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Assistance in the Preparation of PjBL LKPD for Deepening Science for Grade V Elementary School

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Abstract
This community service article describes mentoring for developing Project Based Learning (PjBL)-oriented student worksheets to strengthen grade V elementary science learning. The program was implemented at SDN Kalisongo 1 Kota Malang with teachers as the target group. The mentoring combined adult learning, brainstorming, conceptual reinforcement on PjBL, guided worksheet design, presentation, reflection, and pretest-posttest evaluation. The results indicate an increase in teacher understanding from a pretest mean of 48.58 to a posttest mean of 68.88. Normality and homogeneity assumptions were met, and the paired t-test showed a significant difference between pretest and posttest scores, t(23) = -30.337, p < 0.001. The mentoring supported teachers in translating classroom problems into project triggers and in preparing PjBL-based worksheets for science learning. Follow-up support is recommended to test the worksheets directly in classroom practice and to integrate digital or artificial intelligence-based tools into the next mentoring cycle.

Keywords:
student worksheet;
project based learning;
science learning;
elementary school;
teacher mentoring.

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1. INTRODUCTION

Basic education requires learning tools that go beyond simply presenting information, but also guide students to observe problems, formulate solutions, work collaboratively, and produce meaningful learning products. Project-Based Learning (PjBL) is relevant to these needs because it positions projects as a vehicle for knowledge construction, decision-making, collaboration, and reflection. A recent meta-analysis shows that PjBL contributes positively to students' learning outcomes, affective attitudes, and higher-order thinking skills.[1][2] In the context of science and STEAM, PjBL is also seen as effective because it provides authentic space for students to connect concepts to real-world problems.[3].

Recent studies on PjBL in K-12 education confirm that the success of this model is greatly influenced by the quality of task design, clarity of prompting questions, teacher support, and opportunities for students to reflect on their learning process.[4]. PjBL is not enough to be interpreted as an activity to create a product, but must be designed as a learning ecosystem that fosters involvement, communication, creativity, and problem-solving skills.[5], [6], [7]. Thus, learning tools such as Student Worksheets (LKPD) have a strategic position because they serve as a bridge between the PjBL syntax and concrete learning activities in the classroom.

This urgency is strongly evident in science learning in elementary schools. Several recent studies have shown that PjBL and its STEAM-PjBL variants can improve elementary school students' scientific literacy, motivation, creativity, learning outcomes, and science process skills.[8], [9], [10], [11]In fifth-grade science learning, PjBL-based student worksheets (LKPD) are needed to help teachers organize contextual problems, conduct investigations, explore learning resources, create products, conduct presentations, and conduct evaluations. A study of PjBL-based e-LKPD in fifth-grade science learning also shows that this tool can support more active and focused learning.[12]. Similar results were found in the development of STEAM-PjBL-based worksheets that encouraged student motivation, creativity, scientific reasoning, and involvement in projects.[13], [14].

On the other hand, research on PjBL modules and teaching materials shows that the effectiveness of PjBL increases when the learning tools have an explicit structure, are based on real problems, and provide support for the concept exploration process.[15], [16]. The meta-analysis study of blended PjBL also shows that activity design, student characteristics, and technological support are factors that influence the success of project-based learning.[17], [18] In school practice, implementation challenges often arise in the form of teachers' difficulties developing guiding questions, identifying relevant products, selecting mentoring strategies, and assessing the contribution of learning processes and products. Similar challenges were also found in studies of PjBL e-learning platforms and technology-assisted project-based learning, which emphasized the importance of teacher readiness, design support, and ongoing mentoring.[19], [20].

Teacher mentoring is crucial because implementing PjBL requires more complex pedagogical skills than simply selecting a learning model. Teachers need to understand how to translate classroom problems into projects, structure activity stages, develop assessment rubrics, and ensure projects remain aligned with learning objectives. Recent studies of pre-service and university teachers have shown that PjBL can foster metacognition, independent learning, STEAM competencies, and cross-disciplinary thinking skills when activities are systematically designed.[21], [22], [23] Meanwhile, a study of PjBL-assisted technology shows that digital support can enrich the learning process, but still requires pedagogical readiness of teachers.[24].

This community service activity was carried out to address the needs of teachers at SDN Kalisongo 1, Malang City, in compiling PjBL-based LKPD for in-depth study of science material for grade V. Based on the implementation of the activity, most teachers have become familiar with the basic concepts of PjBL and have understood the preparation of LKPD at the minimum standard. However, teachers still experience difficulties in starting to develop PjBL-based LKPD, especially in formulating initial questions or problems as project triggers. This mentoring was designed through an andragogical approach because the participants are adult teachers who have classroom experience and need a reflective space to analyze learning problems.[25] The LKPD training and mentoring approach for elementary school teachers is also in line with similar community service practices that emphasize improving teacher skills through demonstration, practice, evaluation, and feedback.[26], [27].

The purpose of this article is to describe the implementation of PjBL-based LKPD preparation assistance for deepening science material for grade V elementary school, analyzing activity achievements based on pretest-posttest data and implementation notes, and formulating follow-up recommendations for partners.

