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Development of an Inquiry-Based Student Worksheets on the Topic Plants as Sources of Life on Earth for Elementary School Students

Pengembangan Lembar Kerja Siswa Berbasis Inkuiri pada Materi Tumbuhan sebagai Sumber Kehidupan di Bumi untuk Siswa Sekolah Dasar

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Abstract

The development of inquiry-based Student Worksheets (LKPD) was carried out as an effort to create learning that places students as active subjects in discovering concepts independently. This study aims to develop student worksheets inquiry-based on the material of plants as sources of life on earth that are valid, feasible, and practical for learning at SD Negeri 1 Kota Ternate. The method used in this study was a research and development method adapted from Borg & Gall, which included the stages of data/information collection, product planning, initial product development, product validation and testing, and final product. The results of the study showed that the developed student worksheets met the criteria of being highly valid. Based on the validation results by subject matter experts, a score of 4.8 was obtained, which is considered highly valid. The validation results by media experts obtained a score of 4.1, which is considered valid, while the practicality assessment results obtained a score of 88%, which means that the inquiry-based LKP developed is very feasible for use. This means that the student worksheets developed can be used in science learning. The flip book learning media is highly valid and very feasible for use.

Pengembangan Lembar Kerja Peserta Didik (LKPD) berbasis inkuiri dilakukan sebagai upaya untuk menciptakan pembelajaran yang menempatkan peserta didik sebagai subjek aktif dalam menemukan konsep secara mandiri. Penelitian ini bertujuan untuk mengembangkan LKPD berbasis pembelajaran inkuiri pada materi tumbuhan sumber kehidupan di bumi yang valid, layak, dan praktis untuk pembelajaran di SD Negeri 1 Kota Ternate. Metode yang digunakan dalam penelitian ini yaitu metode penelitian dan pengembangan yang diadaptasi dari Borg & Gall yang meliputi tahap pengumpulan data/informasi, perencanaan pembuatan produk, pengembangan produk awal, validasi dan uji coba produk, serta produk akhir. Hasil penelitian menunjukan bahwa LKPD yang dikembangkan telah memenuhi kriteria sangat valid dengan. Berdasarkan hasil validasi oleh ahli materi diperoleh skor 4,8 dengan kriteria sangat valid, hasil validasi oleh ahli media memperoleh skor 4,1 yang termasuk dalam kategori valid, sedangkan dari hasil penilaian kepraktisan diperoleh skor 88% yang berarti bahwa LKP berbasis pembelajaran inkuiri yang dikembangkan sangat layak untuk digunakan. Hal ini berarti bahwa LKPD yang dikembangkan dapat digunakan dalam pembelajaran IPAmedia pembelajaran flip book sangat valid dan sangat layak digunakan.

Article Information

Keywords:
student worksheet; iquiry learning; students; plant

Kata kunci:
lkpd; pembelajaran inkuiri; siswa; tumbuhan

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A. INTRODUCTION

The teaching and learning process will be active, effective, creative, interesting, and enjoyable if supported by the availability of teaching materials, and one of the teaching materials that can be used is student worksheets (Ulfa, 2018). Student worksheets are a teaching material that contains concise and focused tasks that students must complete. Student worksheets can position students as learning subjects, allowing them to independently explore knowledge through their learning experiences through activities encompassing several stages, including observing, questioning, reasoning, experimenting, and communicating the results. In using these student worksheets, teachers act only as facilitators, guiding students when encountering difficulties. The teacher's role is to design student worksheets that are structured and engaging, which can foster independent learning (Prastowo, 2015).

The development of inquiry-based student worksheets has been proven effective in improving students' learning outcomes and scientific attitudes in science learning in elementary schools (Risky et al., 2018; Sati & Mutmainnah, 2023). This is in agreement with Ramlianti et al., (2025), that inquiry-based student worksheets not only improves academic outcomes but also enhances critical thinking and problem-solving skills. Science learning emphasizes direct experience to develop competencies so that students can understand the natural environment through the process of "finding out" and "making" (Trianto, 2017). The material on plants as sources of life on earth is one of the science learning materials in the Merdeka curriculum. Science learning emphasizes the process of inquiry and doing to develop competencies so that students gain experience and a deeper understanding of the natural environment scientifically (Widhy et al., 2013).

