suarni, N. K., & Arnyana, I. B. P. (2020). Pengembangan Instrumen Kemampuan Berpikir Kritis Dan Literasi Sains Siswa Kelas V Sd. *Pendasi: Jurnal Pendidikan Dasar Indonesia*, *5*(1), 12–22. Https://Doi.Org/10.23887/Jurnal_Pendas.V5i1.270.
Hapsari, L. A., & Suryadarma, I. (2020). Development Of Student Worksheet Based On Local Wisdom With Discovery Learning Model. *5thicriems Proceedings*, 39–48. Http://Seminar.Uny.Ac.Id/Icriems/Sites/Seminar.Uny.Ac.Id.Icriems/Files/Proceeding2018/Be07_Laras.Pdf.
Hayati, N., & Setiawan, D. (2019). Dampak Rendahnya Kemampuan Berbahasa Dan Bernalar Terhadap Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *Jurnal Basicedu*, *6*(5), 8517–8528. Https://Doi.Org/10.31004/Basicedu.V6i5.3650.
Heard, J., Scoular, C., Duckworth, D., Ramalingam, D., & Teo, I. (2019). Critical Thinking : Skill Development Framework. *Australian Council For Educational Research*, *1–23*(5), 54. Https://Doi.Org/Https://Research.Acer.Edu.Au/Ar_Misc/41.
Hidayati, A. R., Fadly, W., & Ekapti, R. F. (2018). Analisis Keterampilan Berpikir Kritis Siswa Pada Pembelajaran Ipa Materi Bioteknologi. *Jurnal Tadris Ipa Indonesia*, *1*(1), 34–48. Https://Doi.Org/10.21154/Jtii.V1i1.68.
Irhasyuarna, Y., Kusasi, M., Fahmi, F., Fajeriadi, H., Aulia, W. R., Nikmah, S., & Rahili, Z. (2019). Integrated Science Teaching Materials With Local Wisdom Insights To Improve Students' Critical Thinking Ability. *Bio-Inoved : Jurnal Biologi-Inovasi Pendidikan*, *4*(3), 328. Https://Doi.Org/10.20527/Bino.V4i3.14148.
Kemendikbudristek, Pembelajaran, C. P. M. P. I. P. A. F. D. P. K. D., Standar, B., Kurikulum, D. A. P., Pendidikan, K., & Kebudayaan, R. (2020). No Title. *Dan Teknologi*, *3*(3), 103–111. Https://Kurikulum.Kemdikbud.Go.Id/File/Cp/Dasmen/14.
Krisnayanti, N. L. W., & Sujana, I. W. (2019). Lkpd Berbasis Pendekatan Kontekstual Pada Muatan Ipa Materi Pelestarian Sumber Daya Alam. *Jurnal Pedagogi Dan Pembelajaran*, *5*(3), 437–445. Https://Doi.Org/10.23887/Jp2.V5i2.48297.
Kurniawan, N. A., Hidayah, N., & Rahman, D. H. (2020). Analisis Kemampuan Berpikir Kritis Siswa Smk. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *6*(3), 334. Https://Doi.Org/10.17977/Jptpp.V6i3.14579.
Liu, Y., & Pásztor, A. (2020). Effects Of Problem-Based Learning Instructional Intervention On Critical Thinking In Higher Education: A Meta-Analysis. *Thinking Skills And Creativity*, *45*(7), 87. Https://Doi.Org/10.1016/J.Tsc.2022.101069.
Mareti, J. W., & Hadiyanti, A. H. D. (2018). Model Problem Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Dan Hasil Belajar Ipa Siswa. *Jurnal Elementaria Edukasia*, *4*(1), 31–41. Https://Doi.Org/10.31949/Jee.V4i1.3047.

Marshall, E., & Marquire, B. (2019). Wilcoxon Signed-Rank Test In Spss (Non-Parametric Equivalent To Paired T-Test. *Encyclopedia Of Statistical Sciences*, *3*(3), 87. Https://Doi.Org/10.1002/0471667196.Ess2935.

Maulidya, H. Z., Aprilia, N., & Hanafi, Y. (2020). Studi Literatur Peningkatan Kemampuan Analisis Siswa Melalui Model Pbl Pada Pembelajaran Ipa Biologi. *Journal Of Biology Learning*, *3*(2), 55. Https://Doi.Org/10.32585/Jbl.V3i2.1526.

Maya, F. A., Sari, I. K., & Zanthy, L. S. (2019). Analisis Kemampuan Berpikir Kreatif, Berpikir Kritis Matematik Siswa Smk Pada Materi Spldv. *Jpmi (Jurnal Pembelajaran Matematika Inovatif*, *2*(4), 167. Https://Doi.Org/10.22460/Jpmi.V2i4.P167-176.

Mitasari, R. A., & Hidayah, R. (2021). Development E-Worksheet Based On Problem Based Learning To Improve Student's Metacognitive Ability. *Journal Of Science Education Research*, *6*(2), 66–74. Https://Doi.Org/10.21831/Jser.V6i2.53067.

Novitasari, F., & Puspitawati, R. P. (2020). Pengembangan E-Lkpd Berbasis Problem Solving Pada Materi Pertumbuhan Dan Perkembangan Untuk Melatih Keterampilan Berpikir Kritis Siswa Kelas Xii Sma. *Jurnal Inovasi Pembelajaran Biologi*, *3*(1), 31–42. Https://Doi.Org/10.26740/Jipb.V3n1.P31-42.

Nursera, N., Susilawati, S., & Rasmiwetti, R. (2018). The Effect Of Scientific-Based E-Worksheet On Hydrocarbon Material On Students' Critical Thinking Ability At Vocational High Schools. *Al-Ishlah: Jurnal Pendidikan*, *15*(4), 6132–6141. Https://Doi.Org/10.35445/Alishlah.V15i4.3450.