2. IMPLEMENTATION METHOD

This activity uses a community service design in the form of training and mentoring. The focus of the activity is to improve teachers' abilities in compiling PjBL-based LKPD for deepening science material for grade V elementary schools. The activity partner is the Kalisongo Elementary School Cluster, Kalisongo Village, Dau District, Malang Regency, East Java. The target of the activity is teachers at the Kalisongo Elementary School Cluster, Malang Regency. The number of participants who took part in the activity was 24. The activity was carried out through a series of coordination, communication with partners, prototype development, validation, trials, effectiveness testing, data analysis, and output development.

The mentoring strategy combines brainstorming, concept reinforcement, practice, presentation, and reflection. In the initial stage, participants are invited to explore their initial knowledge of PjBL and LKPD. The next stage includes an explanation of competency dimensions and activity indicators, including basic PjBL concepts, PjBL procedures, PjBL-based LKPD development, and presentation of results. Afterward, participants explore, explain, and confirm. Exploration is directed at identifying classroom problems that can be used as project-provoking questions. Explanation is used to translate classroom problems into study material worthy of follow-up in learning. Confirmation is carried out to ensure that the solution design and action plan are aligned with the issues raised.

The mentoring uses an andragogical approach by placing teacher experience as a learning resource. The instructor acts as a facilitator who helps participants analyze learning experiences, conclude problem patterns, and generalize strategies for compiling PjBL-based LKPD. The activity material includes basic PjBL concepts, PjBL implementation procedures, compiling PjBL-based LKPD, and writing a report on the results. The time allocation based on the appropriate technology attachment is 120 minutes for the basic concepts of PjBL offline, 120 minutes for the procedures for implementing PjBL online, 120 minutes for compiling PjBL-based LKPD online, and 180 minutes for writing the report on the results online.

Evaluation of the program's success was conducted through pretests and posttests to measure changes in teachers' understanding of the PjBL-based worksheets. Quantitative analysis used the Kolmogorov-Smirnov normality test, Levene's homogeneity test, and the paired t-test. The quantitative data used in this article fully follow the analysis results table in the report. Furthermore, responses and implementation notes were analyzed descriptively from activity descriptions, reflections, and documentation.

Table 1. Design of stages and mentoring materials

Level	Form of activity	Target
Preparation	Coordination, communication with partners, prototype design, prototype validation	Schedule, partner agreements, and validated prototypes
Concept training	Brainstorming, strengthening basic PjBL concepts, and discussing PjBL procedures	Teachers understand the basics and procedures of PjBL
Practical assistance	Exploration of class problems, preparation of provocative questions, and design of LKPD activities	PjBL-based LKPD draft
Presentation and reflection	Presentation of design results, reflection between teachers and lecturers, and feedback for improvements	Improvement of the LKPD draft and action plan
Evaluation	Pretest, posttest, normality test, homogeneity test, and paired t-test	Data on the effectiveness of mentoring

3. RESULTS AND DISCUSSION

Implementation Results

The results of the activity indicate that mentoring begins with an introduction to the partner's context and a mapping of teacher readiness. Teachers at the Kalisongo Elementary School Cluster have relatively adequate facilities to support project-based learning, both inside and outside the classroom. This is a crucial asset because Project-Based Learning (PjBL) requires exploration space, tools, materials, documentation, and support from the school environment. Most participants were familiar with the basic concepts of Project-Based Learning (PjBL), but there were still differing perceptions about how to translate classroom problems into projects and student worksheets (LKPD).

The brainstorming activity revealed that the main difficulty for teachers was not in introducing the term PjBL, but rather in its operationalization. Teachers needed guidance in identifying problems that were suitable for use as trigger questions, connecting these problems to fifth-grade science material, determining project products, developing learning activities, and preparing evaluations. Through exploration, explanation, and confirmation, participants were guided to analyze key classroom problems, explore their causes, design alternative solutions, and develop action plans. This pattern enabled the mentoring to be more than just a lecture, but also encouraged teachers to use their classroom experiences as material for developing tools. Figure 1 presents documentation of the mentoring activities.

Figure 1. Documentation of assistance in preparing PjBL-based LKPD at SDN Kalisongo 1, Malang City.

The quantitative evaluation used pretest and posttest data. Descriptive results show that the mean score increased from 48.58 in the pretest to 68.88 in the posttest. This average increase of 20.29 points indicates a change in understanding after the training and mentoring. A summary of the descriptive data is presented in Table 3.

Table 2. Descriptive statistics of pretest and posttest results

Hand	N	Mean	Std. Deviation
Pretest	24	48.5833	18.09856
Posttest	24	68.8750	15.99270

The prerequisite test shows that the pretest and posttest data are normally distributed. The Kolmogorov-Smirnov significance value for the pretest is 0.060 and for the posttest is 0.065, both greater than 0.05. The homogeneity test also shows a significance value of 0.744, so the data variance is declared homogeneous. After the prerequisites are met, the paired t-test shows a significant difference between the pretest and posttest scores, $t(23) = -30.337$, $p < 0.001$. A summary of the statistical tests is presented in Table 4.