Based on the results of observations and interviews with class teachers at State Elementary School 1 Ternate City, it was found that 1) student worksheets based on Inquiry Learning had not been developed, 2) teachers also did not understand student worksheets based on inquiry learning, 3) Teachers only used student worksheets that had been made previously, where the student worksheets seemed to be dominated by knowledge that had to be memorized by students, resulting in students' science process skills and scientific attitudes being neglected. Scientific Attitude is an attitude of being able to act in solving a problem systematically through the steps of scientific activities (Suryantari et al., 2019; Ulfa, 2018). One of the learning models that can develop science process skills and scientific attitudes in students is the inquiry learning model (Mardianti et al., 2020; Masrurah & Wahyuni, 2022). The inquiry learning model is a learning model that emphasizes the process of thinking critically and analytically to seek and find answers to a problem in question (Sani, A., 2017; Sanjaya, 2015).

Based on the results of observations that have been conducted, research is needed to develop inquiry-based student worksheets that can be used in school learning. Thus, research was conducted to develop inquiry-based student worksheets on the topic of plants as sources of life on earth for fourth-grade students at SD Negeri 1 Kota Ternate. Inquiry-based student worksheets have been widely developed in various primary and secondary educational units, but there has been no application at SD Negeri 1 Kota Ternate, especially in relation to students' scientific process skills and scientific attitudes. Scientific process skills help students conduct scientific investigations, while scientific attitudes shape students' characters as future scientists. Therefore, this study aims to determine the validity, feasibility, and practicality of the product developed in accordance with the steps of the inquiry learning model.

This student worksheet product is a series of learning activities that involve all students' abilities to search and investigate systematically, logically, critically, and analytically, so that

students can formulate their findings with full confidence. The results of this study are useful for teachers and students in developing science process skills through the steps of the scientific method, namely, student orientation to the problem, formulating the problem, proposing a hypothesis, collecting data, testing the hypothesis, and formulating conclusions.

B. METHOD

This research is a type of research and development. According to (Sugiyono, 2020), research and development is a research method used to produce a specific product and test its effectiveness. The research method used in this study is the (Gall, 1989) model with the following stages:

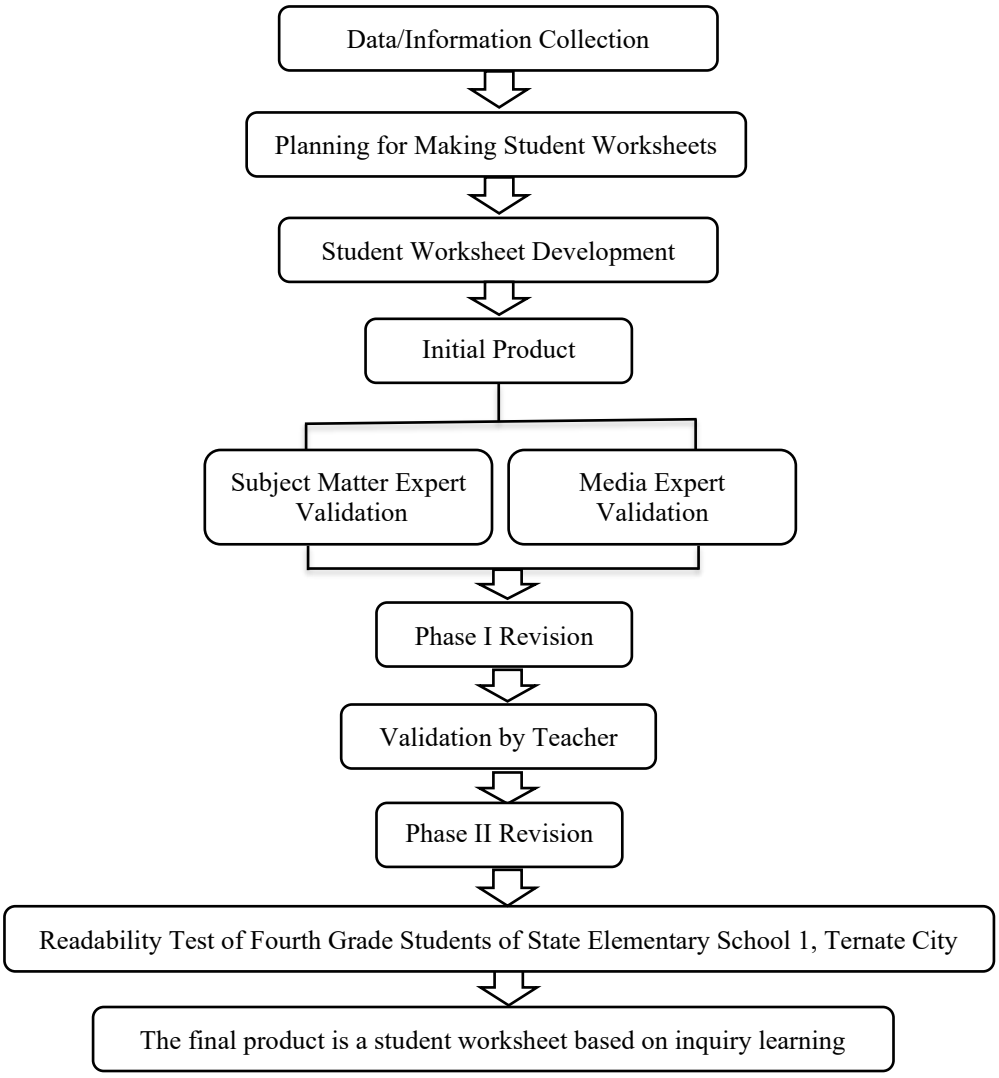

Figure 1. Procedure chart for developing Student Worksheets

The trial subjects included expert validation and a readability test. This expert validation activity was conducted to test the validity of the developed product design. The material and media experts were lecturers and elementary school teachers. The validators consisted of two lecturers from the Elementary School Teacher Education program at Khairun University and two teachers from State Elementary School 1 in Ternate City. The readability test was conducted on five fourth-

grade students from State Elementary School 1 in Ternate City, serving as the trial sample. This test was performed to obtain data on the practicality of the developed Student Worksheet.

The data collection instrument in this study was a validation sheet. The validation sheet was used to gather data on the validity of the developed inquiry-based learning Student Worksheet, examining both material and media aspects. The validation sheet instrument was designed based on a five-point scale (Arifin, 2019; Widoyoko, 2017).

The data analysis techniques employed in this study utilised both qualitative and quantitative approaches. Data in the form of suggestions and criticisms from experts were analysed using a qualitative approach. In contrast, data on the feasibility of the inquiry-based learning worksheets were processed using a quantitative descriptive approach. To analyse the validity of the data of the inquiry-based learning worksheets, the following steps were taken:

The first step was to score each assessment item according to the criteria in Table 1.

Table 1. Assessment Scoring Guidelines

Criteria	Score
Very good	5
Good	4
Enough	3
Not enough	2
Very less	1

(Source: Majid, 2014).

The second step is to calculate the average score for each assessment aspect using the formula:

$$\bar{X} = \frac{\sum X}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Information:

$\bar{X}$ = Average score

$\sum$x = Total score

n = Number of Assessors (Arikunto, 2016)

The third step is to convert the scores into values and categories to determine the quality of the inquiry-based learning student worksheets developed from both material and media aspects. The initial score data is then converted into qualitative data (interval data) on a five-point scale. The guidelines for converting scores to a five-point scale are presented in Table 2.

Table 2. Five-point Scale Score Conversion Guidelines

Score Interval	Average Score	Category
$X > \bar{Xi} + 1{,}8\ SBi$	> 4,2	Very Valid
$\bar{Xi} + 0{,}6\ SBi < X \leq \bar{Xi} + 1{,}8\ SBi$	> 3,4 - 4,2	Valid
$\bar{Xi} - 0{,}6\ SBi < X \leq \bar{Xi} + 0{,}6\ SBi$	> 2,6 – 3,4	Quite Valid
$\bar{Xi} - 1{,}8\ SBi < X \leq \bar{Xi} - 0{,}6\ SBi$	> 1,8 – 2,6	Less Valid
$X \leq xi - 1{,}8\ SBi$	≤ 1,8	Invalid

