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DEVELOPMENT OF LOCAL WISDOM-BASED MEDIA AND EXPERIMENTAL STUDENT WORKSHEETS (LKPD) USING PJBL ON PHOTOSYNTHESIS FOR GRADE IV ELEMENTARY SCHOOL STUDENTS

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ABSTRACT

This study aims to develop an interactive learning media based on PowerPoint (PPT) integrated with digital Student Worksheets (LKPD), instructional videos, and a simple experiment guide on the topic of photosynthesis for fourth-grade students of SD Negeri Sindurjan. The research employed the Research and Development (R&D) method using the ADDIE model, which consists of the stages of needs analysis, media design, development and expert validation, implementation of project-based learning, and evaluation of effectiveness. The media was designed using Canva and then converted into PPT format. The main components include material visualization, videos explaining concepts and demonstrating experiments, project-based digital LKPD, and an experiment guide using chili plants as the observation object. The validation results indicate that the developed media obtained a very high feasibility score of 4.8/5 from experts, particularly in the aspects of competency alignment and ease of use. The trial conducted with fourth-grade students showed an improvement in students' understanding of the concept of photosynthesis, as indicated by the increase in learning outcomes. Classroom implementation demonstrated an improvement in learning outcomes from an average pretest score of 29% to a posttest score of 77%, with several students, such as KN, showing a significant increase from 53 to 100. In addition, students' responses to the use of the media reached a very good category. These findings indicate that interactive PPT-based learning media integrated with simple experiments are effective in improving students' understanding of photosynthesis concepts, science process skills, and students' awareness of the local potential in their environment.

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1. INTRODUCTION

Elementary education plays an important role in fostering scientific thinking skills and shaping students' character from an early age. At this level, students begin to learn basic science concepts that serve as the foundation for critical thinking skills at higher levels of education. One of the important topics in fourth-grade Natural Science learning is photosynthesis, which is the biological process in which green plants convert light energy into chemical energy in the form of food. However, observations conducted at SD Negeri Sindurjan indicate that many students have not fully understood this process. A total of 9 out of 16 students were only able to memorize the definition without understanding the relationship between important factors such as light, water, carbon dioxide, and chlorophyll. This condition is exacerbated by conventional teaching methods that remain teacher-centered and the limited use of experimental media that allows students to learn in a concrete manner.

Science learning in elementary schools should not only emphasize mastery of concepts but also develop scientific thinking skills through meaningful learning experiences, according to Ni Made Sinta Suwastini et al., (2022). However, classroom practices are still dominated by lecture-based instruction and memorization, which limits students' opportunities to engage in direct observation or experimentation. As a result, students' science process skills and critical thinking abilities tend to remain low Syachruroji et al., (2023).

One solution to address this problem is the implementation of the Project Based Learning (PBL/PJBL) model, which emphasizes authentic learning experiences. This model positions students as active learners who acquire knowledge through relevant and challenging projects. Zulfa et al., (2025) explain that experimental student worksheets (LKPD) based on local wisdom and the PJBL approach can facilitate students in conducting direct experiments and connecting the photosynthesis process with their daily lives. In the context of photosynthesis, PJBL can be implemented through projects such as planting local plants, creating a mini garden, or conducting simple experiments on the effect of light on leaf growth. These activities help students understand the concept of photosynthesis more deeply while simultaneously developing scientific skills and critical thinking.

In addition to project-based learning, the integration of local wisdom also plays a significant role in making science learning more contextual. According to Rediani et al., (2023); Saputra Sanjaya et al., (2023), integrating local wisdom into science learning can foster ecological awareness while also instilling socio-cultural values in students.

The learning activities produced through this approach include observing changes in leaf color, recording experimental results in the LKPD, engaging in group discussions regarding the role of light, and drawing conclusions based on data obtained independently by the students. Such learning activities enable students not only to receive information from the teacher but also to actively participate in the scientific process through observing, predicting, experimenting, and reflecting on results.

The use of appropriate learning media also plays a crucial role in supporting successful science learning. Previous studies have shown that interactive media can improve

both motivation and conceptual understanding among elementary school students Made Mitha Wedayanti et al., (2023). Furthermore, the development of experiment-based Student Worksheets (LKPD) can help students carry out scientific activities in a systematic and independent manner. Several previous studies have developed LKPD based on scientific approaches, STEAM, or digital media, which have been proven to enhance students' science process skills and learning outcomes Safitri et al., (2022); Toyibah Toyibah et al., (2024); Dian Rahmadani et al., (2025).

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The product development in this study uses the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) because it provides a systematic framework for designing, testing, and evaluating learning media. This model allows the product to be validated by experts and revised based on the results of classroom implementation. Through this approach, the developed media and LKPD are expected to achieve a high level of validity, practicality, and effectiveness in supporting science learning.

