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Development of Local Potential Handouts as SDGs-based Teaching Materials to Enhance Critical Thinking

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ABSTRACT

Critical thinking is an active process because it involves question-and-answer activities. This skill is important for students to have as one of the 21st-century skills that can support the achievement of Sustainable Development Goals (SDG's). The objectives of this world program need to be instilled from an early age so that students have an attitude of concern for environmental sustainability. The importance of understanding the SDGs can be taught in schools. The problem raised focuses on the unavailability of handouts that integrate local potential in science material and explore student activities in critical thinking as one of the skills of the 21st century. The role of this teaching material can be to train critical thinking skills in learning to achieve the SDGs goal of protecting terrestrial ecosystems. The aim of the research is to produce a handout on the local potential of the SDGs and determine whether there is an increase in students' critical thinking after using the handout. The method used by Research and Development (R&D) refers to 4D. Critical thinking data measured from description tests were obtained before and after the treatment designed to include students' abilities in providing explanations, building skills, designing strategies and tactics, explaining further and concluding. The results of the research show an increase in critical thinking skills of 0.60 as indicated by the N-gain and positive student responses after using the development product. These results are in line with the research objective of integrating SDGS-oriented local potential into teaching materials. The involvement of a teacher in designing teaching materials containing local SDGs-oriented potential is very necessary as one of the efforts that can be carried out in the education sector. Conclusion the science learning process on plant structure material and its use in technology was effective after using the SDGs-based local potential handout.

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1. INTRODUCTION

Critical thinking is a skilled activity that requires interpretation and evaluation of observations, communication, information and arguments. According (Ennis, 1996), the definition of critical thinking is reasonable and reflective thinking about things, substances, or problems to decide what to believe or do. This critical thinking ability is an important competency in preparing students to participate in overcoming the various global challenges they will face. Student involvement as a main pillar can drive sustainable progress. This sustainable development is an action plan at the global level which is agreed upon by world leaders, including Indonesia, which is called the Sustainable Development Goals (SDGs). One of the goals of the SDGs is to protect the environment. The role of students in understanding a good environment can be realized by using local potential in learning. This needs to be instilled from an early age so that people develop a habit of caring about environmental sustainability. Thus, environmentally friendly development as sustainable development that optimizes the benefits of natural resources can be applied to SDGs-based teaching materials.

One effort that can be made to ensure inclusive and equitable quality education is developing SDG-based local potential handouts. The importance of SDG's in life requires a good understanding of the environment. Critical thinking is a crucial higher-order thinking skill that can enhance students' competence in the 21st century (Ma, 2023) and support the achievement of the world program initiated by the UN in 2015. An action plan at the global level which is agreed upon by world leaders, including Indonesia, is called the Sustainable Development Goals (SDGs). Specifically, educators, students, policy makers and education organizations should affort to meet Sustainable Development Goal 4 by achieving inclusive and equitable quality education and promoting lifelong learning opportunities for all (Morris et al., 2023). Some of the SDG's goals related to Science learning are quality education, protecting land ecosystems, and handling climate change. Recently, there have been a lot of natural disasters including floods, landslides, climate change and so on. This indicates that environmental issues are a topical issue that needs attention since advances in science and technology negatively impact on the environment (Pursitasari et al., 2023).

One of the schools that supports achieving the SDGs goals is located in the Ru-baru sub-district which has local potential in the form of shallot plants in improving the economy of the surrounding community. Learning activities can utilize learning resources that are potential in the region.The old handouts used in science learning at school have not facilitated student activities for developing critical thinking skills. The available handouts are printed media containing content related to a collection of concepts and principles but do not include local potential. The results of research (Sormin et al., 2021) show that local wisdom can be used as teaching material. Another study (Ain, 2022) shows that students' critical thinking becomes effective after implementing sustainability-based teaching materials. Based on the previous description, one effort that can be made to equip 21st century skills and instill environmental awareness in students is to develop local potential handouts. One of the topics based on local potential that can integrate environmental awareness education in Science learning is shallots farming in maintaining land ecosystems. Several studies have been carried out to develop teaching materials. Research (Hidayat, 2023) indicates that implementing learning by adopting the potential of the Goloka area can positively affect on student learning outcomes.

Learning activities can utilize learning resources that are potential in the region. The research problem focuses on developing SDGs-based potential handouts for locals. The regular learning at the school show that Science learning activities have not been directed at exploring critical thinking skills. Moreover, the conventional teaching materials do not yet integrate local potential as a student learning resource. Indeed, the use of teaching materials is able to explore critical thinking skills in learning (Giavrimis et al., 2011).