(Widoyoko, 2017)

Information:

X = actual score sought

$\bar{Xi}$ (ideal average score) = $\frac{1}{2}$ (maximum score + minimum score)

SBi (ideal standard deviation) = $\frac{1}{6}$ (maximum score - minimum score)

Ideal maximum score = Σ criteria items × highest score

Ideal minimum score = Σ criteria items × lowest score

The maximum score for each item is 5, and the minimum score is 1. The details are as follows:

It is known:
Ideal maximum score = 5
Ideal minimum score = 1
Actual score = X

To analyse data on the practicality of student worksheets based on inquiry learning, student responses were measured using the Gutman scale, which provides a score with two alternative answers: "Yes" with a score of 1 and "No" with a score of 0 (Akbar, 2022). Meanwhile, the eligibility data provided by teachers refers to a scale of 4 (four), namely not good (score 1), somewhat good (score 2), good (score 3), perfect (score 4) (Istiqomah & Salirawati, 2023; Mardapi, 2018).

The total score obtained is then analyzed using the following formula:

$$\text{Practical Value} = \frac{\text{Score obtained}}{\text{Maximum score}} x\ 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

The results of the percentage of student and teacher response questionnaires were then qualified into the assessment criteria available in Table 3.

Table 3. Assessment Criteria for Student Worksheets Based on Inquiry Learning

Persentase Skor	Kategori
80 %< x ≤ 100%	Very Practical/Very Feasible
60 %< x ≤ 80%	Practical/Feasible
40 %< x ≤ 60%	Quite Practical/Fairly Feasible
20 %< x ≤ 40%	Less Practical/Less Feasible
0 %< x ≤ 20%	Not Practical/Not Feasible

(Source: Riduwan, 2014)

C. RESULTS AND DISCUSSION

The inquiry-based LKPD research on plants as sources of life on earth refers to the Borg & Gall (1989) development model, which includes data/information collection, student worksheets planning, LKPD development, initial product, media and material expert validation, stage 1 revision, teacher validation, stage 2 revision, readability testing, and final product. The results of the steps taken are presented in more detail below:

1. Data Collection

Initial data collection was conducted through interviews and observations to determine learning needs at SD Negeri 1 Kota Ternate. The first steps taken were to analyze the school curriculum, analyze student stages and development, and analyze the availability of learning resources. The curriculum analysis was conducted to ensure that the products developed were in line with the learning outcomes and characteristics of the students at SD Negeri 1 Kota Ternate. Based on the observations made, it was found that the curriculum used at the school was the Merdeka curriculum, so the development of inquiry-based student worksheets had to take into account the suitability of the content with the Pancasila student profile, learning outcomes, and learning objectives. The content of the student worksheets was created by analyzing the concepts taught in the student worksheets to be developed, specifically material on plants as a source of life

on earth. The concepts to be included in the student worksheets were the parts of plants, photosynthesis as the most important process on earth, and plant reproduction.

Student analysis was conducted through observation of student characteristics. The fourth-grade students who were the subjects of this study were 11 years old on average. At this age, students are able to think abstractly using hypotheses and logical reasoning because they have entered the phase of concrete operational thinking (Rizqiyati & Wardani, 2023). In addition, students can be encouraged to learn using inquiry-based student worksheets because inquiry-based learning can stimulate curiosity in students (Anam, 2016). Subsequently, interviews were conducted with teachers, and it was found that teachers did not yet understand inquiry-based student worksheets. Teachers only used student worksheets that had been created previously, which seemed to be dominated by knowledge that students had to memorize.

2. Product Development Planning

The creation of inquiry-based student worksheets is customized to student needs and the syntax of the inquiry learning model. The worksheet design is created using Microsoft Word, with A4 paper size (21 x 29.7 cm). The student worksheet design includes a title, instructions for using the student worksheet, a profile of Pancasila students, learning outcomes, learning objectives, tasks or work steps that include the stages of inquiry learning, and a bibliography. The content of the student worksheet is compiled from various learning sources and supported by images to help students understand the material. The initial design of the student worksheet is presented in Figure 2.

