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Improving Science Process Skills through Project-Based Worksheets Integrated with Local Potential in Biotechnology Materials

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ABSTRACT

Science process skills (SPS) are Among the abilities required in the twenty-first century. Therefore, SPS needs to be considered carefully, especially for students in schools. The goal of this research was to develop a worksheet integrated with one of local potential in Kudus Regency that is used to improve SPS in students. Local potential that was integrated in this worksheet is "Parijoto". Parijoto is one of the famous plants in Kudus Regency. This study's methodology is R&D utilizing the 4D development paradigm consisting of define, design, develop and disseminate. The subjects of the trial in this study were grade IX students of SMPN 04 Bae Kudus. The results of this study are that the student worksheet integrated with local potential in biotechnology material is valid and feasible to use based on the validity score obtained, namely 0.88, and is practical and effective in improving students' science process skills, as evidenced by the N-gain score of 0.74.

Keywords: biotechnology; local potential; project; science process skills

INTRODUCTION

Science process skills are students' capacity to use scientific techniques to comprehend, develop, and discover science. (Rahayu & Anggraeni, 2017). According to the essence of science, science process skills prioritize overall evaluation and are intimately tied to science learning. (Kurniawati, 2021). Science process skills are essential in solving scientific problems, especially in learning in schools (Astalini et al., 2018). Students who master science process skills will also master the skills needed for higher-level learning such as conducting research and solving problems (Ginting et al., 2022). Based on this, science process skills must be mastered well by students.

However, in developing countries, students' science process skills are still relatively low, such as in Malaysia and the Philippines. The science process abilities that the Malaysian Ministry of Education requires of high school pupils are generally lacking(Tek et al., 2012). In addition, in the Philippines, it was also found that most students have low and inadequate science process skills (Derilo, 2019). Low science process skills are also seen in Indonesia in addition to these other nations (Sifah & Sumarno, 2016; Rahman et al., 2017; Af'idayani et al., 2018;

Pramudiyanti & Munazir, 2021; Yunita & Nurita, 2021; Santiawati et al., 2022). Low science process skills are caused by several factors, including the learning model used (Af'idayani et al., 2018), minimal infrastructure to support learning, learning that does not optimize the role of students (Rahmasiwi et al., 2015), lack of science materials to support science process skills (Astalini et al., 2023) and lack of books as learning guidelines. Based on these problems, science process skills are one of the skills that need to be given proper attention.

Integrating local potential in the learning process is one way to combine science materials with local culture or local potential (Dewi et al., 2019). There are many benefits obtained by integrating local potential in learning, including: students become more concerned and more respectful of their surroundings (Nurhidayati, 2019) better understand the concept of the subject matter (Muthmainah et al., 2016) and can improve students' science process skills (Sudirman et al., 2024). Each region has local potential that can be used as a teaching resource for integrated scientific studies. One of the local potentials in Kudus Regency is parijoto. Parijoto is one of the famous plants in the Muria Mountains, Kudus Regency (Sidiq & Mumpuni, 2019). However, the local potential of parijoto is not yet widely known by students, especially in Kudus Regency. Parijoto is a plant with many benefits (Sholikhati et al., 2024). One of the benefits of parijoto is as an antibacterial (Sugiarti & Pujiastuti, 2017; Farida et al., 2021; Milanda et al., 2021). The antibacterial content in parijoto can be used as an ingredient in making hand sanitizer (Setyowati et al., 2023). Hand sanitizer is one of the results of biotechnology products because one of the main ingredients in making biotechnology is alcohol. In making parijoto hand sanitizer, alcohol functions as an ingredient to extract substances found in parijoto as well as an additional ingredient as a bacteria killer (Ranabhat et al., 2021).

One way to introduce local potential in the school environment is to integrate it with the teaching materials used in the learning process (Sari et al., 2024). However, research shows that the integration of local potential in learning is still not optimized properly (Wilujeng et al., 2020; Fara et al., 2022). Based on the results of observations at SMPN 04 Bae as one of the schools located in the local potential producing area of Parijoto, teaching materials or learning media that integrate local potential with science learning have not been found. The lack of optimization of local potential in learning is caused by several factors, including factors in the school environment (Nebres, 2023), the lack of varied learning media that integrate local potential (Rejekiningsih et al., 2021) and also the lack of teaching materials that integrate local potential (Masihu & Augustyn, 2021). Based on the description, the efforts that can be made are to develop integrated worksheets for local potential projects to improve students' science process skills.

METHOD

The method used in this study is research and development (R&D) using the 4D model consisting of define, design, develop and disseminate. The research was conducted at SMPN 04 Bae Kudus. The research subjects for the trial were carried out in class IX of the 2024/2025 academic year with a sample of class IX B totalling 32 students. The development procedure was carried out in several stages including defines. Define is carried out with a preliminary study

by conducting interviews with teachers regarding student learning resources that are integrated with local potential, learning models and direct observation of students. The next step is design, the researcher carries out a design in developing a worksheet in the form of creating a format and content on the worksheet to be developed. Continued with the next step in the form of develop, the researcher carries out development in the form of a worksheet integrated with local potential in the form of the Parijoto plant typical of Kudus which is designed and developed as a project-based worksheet on making hand sanitizers from local potential Parijoto to be validated by experts to determine the feasibility of the worksheet developed. In this study, there were two expert validators, namely a science teacher and a master science student. The aspects assessed in this student worksheet are clarity of content, appearance, language and usefulness. The results of the assessment data obtained will be analyzed using Aiken V.

$$V = \frac{\sum s}{n\,(C-1)}$$

Information:

V = Aiken validity index

s = the difference between the score given by the expert and the lowest score on the rating scale

c = number of categories/assessment scales

n = number of experts

Table 1. Validity categories

Score	Category
0,8-1	Very high
0,6-0,79	High
0,40-0,59	Medium
0,20-0,39	Bad
0,00-0,19	Very bad

After the worksheet was declared valid, the worksheet was tested on grade IX B students. In this study, there are several indicators of science process skills that will be assessed, namely: observing, predicting, concluding, and communicating skills (Padilla, 1990; Yildirim & Yalcin, 2011). Purposive sampling was used to choose the study sample. The last step is disseminating, the researcher distributed the worksheet through training to teachers who teach the P5 project at SMPN 04 Bae. The trial was conducted using a one group pretest-posttest only experimental design presented in Figure 1.