Parno, P., Fathurrahman, F., Asim, A., Suwasono, P., & Ali, M. (2023). The Influence Of Problem Based Learning On Critical Thinking Ability For Students In Optical Instrument Topic. *Jurnal Pendidikan Fisika Indonesia*, *15*(1), 39–45. Https://Doi.Org/10.15294/Jpfi.V15i1.19309.

Prasadi, A. H., Wiyanto, W., & Suharini, E. (2020). The Implementation Of Student Worksheet Based On Stem (Science, Technology, Engineering, Mathematics) And Local Wisdom To Improve Of Critical Thinking Ability Of Fourth Grade Student.Pdf. *Journal Of Primary Education*, *9*(3), 227–237. Https://Doi.Org/10.15294/Jpe.V9i3.37712.

Ramdani, A., Jufri, A. W., Gunawan, F., M., & Yustiqvar, M. (2019). Analysis Of Students' Critical Thinking Skills In Terms Of Gender Using Science Teaching Materials Based On The 5e Learning Cycle Integrated With Local Wisdom. *Jurnal Pendidikan Ipa Indonesia*, *10*(2), 187–199. Https://Doi.Org/10.15294/Jpii.V10i2.29956.

Ramdiah, S., Mayasari, R., Husamah, & Fauzi, A. (2020). The Effect Of Tps And Pbl Learning Models To The Analytical Ability Of Students In Biology Classroom. *Asia-Pacific Forum On Science Learning And Teaching*, *19*(2), 78. Https://Doi.Org/Https://Www.Proquest.Com/Openview/6def38adc68639a04c4dc54682ea8264/1?Pq-Origsite=Gscholar&Cbl=2046135.

Ridho, S., Wardani, S., & Saptono, S. (2020). Development Of Local Wisdom Digital Books To Improve Critical Thinking Skills Through Problem Based Learning. *Journal Of Innovative Science Education*, *9*(3), 1–7. Https://Doi.Org/10.15294/Jise.V9i1.37041.

Sarah, S., & Maryono. (2020). Keefektivan Pembelajaran Berbasis Potensi Lokal Dalam Pembelajaran Fisika Sma Dalam Meningkatkan Living Values Siswa. *Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang*, *02*(01), 6–13. Https://Doi.Org/10.26714/Jps.2.1.2014.36-42.

Sari, E. E., Usman, & Hakim, A. (2019). *Effectiveness Of Using Google Forms In The Problem Based Learning Model To Increase The Critical Thinking Ability Of High School Students* (Vol. 432, Issue Esic 2019, Pp. 4–7). Https://Doi.Org/10.2991/Assehr.K.200417.002.

Sari, R., Perdana, R., Riwayani, R., Jumadi, J., Wilujeng, I., & Kuswanto, H. (2020). The Implementation Of Problem-Based Learning Model With Online Simulation To Enhance The Student's Analytical Thinking Skill In Learning Physics. *Journal Of Physics: Conference Series*, *1233*(1), 38. Https://Doi.Org/10.1088/1742-6596/1233/1/012030.

Sartika, W., Rahman, S. R., & Irfan, M. (2019). Empowering Students' Critical Thinking Skills Using Problem-Based Learning. *Inornatus: Biology Education Journal*, *3*(2), 67–74. Https://Doi.Org/10.30862/Inornatus.V3i2.427.

Shofiyah, N., Setiyawati, E., & Nurdyansah, N. (2020). The Role Of Local Wisdom-Based Student Worksheet On Scientific Reasoning. *95(Miseic*, *87*(3), 143–146. Https://Doi.Org/10.2991/Miseic-19.2019.34.

Suarningtyas, S. (2020). Development Of Student E-Worksheet Based On Pbl (Problem Based Learning) To Practice Metacognitive Abilities Of High School Student On Reaction Rate Material. *International Journal Of Current Science Research And Review*, *05*(05), 1680–1687. Https://Doi.Org/10.47191/Ijcsrr/V5-I5-35.

Sugiyono. (2021). *Metode Penelitian Kuantitatif, Kualitatif, Dan Tindakan*. Alfabeta.

Sumarni, W., & Kadarwati, S. (2019). Ethno-Stem Project-Based Learning: Its Impact To Critical And Creative Thinking Skills. *Jurnal Pendidikan Ipa Indonesia*, *9*(1), 11–21.

Https://Doi.Org/10.15294/Jpii.V9i1.21754.

Sumarni, W., Supardi, K. I., & Widiarti, N. (2019). Development Of Assessment Instruments To Measure Critical Thinking Skills. *Iop Conference Series: Materials Science And Engineering*, *349*(1), 87. Https://Doi.Org/10.1088/1757-899x/349/1/012066.

Tari, D. K., & Rosana, D. (2020). Contextual Teaching And Learning To Develop Critical Thinking And Practical Skills. *Journal Of Physics: Conference Series*, *1233*(1), 87. Https://Doi.Org/10.1088/1742-6596/1233/1/012102.

Wati, W., Kartimi, K., & Mulyani, A. (2021). Application Of Biology Learning Based On Local Wisdom Cibulan Tourism To Improve Students' Critical Thinking Skills. *Scientiae Educatia*, *10*(2), 148. Https://Doi.Org/10.24235/Sc.Educatia.V10i2.9356.

Widiastuti, I. A. M. S., Mantra, I. B. N., Utami, I. L. P., Sukanadi, N. L., & Susrawan, I. N. A. (2019). Implementing Problem-Based Learning To Develop Students' Critical And Creative Thinking Skills. *Jpi (Jurnal Pendidikan Indonesia*, *12*(4), 658–667. Https://Doi.Org/10.23887/Jpiundiksha.V12i4.63588.