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The Influence of Project-Based Learning Model Based on Local Water Issues in IPAS Subject on Students' Sustainability Awareness at MIN 1 Semarang

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ABSTRACT

This study aims to analyze the effect of Project Based Learning (PjBL) with a local water issue context on students' sustainability awareness in the IPAS subject at MIN 1 Semarang. The research employed a quasi-experimental design with a nonequivalent control group, involving fifth-grade students divided into experimental and control classes. Data were collected through sustainability awareness questionnaires, observation sheets, and project-based worksheets, and analyzed using t-test and N-gain. The findings revealed that students in the experimental class experienced a significant increase in sustainability awareness, with an N-gain categorized as medium to high, while the control class showed only a low to medium improvement. Observations further indicated that students in the experimental class demonstrated stronger cognitive understanding, affective commitment, and conative actions related to water conservation compared to the control group. These results confirm that PjBL based on local water issues effectively fosters holistic sustainability awareness, encompassing knowledge, attitudes, and actions. Conceptually, this research highlights the importance of contextualized project-based learning in supporting sustainable development education at the elementary level, particularly in relation to Sustainable Development Goal 6 (Clean Water and Sanitation).

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INTRODUCTION

Environmental sustainability issues are increasingly urgent to be integrated into 21st-century learning, particularly in the subject of Natural and Social Sciences (IPAS) at the elementary madrasah level. Local phenomena such as water pollution, limited resources, and community consumption behavior present real challenges that demand early student involvement in understanding and finding solutions. Contextual problem-based education is believed to foster sustainability awareness, as students not only learn concepts theoretically but

also directly confront environmental problems around them (Winarti et al., 2025; Espino-Díaz et al., 2025).

The Project-Based Learning (PjBL) model has been widely studied as an effective instructional strategy to enhance critical thinking, collaboration, and problem-solving skills. However, most previous studies have focused more on cognitive aspects or general 21st-century skills, without specifically linking them to local issues relevant to students' lives. On the other hand, research integrating PjBL with environmental issues has been limited to secondary school contexts, leaving little empirical evidence at the elementary madrasah level (Melindawati et al., 2025; Nurazizah et al., 2024; Susanti et al., 2023; Marlangen et al.,2023). This creates a research gap, namely the lack of studies connecting PjBL based on local water issues with the development of sustainability awareness among elementary/madrasah students.

The urgency of this research is reinforced by preliminary observations at MIN 1 Semarang, which revealed that most students do not yet have adequate awareness of the importance of maintaining water quality and practicing water-saving behavior in daily life. Water is a fundamental need closely related to environmental sustainability and public health. These initial findings are consistent with Anggraini et al. (2025), who emphasized the importance of integrating STEAM-based PjBL to enhance environmental awareness, and Mulwandani et al. (2024), who demonstrated the effectiveness of green economy-based PjBL in improving sustainability literacy. In addition, Sari et al. (2025) developed a STEAM-PjBL water purifier kit to train critical thinking skills in water pollution topics, while international research by Espino-Díaz et al. (2025) confirmed that PjBL significantly contributes to students' understanding of the Sustainable Development Goals (SDGs). Susanti et al. (2023) also showed that local potential-based PjBL can improve environmental care attitudes among elementary students. However, these studies have not explicitly highlighted the madrasah ibtidaiyah context with local water issues as the main focus.

Thus, this study occupies a position that supports and complements previous research. While earlier studies emphasized the effectiveness of PjBL in improving cognitive learning outcomes, this research offers novelty by applying PjBL based on local water issues to develop sustainability awareness among elementary madrasah students. This study does not intend to contradict previous findings but rather to expand the scope of PjBL implementation by emphasizing affective dimensions and sustainable attitudes.

The purpose of this study is to analyze the influence of implementing the Project-Based Learning (PjBL) model based on local water issues in the IPAS subject on the sustainability awareness of students at MIN 1 Semarang.