This research is also relevant to the implementation of the Merdeka Curriculum, which emphasizes contextual learning, environmental exploration, and project-based activities. By utilizing the local potential around the school environment, students can understand the concept of photosynthesis more concretely while also developing 21st-century skills such as collaboration, communication, and critical thinking.

Based on the description above, this study aims to: (1) develop learning media and experimental LKPD based on local wisdom using the Project Based Learning approach and the ADDIE model on the topic of photosynthesis for fourth-grade students of SD Negeri Sindurjan; and (2) analyze the level of validity, practicality, and effectiveness of the developed product. This research is expected to contribute theoretically to the development of learning media based on local potential and to provide practical guidance for teachers in implementing more contextual and meaningful science learning in elementary schools.

2. RESEARCH METHODS

This study employed a qualitative approach using the Research and Development (R&D) method adapted from the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). This model was chosen because it provides a systematic and flexible workflow, allowing continuous revisions at each stage and accommodating the needs of contextual learning based on local wisdom Safitri & Aziz, (2022). This approach is appropriate for the characteristics of research oriented toward the development of educational products, where the final output is an interactive learning media and experimental Student Worksheets (LKPD) based on local wisdom for the topic of photosynthesis in the fourth grade of SD Negeri Sindurjan.

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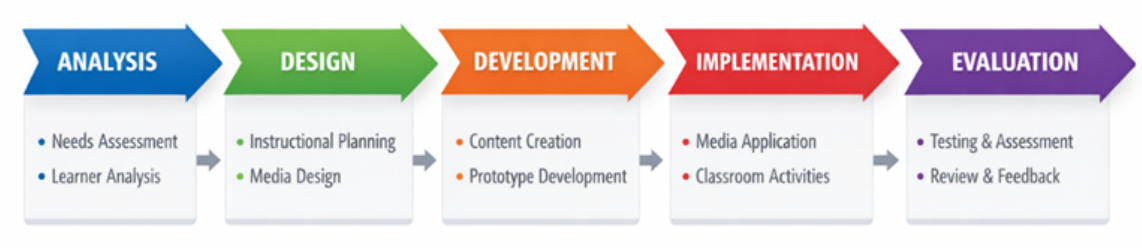

Figure 1. Stages of the ADDIE Development Model

This study employed a qualitative approach combined with the Research and Development (R&D) method using the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was selected because of its systematic and flexible nature, allowing researchers to adapt the development of learning media to students' needs while emphasizing continuous evaluation throughout the process Safitri & Aziz, (2022).

The research was conducted at SD Negeri Sindurjan, Purworejo Regency, on August 19, 2025, involving 16 fourth-grade students and one classroom teacher as the research subjects. The researcher was directly present in the classroom as a participant observer, interacting with students to understand their learning experiences in a real classroom setting. In addition, three experts were involved in the product validation process, including a subject-matter expert, a media expert, and a learning expert, to ensure the quality and relevance of the developed learning media.

The implementation of the ADDIE model began with an analysis of students' learning needs and classroom conditions, followed by the design of interactive learning media using Canva and PowerPoint. The next stage involved the development of the prototype and expert validation, followed by the implementation of the media through a photosynthesis experiment project in the classroom. The final stage consisted of evaluation, which aimed to assess the effectiveness of the learning process and the achievement of the media development objectives.

Research data were collected through observation, interviews, questionnaires, learning outcome tests, and expert validation. Observations were used to document students' learning activities, group interactions, and their engagement in experimental activities. In-depth interviews were conducted with the classroom teacher to obtain information regarding students' difficulties in understanding the concept of photosynthesis and the need for more contextual learning media. Qualitative data obtained from observations and interviews were analyzed descriptively to describe the implementation process of the media and students' responses during the learning activities.

Meanwhile, quantitative data were obtained from expert validation sheets, teacher and student response questionnaires, and pre-test and post-test results. The expert validation sheet used a Likert scale ranging from 1-4 to assess aspects of content, visual design, and instructional quality. The scores were then calculated as average values to determine the feasibility category of the product. Teacher and student questionnaires were used to assess the practicality of the media in the learning process.

The effectiveness of the learning media was analyzed using the N-Gain calculation based on the pre-test and post-test results to determine the improvement in students' conceptual understanding. The N-Gain scores were categorized into high (≥0.70), moderate (0.30–0.69), and low (<0.30). These quantitative results were then interpreted together with qualitative findings from observations and interviews to provide a more comprehensive understanding of the effectiveness of the media and students' learning experiences.