The urgency of this research requires the development of Science learning teaching materials that include local potential in the Rubaru sub-district to explore the critical thinking skills of MTs Al Mujahidin students. This product is SDG-oriented and has the goal of protecting the land ecosystem. The local potential of this school is located in Rubaru sub-district as a golden triangle area which has an abundance

of shallot farming in Sumenep Regency. However, students at this school have not payed attention toward environmental knowledge and attitudes. Students' moral sensitivity in preserving the environment needs to be explored through assignments that address the importance of local potential in line with the SDGs goals.

The research questions are (1) to determine the validity of the SDG-based local potential handout; (2) to analyze whether there is an increase in students' critical thinking skills after using the SDG's local potential handout; and (3) to understand students' responses to these development products. This research aims to produce SDGs-based local potential handouts and determine the increase in students' critical thinking after using these handouts. Research limitations lie in one of the SDGs goals, namely protecting, restoring and increasing sustainable use of terrestrial ecosystems. Therefore, the research focused on utilizing the local potential of shallot farming integrated in the form of handout teaching materials that students can use to study. Previous research (Ramdayani et al., 2021) shows that student completion is 100% after using handouts based on local potential of ecosystem materials.

One learning approach which is environment-based and aims to bring students closer to their environment through education is SDGs. Students can have a sense of love, care and responsibility for their environment. The proposed problem-solving approach is through local potential. Previous research (Setyorini, 2023) reports that 80% of students agreed to develop teaching materials based on local potential. According to (Wilujeng, 2020) local potential is an educational program that contains materials and teaching materials delivered by teachers that can be linked to the natural, social, cultural environment or regional needs where students are obliged to study them.

Designing teaching materials related to the environment indicates a concern for the education sector regarding the SDGs. The novelty of this research is designing a handout containing an assessment of local potential in supporting the SDGs. The location of this school is in Rubaru sub-district which has potential for shallot farming. Previous research has not yet developed handouts that integrate local potential in students' school environments. Several studies still focused on general material in compiling handouts. Thus, the existence of potential local content in the school area might help explore students' critical thinking skills. The results of research (Anindita et al., 2023) show that the effectiveness of the biology module containing local potential in freshwater lakes is 100%, that could improve student learning outcomes.

2. METHODS

This research employs the Research and Development (R&D) method, which is a research method that produces and tests the effectiveness of certain products (Sugiyono, 2019). The research procedure refers to (Thiagarajan et al., 1974) 4D including the define, design, develop and disseminate stages as shown in Figure 1.

First, the define stage aims to find problems and potential causes of problem gaps. The steps included (a) conducting interviews with Science teachers and students to collect initial information; and (b) conducting classroom observations to identify problems and potential encountered in Science learning. Second, the design stage aims to prepare a design for teaching materials based on the analysis results of the problems and potential that have been obtained. Handout design planning materials include competency distribution analysis, instructional analysis, and design validation. The next step is to revise the design based on suggestions from validators. Third, the develop stage aims to develop teaching material products by implementing learning using handouts. At this stage, a small group trial was carried out using a readability test for students from different levels of academic ability, including high and medium low. The next step is to carry out usage trials on class VIII students. Last, the disseminate stage aims to assess product quality by filling out questionnaires by students. The questionnaire uses a Likert scale, and is distributed after the implementation of Science learning.

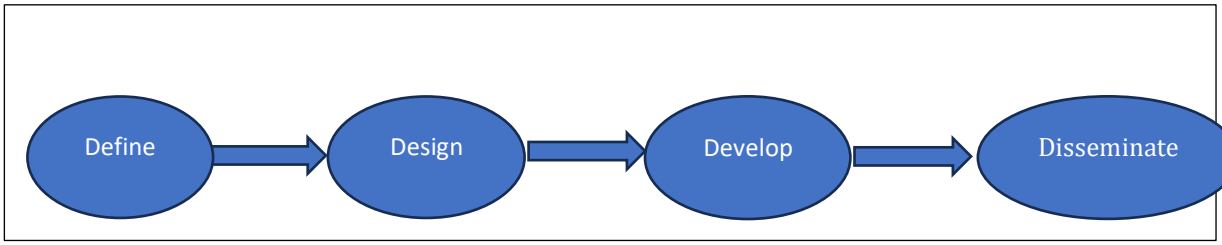

Figure 1. Research and Development (R&D) method with 4D model

The trial design was One-group Pretest-Posttest (single group Pretest Posttest). The research subjects were students of VIII grade who attended MTs Al Mujahidin. The research period started from August to December 2023.