METHODS

This study employed a quasi-experimental design with a *nonequivalent control group design* (Sugiyono, 2021). This design is relevant to examine the influence of implementing Project-Based Learning (PjBL) based on local water issues on students' sustainability awareness. A similar model was used by Rahayu et al. (2025) in their study on differentiated PjBL for elementary students' ecoliteracy, which demonstrated the effectiveness of project approaches in fostering ecological awareness.

The subjects of this study were fifth-grade students of MIN 1 Semarang in the 2025/2026 academic year. Class VA was designated as the experimental group, receiving PjBL instruction

based on local water issues, while Class VB served as the control group with conventional instruction. Sampling was conducted using purposive sampling technique (Arikunto, 2019). A comparable study was conducted by Rahmawati et al. (2025), who emphasized student engagement in STEAM-PjBL based on design thinking to enhance environmental literacy.

The instruments used in this study included:

1. Sustainability awareness questionnaire, developed based on UNESCO (2019) indicators. A similar instrument was used by Abdullah (2025) in the *Journal of Environment and Sustainability Education* to measure students' sustainability awareness.
2. Observation sheets to monitor student engagement during the project, as applied by Rahayu et al. (2025) in their ecoliteracy study using PjBL.
3. Student worksheets (LKPD) based on PjBL, incorporating local water issues such as river pollution, clean water usage, and conservation.

The instruments were validated through expert judgment and tested for reliability using Cronbach's Alpha (Nunnally, 1978).

The research procedure consisted of the following stages:

1. Preparation: Development of instructional tools (lesson plans, worksheets, assessment rubrics) based on PjBL with local water issues.
2. Implementation**:**
   a. The experimental group followed PjBL stages: *start with essential question, design project plan, create schedule, monitor progress, assess outcome, evaluate experience* (Thomas, 2000).
   b. The control group received IPAS instruction through conventional lecture and discussion methods. Rahmawati et al. (2025) also emphasized PjBL stages as a strategy to increase student engagement in environmental issues..
3. Data Collection: Conducted through pretest and posttest questionnaires on sustainability awareness, as well as observation of student activities during the project.
4. Data Analysis:
   a. Normality and homogeneity tests were conducted to ensure data feasibility (Santoso, 2020).
   b. Independent t-test was used to compare results between the experimental and control groups, as applied by Rahayu et al. (2025) in their ecoliteracy study.
   c. N-gain analysis was calculated to determine the improvement in students' sustainability awareness (Hake, 1999).

Data were analyzed quantitatively using statistical software (SPSS). The results of the *t-test* were used to determine the significance of the influence of the PjBL model based on local water issues on students' sustainability awareness. N-gain analysis provided an overview of the relative effectiveness of the instructional intervention. In addition, observational data were analyzed descriptively to support the quantitative findings.

RESULTS AND DISCUSSION

Data collection was carried out through sustainability awareness questionnaires, student engagement observations, and N-gain analysis from pretest and posttest. Quantitative analysis used an independent t-test to compare the results between the experimental and control classes, while observational data were analyzed descriptively to support the quantitative findings.

In general, the results showed an increase in sustainability awareness in both groups; however, the increase in the experimental class was higher and more significant compared to the control class. This can be seen from the average pretest and posttest scores, the N-gain values, and the statistical test results. To clarify these findings, the quantitative data are presented in **Table 1** below.

Table 1. Average Scores of Students' Sustainability Awareness

Group	Pretest (Mean ± SD)	Posttest (Mean ± SD)	N-gain	Category
Experimental (VA)	62.15 ± 8.32	84.72 ± 7.45	0.67	Medium–High
Control (VB)	61.87 ± 7.95	72.34 ± 8.21	0.32	Low–Medium

Interpretation: The experimental class showed a higher increase in sustainability awareness scores compared to the control class, with the N-gain categorized as medium–high.