Figure 2. Student Worksheet Design Based on Inquiry Learning
Developing the Initial Product

3. Developing the Initial Product

After the planning stage, proceed to the initial product development stage. Student worksheets are written in simple, communicative language that is appropriate for the students' level of thinking. The student worksheets are then explicitly integrated with inquiry steps into the activities. The display is designed to be visually appealing in order to motivate students and to organize instructions for both teachers and students. The initial products are then validated by media and material experts.

Product validation is carried out in two stages, namely the first stage is validation by subject matter experts and media experts, and the second stage is by teachers as practitioners. In the first stage, several suggestions were obtained from the validators, including reviewing the substance of the student worksheets, replacing the images used with higher resolution so that the images are clearly visible, and improving the layout. In addition, the instructions displayed on the worksheets must be clear and easy for students to understand.

The subject matter experts who validated the inquiry-based learning worksheets were biology lecturers from Khairun University. There were four aspects assessed by the subject matter experts, including the completeness of the worksheet elements, the suitability of the content and material, the construction, the technical aspects, and the inquiry learning stages. The data on the results of the validation of student worksheets by subject matter experts can be presented in Table 4.

Table 4. Data from the Validation Results of Student Worksheets by Subject Matter Experts

No	Validated aspects	Average score	Category
1	Completeness of student worksheet elements	5	Very Valid
2	Suitability of content and materials	4,42	Very Valid
3	Construction	4,71	Very Valid
4	Technical	5	Very Valid
5	Stages of inquiry learning	5	Very Valid
	Average	**4,8**	**Very Valid**

Based on the results of the validation of student worksheets based on inquiry learning by material experts, as shown in Table 4, they have met the criteria for being very valid, with the overall average score of all aspects being 4.82. The assessment with the very valid criteria in these aspects is due to the material presented in the inquiry-based worksheets guiding students to discover the concepts to be learned, helping to develop students' cognitive abilities, critical thinking, and enhancing problem-solving skills (Lailiah et al., 2021; Larosa, 2023).

The sentence structure used is accompanied by operational verbs with measurable achievability, using references/literature that support the teaching material, readability of the writing and the font used, images and text are made proportional, and student worksheets are developed in accordance with the steps of inquiry learning, namely: 1) The orientation step is a step to foster a responsive learning environment that encourages problem-solving thinking, 2) Formulating the problem is a step that brings students to an issue that contains a puzzle, 3) Proposing a hypothesis is formulating a tentative answer to a problem being studied, 4) Collecting data is the step of gathering the information needed to test the hypothesis, 5) Testing the hypothesis is the process of determining an answer that is considered acceptable according to the data or information obtained based on data collection, and and 6) Drawing conclusions is the process of describing the findings obtained based on the results of hypothesis testing (Firdaus & Wilujeng, 2018; Sanjaya, 2015). Inquiry-based student worksheets are classified as printed teaching materials that contain information in the form of text and are characterized by relying on problem-solving exercises as well as training students in discovery and skill development (Prastowo, 2015).

Media validation consists of four aspects, namely coloring, design, graphics, and language, with the data from media expert validation presented in Table 5.

Table 5. Data from the Validation Results of Student Worksheets by Media Experts

No	Validated aspects	Average score	Category
1	Coloring	4,5	Very Valid
2	Design	3,25	Valid
3	Graphics	4	Valid
4	Language	4,5	Very Valid
	Average	**4,06**	**Valid**

Based on the results of the validation of inquiry-based learning worksheets by media experts in Table 5, the worksheets have met the validity criteria with an overall average score of 4.06. The student worksheet based on inquiry learning received a valid category assessment because the colors used did not interfere with the material, a combination of colors was used, and it was by the surrounding environment, which could improve learning outcomes (Anggela & Rina., 2023). The appearance of student worksheets is attractive, the images used are related to the material, using language that is appropriate to the refined spelling (Hayong & Putra, 2020), using language that is easy for students to understand according to their level of cognitive development (Pratiwi & Margunayasa, 2022). Inquiry-based student worksheets also use communicative statements and can encourage students' curiosity (Utami & Dafit, 2021; Widati, 2021). Curiosity is important for a student to have to understand the world around them (Kurniawan & Lisarani, 2021). Curiosity is a student's motivation to obtain information through questions such as "what is this?", why and so on. These questions will continue to develop further with questions such as "how did this happen?" or "how to solve this problem?"(Ulya & Hayati, 2020). In inquiry-based learning, students are asked to seek and discover answers to a given problem through data collection, information analysis, and conclusions (Anam, 2016; Depin et al., 2024).