The data collection methods are questionnaire and test methods. The research instruments used a validity questionnaire for teaching materials, a readability questionnaire, and a student response questionnaire. Critical thinking skills were assed using pretest and posttest written tests as the essay questions. The data analysis technique for handout development was obtained from calculating the validity of handout teaching materials about shallots and their use using the following formula (Akbar, 2013).

$$V = \frac{\text{Tse}}{\text{Tsh}} x\ 100\% \quad (1)$$

Description:
V = validity
Tse = Total validation score from validators
Tsh = Total expected maximum score

The following validity criteria, as shown in Table 1 are used to determine the validity category from the percentage results obtained.

Table 1. Validity criteria

Percentage	Category
81%-100%	Very valid
71%-80%	Fairly valid
51%-70%	Less valid
0%-50%	Invalid

The obtained data analysis is used to describe the readability of plant structure material handouts and their use in technology. It is calculated according to the handout readability scores using the following formula (Jauharati et al., 2022).

$$PK = \frac{\text{Total score results of data collection}}{\text{Criteria score}} x\ 100\% \quad (2)$$

Description:
PK = Readibility percentage (%)
Criteria score = The maximum score total of readibility

The results of the handout readability analysis are in percentages that can be interpreted using the readability criteria table described below.

Table 2. Handout readability criteria

Percentage	Category
81%-100%	Excellent
61%-80%	Good
41%-60%	Average
21%-40%	Poor
0%-20%	Very poor

Student responses can be analyzed using a percentage formula which can then be interpreted in the table below. A developed teaching material is categorized as successful if it obtains a positive response ≥ 75%.

$$P = \frac{\mathrm{n}}{\mathrm{N}} x\ 100\% \quad (3)$$

Description:
P = Response percentage (%)
n = Total score obtained
N = Total criteria score
100% = Fixed number

Table 3. Response criteria

Percentage	Category
91%-100%	Very good
76%-90%	Good
66%-75%	Adequate
56%-65%	Low
0%-55%	Very low

This study measured the differences before and after using the SDGs-based local potential handout in students that were tested using the Wilcoxon test assisted by SPSS v22. Moreover, an increase in critical thinking skills was also measured and analyzed using the results of the N-gain score (Tucker & Stronge, 2005). These results can be interpreted based on table 4 and table 5 below.

$$\text{N Gain} = \frac{\text{Postpercent correct} - \text{Prepercent correct}}{\text{100 percent} - \text{Prepercent correct}} \quad (4)$$

Description:
N-gain (*normalized gain*) = Normalized value
Prepercent = Pretest score
Postpercent = Posttest score
100 percent = Ideal score

Table 4. Devision of N-Gain Score

N-Gain Score	Category
g > 0,7	High
0,3 ≤ g ≤ 0,7	Medium
g < 0,3	Low

Table 5. Interpretation Category of N-Gain Effectiveness

Percentage (%)	Interpretation
< 40	Ineffective
40-55	Less effective
56-75	Fairly effective
>76	Effective

3. FINDINGS AND DISCUSSION

3.1. Findings Teaching Material Development

This research produced teaching materials as handouts on the topic of getting to know the shallot plant and its use as a local potential based on SDGs. The chosen teaching material is the structure of plants and their use in technology. Local potential integrated into teaching materials can make it easier for students to understand the material better so that question and answer discussions increase. This is in accordance with (Ennis, 1996) that critical reasoning starts from students' involvement in the argumentation process and then being able to look back at what has been done previously. Students are able to answer the questions contained in the thinking map because the science material studied has been encountered in everyday life. The local potential of shallot farming contained in the handout trains students to think about issues that involve critical thinking skills.

3.1.2 Define Stage

The results of interviews show that accompanying books for teaching materials in Science teaching and learning activities remain very limited and do not provide adequate examples regarding the integration of local potential based on SDGs. On the other hand, the interview results also reveal that there is less attention to the development of critical thinking skills since teachers focus more on completing material and assessment questions, including daily assessments, mid-term exams and final term assessments. Due to these problems, it is important to develop teaching materials especially SDGs-based local potential handouts. The chosen material is plant structure and its use in technology. This material was chosen because of the potential of plants in Rubaru Village, Sumenep Regency, namely shallot.

3.1.3 Design Stage

The product design of the handout adopting the local potential of the SDGs was carried out in this stage. The stage involves a series of processes namely; (a) the process of designing the content view of the handout using the online design application in Microsoft Word 365; (b) the process of designing the content of the material which adapts to the potential of shallot plants in Rubaru sub-district as the location of MTs Al-Mujahidin; and (c) the process of the whole product design, including contextual images in handouts to attract students to study Science. Teaching materials are made based on the ISO size of teaching materials, namely A4 (21x29.7 cm). The final result at this stage is a handout based on local potential in plant structure material and its use in technology shown in Figure 2.