After observing the differences in the average pretest and posttest scores of both groups, the next step was to test the statistical significance of these differences. An independent t-test was used to determine whether the increase in sustainability awareness in the experimental class was truly significantly different compared to the control class. The statistical test results are presented in

Table 2. Results of Independent t-test

Variable	t-value	Sig. (p)	Description
Sustainability Awareness	4.82	0.000	Significant ($p < 0.05$)

Interpretation: There is a significant difference between the experimental and control classes, indicating that the implementation of Project Based Learning (PjBL) based on local water issues has a real impact on improving students' sustainability awareness.

In addition to quantitative data, this study also involved observations of student engagement during the learning process. The observations were conducted to assess cognitive, affective, and conative aspects based on UNESCO indicators (2019). These observational data provide a more comprehensive picture of how students engaged in the project and how sustainability attitudes were formed. The results of the observations are presented in **Table 3**.

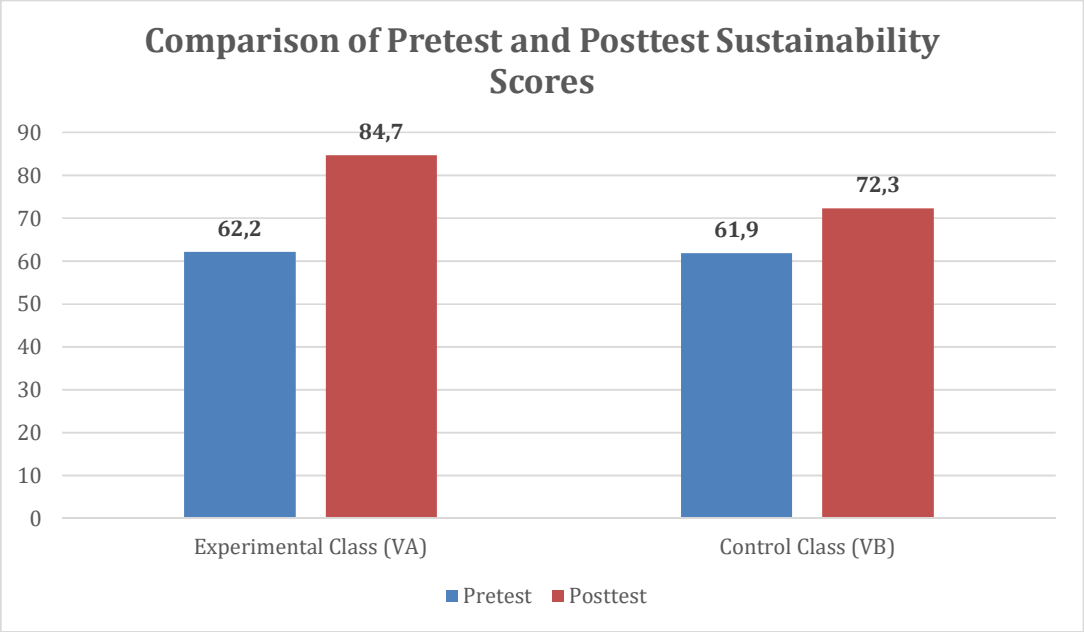
Table 3. Student Engagement Observation

Observation Indicator (UNESCO, 2019)	Experimental (VA)	Control (VB)
Cognitive (concept understanding)	High (actively explaining water pollution, conservation)	Medium (answering teacher's questions)
Affective (caring attitude)	High (commitment to saving water, discussing solutions)	Low (passive, lacking initiative)
Conative (real actions)	Medium–High (bringing water bottles, creating water-saving posters)	Low (minimal real actions)

Interpretation: Student engagement in the experimental class was more dominant in cognitive, affective, and conative aspects compared to the control class.

After the quantitative data were presented in tables, the next step was to provide a visualization to clarify the differences in pretest and posttest scores between the experimental and control classes. This visualization is important so that readers can directly observe the pattern of sustainability awareness improvement that occurred. The following bar chart (Figure

1) illustrates the comparison of pretest and posttest scores in both groups, making it easier to interpret the research findings more intuitively.