Teachers' assessment of inquiry-based student worksheets consists of six aspects: appearance and effectiveness, material presentation, relevance, student engagement in using the worksheets, language, and inquiry learning. The assessment data for inquiry-based student worksheets are presented in Table 6.

Table 6. Class Teacher Assessment Results Data

No	Rated aspect	Percentage (%)	Category
1	Didactic	90	Very appropriate
2	Construction	92	Very appropriate
3	Technical	82	Very appropriate
	Average	**88**	**Very appropriate**

Based on the results of classroom teachers' responses to inquiry-based learning worksheets developed in Table 6, it can be seen that teachers' assessment of practicality obtained a score of 88%, with a category of very appropriate. The assessment with very appropriate criteria for these aspects is because the student worksheets are directed to find the concepts to be learned, Clarity of learning objectives in the student worksheets, Components of the student worksheets help develop students' cognitive abilities, Student worksheet activities train critical thinking skills, Identity of the student worksheets describes the student profile, The sentence structure used is accompanied by operational verbs whose achievement is measurable, Use of language is appropriate to the level of cognitive development of students, Student worksheets use references/literature that support the teaching material, Student worksheets use effective sentences, Activity titles describe the contents of the student worksheets, Readability of writing and the type of font used, images and writing are made proportional, and the images used help explain the concept. According to Iramahdewi et al.,

(2025), worksheets play an important role in the learning process by increasing student engagement, facilitating active learning, and encouraging critical and creative thinking skills. They increase motivation, assist teachers in delivering material, and make learning more effective and meaningful.. According to Bruner's view in Markaban (2008), learning by discovery is learning to discover, where a student is faced with a problem or situation that seems odd so that students can find a way to solve it. Inquiry learning provides opportunities for students to actively participate in building the knowledge they will acquire. Student participation directs learning to a student-centered, active, fun learning process, and allows for information to occur between students, between students and teachers, and between students and the environment. .

4. Student Readability Assessment

After the initial product was revised, it was piloted with students to determine the practicality of the inquiry-based student worksheet. Student responses to the inquiry-based student worksheet consisted of three aspects: appearance, material presentation, and usability. The assessment data for the inquiry-based student worksheet are presented in Table 7.

Table 7. Data on Student Response Results to Inquiry Learning-Based Student Worksheets

No	Response Aspect	Percentage (%)	Category
1	Appearance	100	Very Practical
2	Material Presentation	100	Very Practical
3	Benefits	100	Very Practical
	Average	**100**	**Very Practical**

Student response data on the Inquiry Learning-based student worksheets developed using a questionnaire instrument measured using a score with two alternative answers, namely a "Yes" answer with a score of 1 and a "No" answer with a score of 0. Table 7 shows that student responses to the Inquiry Learning-based student worksheets obtained an average percentage of 100% in the "Very Practical" category in learning. The student worksheets are assessed using the criterion "Very Practical." Based on the aspects assessed, the text or writing on the student worksheets is easy to read, the images presented are very clear, there are image captions, and they are presented in accordance with the material. The material presented can increase learning motivation, independent learning skills, and facilitate students in the process of solving the problems presented. Students can utilize information, both through the internet and other sites, to conduct scientific investigations. The presentation of the material is very communicative so that students are motivated to study the student worksheets thoroughly. The design of the material and the writing are very attractive, and the language used is easy to understand. The instructions on the worksheets are very clear, making it easy for students to use them.

D. CONCLUSION

Based on the results of the study, it can be concluded that the inquiry-based student worksheets on the subject of plants as sources of life on earth for students at SD Negeri 1 Kota Ternate are classified as highly valid according to subject matter experts with a score of 4.8, classified as highly valid according to media experts with a score of 4.06, and highly feasible according to practitioners with a score of 88%. Meanwhile, based on student responses, the practicality of inquiry-based learning worksheets falls into the highly practical category.

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