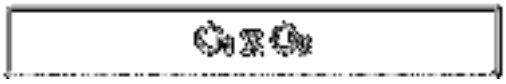

Figure 1. Research design

Information:

O_1 : Pretest

X : Treatment

O_2 : Post-test

After the trial is carried out, a value is obtained from the students' project results based on the worksheet that has been used in learning. This value is then analyzed using the gain score with the following equation.

$$g = \frac{s_{pos} - s_{pre}}{s_{max} - s_{pre}}$$

Information:

g : gain

s_{pos} : *posttest*

s_{pre} : *pretest*

s_{max} : ideal maximum score

(Hake, 1999)

Gain score categories were then used to examine the pretest and posttest results.

Table 2. Gain score categories

Gain score level	Category
g ≥ 0,7	High
0,3 ≤ g < 0,7	Medium
g < 0,3	Low

RESULT AND DISCUSSION

Data for the definition formulation stage came from interviews with science instructors at SMPN 04 Bae Kudus, who revealed that there was no locally relevant teaching resources used in the scientific curriculum. The teaching materials used only refer to textbooks from the Ministry of Education. Based on this, researchers developed teaching materials in the form of worksheets that are integrated with local potential in the form of the local potential "Parijoto". The next stage is design. Researchers carry out the design by determining materials that are appropriate to local potential that will be used as well as preparing teaching modules and worksheet designs that will be developed. The material chosen is biotechnology with a project to make hand sanitizer from local potential "Parijoto". After the worksheet has been developed, the worksheet will then be validated by an expert, namely the science teacher at SMPN 02 Bae Kudus. The worksheet design is visible in the picture that follows.

After the product has been developed, the next step is a feasibility assessment by experts. The results of the expert assessment can be seen in the Table 3. After the worksheet was declared valid, the worksheet was tested to determine whether the developed worksheet was efficient in increasing pupils' proficiency in the scientific method. The aspects of KPS that were assessed included: observing, predicting, investigating, concluding, and communicating (Padilla, 1990; Yildirim et al., 2011; Okanlawon, 2015). The gain score findings showed that it was in the high category with a value of 0.74. The assessment of indicators for each aspect of science process skills can be seen in the Table 4.

Based on table 4, it shows that each aspect of the science process skills assessed received a high score. This shows that the developed student worksheets are effective in improving students' science process skills. This demonstrates how well the created worksheet works to help students enhance their science process abilities. This is consistent with studies conducted by (Maryani et al., 2017) this demonstrates the effectiveness of project-based worksheets in enhancing science process skills. According to other studies, employing project-based worksheets is one way to help kids develop their science process abilities (Berlian et al., 2023). The use of project-based worksheets can be applied to improve SPS due to several reasons, including: it can facilitate students to develop concepts, train process skills with project activities, and students can be directly involved with real objects (Pertiwi, Sudiatmika, 2024).

Figure 2. Cover

Figure 3. Competency

Figure 4. Activity

Figure 6. Activity

Figure 7. Activity

Table 3. Validity assessment results

Indicator aspect	Average	Category
Clarity of content	1,00	Very high
Appearance	0,83	Very high
Language	0,78	High
Usefulness	0,92	Very high
Total	**0,88**	**Very high**

Table 4. Score of science process skills

Science process skills	Score
Observing	0,96
Predicting	0,87
Investigating	0,90
Concluding	0,88
Communicating	0,85

The use of the PjBL model has a beneficial effect on pupils' learning, one of which is creating innovative learning experiences (Antari, 2023). Students' science process abilities are also significantly impacted when the PjBL paradigm is used in the classroom. (Amanda et al., 2023). This is due to the fact that students must solve tangible problems as part of project-based learning. (Bariyah & Sugandi, 2022). Students learn how to tackle challenges through project-based learning, be able to work together well, be more confident and creative (Sutrisna et al., 2019; Asidiqi, 2024).

In addition, by integrating local potential-based learning, it can foster awareness and responsibility of students to maintain and preserve local potential around them and to enhance pupils' understanding and proficiency (Endah, 2020; Reka Nurjanah et al., 2024). By integrating local potential in science learning, students become more aware of their surroundings (Nurhidayati et al., 2022), science learning becomes more enjoyable and varied (Dini & Rini,

2024), and in accordance with the independent curriculum where students can learn from their surroundings and explore the results of products from local potential around them.

CONCLUSION

The results of the study indicate that the Project-Based Worksheets Integrated with Local Potential in Biotechnology Materials developed are valid and feasible to use with a validity score of 0.88 and are practical and effective in improving students' science process skills with an N-Gain score of 0.74. Thus, student worksheets can be used for further science learning. With this worksheet, it is expected that it can be used as one of the supports for smooth science learning and can increase students' insight to always learn from their surroundings, especially to be more aware of the local potential around them. The next hope is that this research can be used as one of the references or references for further researchers. Especially in the field of research on the development of teaching materials, research related to students' science process skills, the use of the PjBL model, and the integration of local potential in science learning.

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