Potensi Lokal

Salah satu potensi lokal yang dapat dikembangkan dari pulau Madura, tepatnya di daerah Rubaru adalah bawang merah. Potensi bawang merah dapat diintegrasikan pada pembelajaran IPA pada materi Struktur Tumbuhan dan Pemanfaatannya dalam Teknologi.

Varietas Lokal Asal Sumenep

Bawang merah varietas Sumenep umumnya dipanen umur 3 bulan atau sekitar 70 hari setelah tanam. Produksi bawang merah ini tergolong tinggi, yaitu rata-rata mencapai 12 ton/ha. Karakteristik tanaman ini memiliki daun bentuk silinder, kaku dan berwarna hijau. Pada satu rumpun terdapat 5 sampai 8 anakan.

Gambar 2. Bawang Merah Variaetas Sumenep

Bentuk umbi bulat memanjang, berwarna kuning pucat atau merah muda, dan bergaris-garis halus. Umbi berwarna keputihan saat tumbuh di lahan.

Jenis bawang varietas ini memiliki kadar air rendah dan tahan penyakit fusarium, antraknose, atau bercak ungu. Konsumen menyukai varietas ini dijadikan sebagai bawang goreng karena memiliki kualitas baik, tahan kering, dan aromanya sangat digemari.

Tanaman bawang merah memerlukan tanah berstruktur remah, drainase dan aerasi baik, mengandung bahan organik, reaksi tanah tidak masam (pH tanah antara 5,6 sampai 6,5). Tanah aluvial atau latosol cocok untuk pertumbuhan tanaman ini. Waktu tanam yang baik pada musim kemarau yang memiliki ketersediaan air cukup yakni pada rentang bulan April atau Mei dan bulan Juli atau Agustus. Bawang merah yang ditanam pada musim penghujan cenderung banyak serangan penyakit seperti layu fusarium, antraknosa, ataupun bercak ungu (Sodiq and Mudjoko, 2019).

Figure 2. The developed handout

The validation results show that 91% (very valid) was obtained in terms of content, construction and language, shown in Table 5 below. The validator's suggestion is to complete the picture of shallot plants growing in the Rubaru sub-district. The revised design results are then ready to be used for the next development stage.

Table 6. Validator assessment results

No	Component	Result (%)	Category
1	Content feasibility	93	Very valid
2	Construction feasibility	92	Very valid
3	Linguistics	89	Very valid
	Mean	**91**	**Very valid**

3.1.4 Develop Stage

The next step is a small-group trial, with more emphasis on the aspect of text readability test. The readability test aims to determine students' understanding and receive suggestions for improving the handout. The readability test results indicate that the SDGs local potential handout has very good readability with 95%, which can be seen in Table 7 below.

Table 7. Readability assessment results

No	Topic	Mean score
1	Identifying shallots as a local potential	90 %
2	The use of shallots in technology	100 %
	Mean	**95% (Excellent)**

The usage trial was assessed using the Wilcoxon test. The results show a significance value of 0.000 which is less than 0.05 (0.000 <0.05). It means that there is a difference between before and after using handouts in VIII grade. Besides, there is an increase in critical thinking after being given handouts during learning. Based on the results of the N-gain score, it was found that the average N-Gain score value was 0.60 (60%) categorized as medium level, shown in table 8 below. The N-gain test aims to

determine the increase in students' critical thinking abilities. It can be stated that learning in VIII grade using local potential handouts based on SDGs is fairly effective in improving critical thinking.

Table 8. Assessment results of critical thinking skills for each indicator

No	Indicator	N-gain	Category
1	Providing a basic explanation	0,50	Medium
2	Building primary skills	0,50	Medium
3	Strategy and tactics	0,33	Medium
4	Providing further explanation	1,00	High
5	Making a conclusion	0,64	Medium
	Mean	**0,60**	Medium

3.1.5 Disseminate Stage

The response results from 10 students in the VIII grade after learning Science using SDGs-based local potential handouts showed positive responses. Science learning activities encourage students' interest in repeating the learning process at home 100%. The learning process can foster a connection between learning activities and the benefits obtained by students at 100%. Students believe that the learning activities are easy and they are also enthusiastic to put them into practice with 100% positive response, as shown in Table 9.