Table 4. Summary of prerequisite tests and paired t-tests

Test	Statistics/parameter	Mar k	Results
Pretest normality	Kolmogorov-Smirnov Sig.	0.060	Normal
Posttest normality	Kolmogorov-Smirnov Sig.	0.065	Normal
Homogeneity	Levene Statistic = 0.108; df1 = 1; df2 = 46; Sig.	0.744	Homogeneous
Paired t-test	Mean difference = -20.29167; 95% CI = -21.67533 sampai -18.90800; t = -30.337; df = 23; Sig.	0.000	Significantly different

Based on these data, mentoring has been shown to improve teachers' understanding of developing PjBL-based worksheets (LKPD). This improvement cannot be directly interpreted as an improvement in student learning outcomes because it does not present data on LKPD implementation in the classroom or include student achievement data. Therefore, the conclusion regarding effectiveness is limited to the improvement in teachers' understanding and preparedness after mentoring.

Discussion

The main findings of this activity indicate that mentoring in the development of PjBL-based worksheets (LKPD) is relevant to the needs of elementary school teachers. Teachers already have initial knowledge of PjBL but require mentoring to transform conceptual knowledge into operational worksheet designs. This condition aligns with literature that emphasizes that the success of PjBL depends on the quality of the problem design, the originality of the project, the structure of group work, and the clarity of evaluation.[1], [28]. PjBL doesn't automatically succeed simply because teachers ask students to create a product. PjBL needs to be developed through strong guiding questions, investigative activities, supporting learning resources, monitoring, presentations, and reflection.

In fifth-grade science learning, the need for PjBL-based worksheets (LKPD) is increasingly important because science concepts cannot be understood simply by rote learning. Students need to observe, measure, compare, conclude, and communicate their findings. Research in elementary school contexts shows that PjBL can improve scientific literacy, learning outcomes, motivation, creativity, and science process skills.[8], [29]. Thus, teacher training to compile PjBL LKPD can be seen as an appropriate pedagogical intervention because the target of change is in the core tools used by teachers in facilitating learning.

The pretest-posttest results showed an average increase of 20.29 points. This increase indicates that training and mentoring contributed to teachers' understanding. These data also support the findings of similar studies that training in developing student worksheets (LKPD) or e-LKPD can improve teachers' knowledge and skills in designing more interactive teaching materials.[26], [27].

Mentoring using an andragogical approach also aligns with the characteristics of participants as adult teachers. Andragogy emphasizes experience, practical needs, autonomy, and direct relevance to work issues.[25]In this activity, teachers not only receive PjBL materials but are also asked to identify real-life classroom problems, explore their causes, formulate solutions, and confirm action plans. This approach strengthens the transfer of training to teaching practice because teachers work with problems they personally experience, rather than abstract examples detached from the school context.

From an output perspective, the prototype PjBL-based worksheet development guide is an important outcome because it can be used as an initial reference for teachers after the activity concludes. However, the sustainability of the impact requires follow-up. The development of the worksheet needs to be continued with expert validation, practicality testing by teachers, readability testing by students, and effectiveness testing in the classroom. Studies on PjBL-based and STEAM-PjBL worksheets show that the quality of the tools significantly determines student engagement, scientific reasoning, creativity, and learning outcomes.[12] Therefore, the LKPD product from this activity should not remain as a draft, but rather be developed into a tool ready for implementation and ongoing evaluation.

The practical implication of this activity is the need for multi-layered mentoring for teachers. The first stage can focus on understanding the PjBL concept and designing student worksheets. The second stage focuses on product clinics, namely, improving student worksheets based on rubrics. The third stage involves guided implementation in the fifth grade. The fourth stage involves reflecting on the implementation results using student data. This phased pattern will be more robust than a one-time training because PjBL requires a cycle of design, practice, feedback, and revision. The integration of digital technology or artificial intelligence can be a future agenda, but technology needs to be positioned as a support for pedagogical design, not a substitute for teachers' ability to formulate problems and facilitate projects.[19], [20] Academically, this activity contributes to community service practices in elementary education by demonstrating that classroom problem-based mentoring can improve teachers' understanding of PjBL LKPD. Practically, this activity helps teachers move from a general understanding of PjBL to the initial ability to develop tools.

4. CONCLUSIONS

The mentoring of PjBL-based LKPD preparation in the Kalisongo Elementary School Cluster succeeded in improving teachers' understanding of LKPD design for deepening science material for grade V. The activities were carried out through brainstorming, strengthening PjBL concepts, exploring class problems, LKPD preparation practices, presentations, reflections, and pretest-posttest evaluations. The data showed an increase in the average score from 48.58 in the pretest to 68.88 in the posttest, with a significant difference based on the paired t-test, $t(23) = -30.337$, $p < 0.001$.

The main impact of the activity was on improving teachers' readiness in understanding the procedures for compiling PjBL-based LKPD and in formulating class problems as the starting point of the project. Follow-up recommendations were to validate LKPD products, complete the LKPD quality assessment rubric, test the LKPD implementation on fifth-grade students, and integrate digital technology or artificial intelligence in a targeted manner to enrich the learning design and evaluation process.

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