The developed product was considered valid if the average expert validation score was ≥3, practical if teacher and student responses were categorized as good or very good, and effective if the N-Gain value was ≥0.30. Through this combination of qualitative and quantitative analysis, the study ensured that the developed learning media and experimental worksheets not only met academic feasibility standards but were also relevant and easily applicable in elementary school science learning.

3. RESULTS AND DISCUSSION

This study produced experiment-based teaching materials and digital student worksheets (LKPD) developed for learning photosynthesis in the fourth grade of elementary school. According to Anjarini, (2022). Students tend to show greater interest when science learning is conducted through direct experimentation, particularly in topics such as photosynthesis. The product development process employed the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation Safitri & Aziz, (2022) The teaching materials integrate the Project-Based Learning (PJBL) approach and local wisdom from Purworejo through the use of chili plants as experimental media, making the learning process more contextual and meaningful for students.

The needs analysis results showed that 90% of students experienced misconceptions regarding the photosynthesis process, particularly related to the source of plant food and the time when photosynthesis occurs. Most students assumed that plants obtain food directly from the soil through their roots. This finding is consistent with the study by Safitri et al., (2022), which indicates that low understanding of photosynthesis concepts in elementary schools is often caused by teaching methods that do not sufficiently involve direct learning experiences. Therefore, the developed teaching materials were designed to provide authentic learning experiences through simple experimental activities using chili plants.

At the design stage, an interactive digital LKPD was developed using Canva and PowerPoint. The LKPD contains a summary of the material, experiment guidelines, and observation and reflection sheets. The activity structure was designed to guide students through scientific stages, starting from observation, making predictions, conducting experiments, and drawing conclusions. The LKPD design was created to be simple yet engaging through the use of bright colors, visual icons, and an intuitive layout, making it suitable for the characteristics of elementary school students Hardiansyah et al., (2022).

The selection of chili plants as experimental media was based on pedagogical and cultural considerations. This plant is easily found in students' surroundings, has leaves suitable for photosynthesis experiments, and holds economic value for the community in

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Purworejo. The integration of this local wisdom makes learning more relevant to students' daily lives and increases their engagement in the learning process Putri et al., (2025).

The validation process involved a subject-matter expert, a media expert, and a language expert. The evaluation results showed an average score of 4.8 out of 5, which falls into the very feasible category. The subject-matter expert assessed that the conceptual accuracy and alignment with the curriculum were appropriate, while the media expert suggested improvements in navigation and color contrast. These findings are consistent with the study by Pristiwanti et al., (2024). which indicates that the development of local wisdom–based E-LKPD can produce learning products with a very high level of validity.

Table 1. Product Feasibility Results by Experts

No.	Feasibility Aspect	Average Score (Scale 5)	Category	Revision Notes
1	Development Foundation	5.0	Highly Feasible	-
2	Competency Alignment	5.0	Highly Feasible	-
3	Language Content	5.0	Highly Feasible	-
4	Learning Objectives	5.0	Highly Feasible	-
5	Theme and Topic of Material	5.0	Highly Feasible	-
6	Instructional Material	5.0	Highly Feasible	-
7	Visual Display & Readability	4.4	Highly Feasible	Color adjustments
8	Ease of Use	5.0	Highly Feasible	-
Average		**4.8**	**Highly Feasible**	

These results reinforce the findings of Hardiansyah et al., (2022). which emphasize that the ADDIE model is effective in producing systematic learning products that can be easily adapted to students' needs. The implementation of experiment-based digital LKPD in the classroom showed a significant improvement in students' understanding of the concept of photosynthesis. The average pre-test score of 29% increased to 77% in the post-test. The small-scale trial produced an N-Gain score of 0.67, while the large-scale trial reached 0.69, both of which fall into the moderate to high improvement category.

These findings are also consistent with previous research which found that science literacy–based interactive worksheets can significantly improve students' critical thinking skills and conceptual understanding of photosynthesis. This improvement occurs because students gain direct learning experiences through simple experiments, which activate their science process skills and encourage deeper conceptual understanding.

Table 2. Trial Results of Learning Effectiveness

Type of Trial	Average Pre-test	Average Post-test	N-Gain	Category
Small-Scale Trial	38%	78%	0.67	Moderate–High
Large-Scale Trial	29%	77%	0.69	Moderate–High

The improvement in learning outcomes indicates that experiment-based learning helps students understand the relationship between light and the photosynthesis process in a more concrete way. In the experimental activity, students covered part of the chili plant leaves to demonstrate the effect of light on photosynthesis Illah & Amelia, (2025). This direct experience activates students' science process skills, enabling them to build conceptual understanding more effectively. These findings are consistent with the study by Zamilah et al., (2023). which shows that science literacy–based interactive worksheets can significantly improve conceptual understanding.