Table 9. Assessment results of student response

No	Indicator	Percentage	Category
1	Sense of well-being	100%	Very good
2	Relevance	100%	Very good
3	Self-confidence	100%	Very good
	Mean	**100%**	**Very good**

3.2. Discussion Teaching Material Development Process

The integration of local potential in the form of handouts has proven to be effective in improving critical thinking. This is shown by students' activeness in continuously discussing and debating issues. The local potential content presented in the handout contains supporting information that addresses the situation of shallot farming and questions chosen using critical and reflective thinking. The research (Utami & Dewi, 2021) results show that local potential can be integrated into learning materials to overcome low learning outcomes. The implications of this research are that the SDGs-oriented local potential handout can be used as an alternative teaching material to overcome the lack of critical thinking in creating Indonesia's golden generation in 2045. Handouts as discussion material and material sources play an important role in creating effective targets (Ayu & Rinaningsih, 2021).

Product development produces handouts with a validity of 91%. This shows that the validity of the handout in terms of content is considered representative of the learning material provided. In other words, the content is relevant to what has been taught based on the curriculum. In terms of the constructed aspect, it shows that all the question items in the handout are able to measure the concept that should be measured, which is called critical thinking. Research (Sulastri et al., 2022) states that Science handouts are valid and practical in the learning process to train critical thinking skills. The selection of material on the handout plays a significant role in determining how effective the handout is in improving learning outcomes.

This research develops a product that integrates the local potential of shallot into the learning material called plant structure and their use in technology. Research results (Pramesthi et al., 2020) from the use of spice plant species as learning resources help students understand the material so that they

can relate the lesson to real conditions in their environment. The results of another research study (Ramadhani et al., 2023) show that learning activities with biology handouts are considered practical and can act as a reference in developing learning resources. In the same vein, the content of scientific knowledge increased after implementing science learning based on local wisdom in shallot farming (Meri, 2020). Using environmental learning resources by adopting local potential will have a direct and real impact on the learning experience. Research (Annisha, 2023)shows that students' caring attitudes have improved after local potential-based learning is implemented. The role of local potential in learning is likely a supplement to teaching materials that can increase students' understanding and shape students to think critically and be responsive to their surrounding. Another previous research (Soplantila et al., 2023) also reveals that handouts based on local food wisdom can be used as alternative teaching materials since 83% of students strongly agreed that this product was used in Biology.

Critical thinking skills as one of the 21st-century skills, can support the achievement of world programs. One of efforts to provide 21st-century skills and embed environmental awareness in students is developing local potential handouts to be used in the learning process. Handouts were chosen since they have good level of practicality. Also, they are considered effective because they are easy for students to use in Science learning. The highest indicator of MTs Al Muhajidin students' critical thinking skills is shown in the indicator providing further explanation. This shows that students act to analyze the questions carefully and evaluate them to find real reasons. The developed handout provides open-ended questions so that it allow students to think. On the other hand, the chosen cases in the handout are presented by raising environmental issues. Moreover, teaching materials are adapted to local potential in the student's environment. According to (Fisher, 2009) reasoning from cause-effect explanations shows that questions can help students think better about cases.

The findings contribute to the literature that developing SDGs-based local potential handout can improve students' critical thinking. Therefore, SDG-based handouts need to be developed so that students can compete in the 21st century era. Handouts are printed teaching materials that contain a summary of the study so that students do not need to take notes and they can complete the teacher's lesson delivery (Prastowo, 2011). The handout product is able to improve critical thinking skills by 60%, which is considered fairly effective when applied in the science learning process. These results are relevant to previous research (Dharmono et al., 2019) regarding the practicality of handouts to improve critical thinking. Designing teaching materials that involve the environment is part of concern for the education sector towards the SDGs (Pursitasari et al., 2023). According to (Daryanto & Karim, 2017) 21st -21st-century learning must involve students in exploring real-world issues and solving authentic problems. Students of the VIII grade gave positive responses toward the use of handouts as teaching materials. The use of handout should be seen as an integral part of a learning system (Setiawan et al., 2020).

4. CONCLUSION

The use of SDGs-based local potential handouts in teaching the topic of plant structure and its applications in technology has proven to be effective, resulting in positive student responses and a 60% improvement in critical thinking skills. This improvement was observed across key indicators, including providing basic explanations, building foundational skills, applying strategies and tactics, offering further explanations, and drawing conclusions. However, the research is limited to the use of handouts and the specific topic of plant structure, which may limit its generalizability to other subjects or contexts. Future research should explore the integration of local potential into various teaching materials and subject areas to further enhance critical thinking and student engagement across the curriculum.

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