From the aspect of practicality, 77% of teachers and students provided very positive responses to the developed teaching materials. The learning process became more interactive and collaborative because students were directly involved in experimental projects. This practicality was influenced by three main factors:

1. The integration of local wisdom, which makes learning more closely related to students' daily lives;
2. The Project-Based Learning (PJBL) approach, which encourages active participation; and
3. The use of interactive digital media, which helps students follow the stages of the experiment more easily Zulfa et al., (2025).

These findings are also supported by the study of Saputri & Reinita, (2024). which states that Canva-based E-LKPD is easy for teachers to use and attractive for students. Furthermore, Sarwendah, (2023) emphasizes that easy navigation and appealing visual design are important factors in the success of digital learning media.

From a theoretical perspective, the results of this study reinforce the constructivist learning theory, which states that knowledge is constructed through direct experience and social interaction. Through project-based experimental activities, students engage in scientific processes such as observing, questioning, experimenting, reasoning, and communicating results. This process supports contextual learning, allowing students to connect scientific concepts with real phenomena in their environment.

In addition, the use of digital LKPD designed with Canva and PowerPoint demonstrates that the integration of simple technology can increase student engagement in science learning Syarifatunnisa et al., (2024). This approach helps teachers utilize technology in a practical way without requiring complex devices.

The novelty of this study lies in the simultaneous integration of three main components:

1. Photosynthesis experiments based on local plants,
2. Interactive digital LKPD, and

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3. The Project-Based Learning approach within an integrated instructional design.

Unlike previous studies that generally developed culture-based E-LKPD or digital media separately, this research utilizes local wisdom from Purworejo as the main source for science experiment projects. Thus, this study expands the application of contextual learning in elementary science education by integrating project-based learning, digital technology, and local environmental potential simultaneously.

Nevertheless, this study has several limitations. The variation in students' initial abilities caused some students to still require assistance in understanding the instructions in the digital LKPD. In addition, the use of chili plants as experimental objects resulted in variations in observations due to differences in plant conditions in each environment. Another limitation is that teachers' competence in utilizing digital media still needs improvement so that the use of the media can be more optimal. Therefore, future research is recommended to involve a larger research sample and conduct long-term observations to examine the impact of the learning approach on students' science process skills.

Overall, the results of this study indicate that the developed media are valid (score 4.8), practical (77% positive responses), and effective in improving students' understanding of photosynthesis concepts (N-Gain 0.69). The product not only reduces students' misconceptions but also improves science process skills and fosters scientific attitudes through contextual project-based learning integrated with local values. These findings support the view of Sary et al., (2023) that the integration of local wisdom and digital media within PJBL can enrich science learning experiences in elementary schools.

4. CONCLUSION AND SUGGESTIONS

Conclusion

This study demonstrates that the development of experiment-based learning media and local wisdom–based Student Worksheets (LKPD) using the Project-Based Learning (PjBL) approach is effective in improving students' understanding of the concept of photosynthesis among fourth-grade elementary school students. The developed media obtained an average expert validation score of 4.8 out of 5, which falls into the "very feasible" category, and showed a practicality level of 77% based on positive responses from both teachers and students. In terms of learning effectiveness, there was a significant improvement in students' learning outcomes, with the average score increasing from 29% in the pre-test to 77% in the post-test, and an N-Gain value of 0.69, which is categorized as moderate to high improvement. The integration of local wisdom through the use of chili plants as experimental media makes the learning process more contextual, while the PjBL approach encourages active student engagement in activities such as observation, discussion, and experimentation. Therefore, the developed media have been proven to be valid, practical, and effective, and they have the potential to serve as an innovative alternative for supporting contextual science learning and the development of 21st-century skills in elementary schools.

Suggestions

Considering the results and limitations of this study, elementary school teachers are recommended to integrate local wisdom into science learning (IPAS) through simple experimental activities that utilize the potential of the surrounding environment. This approach can increase student engagement and help them understand scientific concepts in a more contextual manner. However, since this study identified several limitations, such as variations in students' initial abilities and limited experimental facilities, teachers need to adapt the LKPD design and provide more intensive guidance for students who experience difficulties in understanding the learning instructions. In addition, the development of local wisdom–based learning media can be expanded to other science topics so that learning becomes increasingly relevant to students' real-life contexts. For future researchers, it is recommended to involve a larger number of participants and schools from different regions in order to obtain a more comprehensive understanding of the effectiveness of the local wisdom–based Project-Based Learning (PjBL) approach. Further studies may also explore the use of more diverse digital learning media and conduct long-term observations to examine their impact on the development of students' science process skills and character development.

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