The observations presented in Table 1 and Figure 1 show a significant increase in sustainability awareness among students in the experimental class (VA) after the implementation of the Project Based Learning (PjBL) model based on local water issues. The average pretest score of 62.15 increased to 84.72 in the posttest, with an N-gain value of 0.67 categorized as medium–high. In contrast, the control class (VB), which used conventional methods, only experienced an increase from 61.87 to 72.34, with an N-gain of 0.32 (low–medium category).

The visualization in Figure 1 reinforces these findings, where the orange bar (posttest) in the experimental class appears much higher than the blue bar (pretest), indicating a substantial improvement in sustainability awareness. Meanwhile, the difference between the pretest and posttest bars in the control class is relatively small, suggesting that conventional teaching methods have not provided a significant impact on changes in students' attitudes and behaviors related to water issues.

The results of the independent t-test (Table 2), with a t-value of 4.82 and $p = 0.000$ ($p < 0.05$), confirm that the difference between the two groups is statistically significant. This means that the implementation of PjBL based on local water issues has a real effect on improving students' sustainability awareness.

Furthermore, the observation results (Table 3) show that students in the experimental class were more active in project activities such as observing water sources, discussing pollution solutions, and creating water-saving posters. These activities not only enhanced cognitive understanding but also fostered affective attitudes and conative actions that reflect sustainable behavior.

Overall, the integration of quantitative data (tables and charts) and qualitative data (observations) demonstrates that PjBL based on local water issues can foster sustainability awareness holistically, encompassing knowledge, attitudes, and actions. These findings strengthen the position of this research as an empirical contribution relevant to the development of IPAS learning in madrasah ibtidaiyah.

Discussion

The results of this study indicate that the implementation of Project Based Learning (PjBL) based on local water issues has a significant effect on increasing sustainability awareness among madrasah ibtidaiyah students. The increase in sustainability awareness scores in the experimental class, with an N-gain categorized as medium–high, confirms that students' involvement in real projects can foster understanding, attitudes, and sustainable actions. This finding is consistent with the study by Rahayu et al. (2025), which emphasized the effectiveness of PjBL in improving elementary students' ecoliteracy, as well as Susanti et al. (2023), who showed that PjBL based on local potential can foster environmental care attitudes.

The affective and conative dimensions that emerged in this study reinforce the view that sustainability awareness is not sufficient if limited to cognitive knowledge. Students in the experimental class demonstrated real commitments to saving water and simple actions such as bringing their own drinking bottles. This aligns with the international study by Espino-Díaz et al. (2025), which highlighted that PjBL contributes significantly to university students' understanding of the Sustainable Development Goals (SDGs), and Alamri et al. (2023), who found that PjBL holistically enhances environmental literacy among elementary students.

Furthermore, this study provides novelty by focusing on local water issues in madrasah ibtidaiyah, which have rarely been examined. Previous studies have mostly emphasized cognitive aspects or the application of PjBL at the secondary level, as shown by Melindawati et al. (2025) in their literature review on PjBL IPAS implementation to support SDGs. By emphasizing local water issues, this study expands the scope of PjBL application by highlighting affective dimensions and sustainable attitudes, making it more relevant to community needs.

The findings also support the integration of PjBL with the STEAM approach. Anggraini & Herwin (2025) demonstrated that STEAM-PjBL activity-based learning can improve students' environmental awareness, while Sari et al. (2025) developed a PjBL-based water purifier kit to train critical thinking skills in water pollution topics. This study strengthens the evidence that local water issues can serve as effective project contexts to foster sustainability awareness while simultaneously training 21st-century skills such as critical thinking, collaboration, and problem solving.

Conceptually, the results of this study affirm that PjBL based on local water issues is relevant to the SDGs, particularly Goal 6 (Clean Water and Sanitation). This is consistent with Winarti et al. (2025), who emphasized the importance of water sustainability projects in raising awareness among preservice elementary teachers, and Abdullah (2025), who developed PjBL instruments to measure students' sustainability awareness. Thus, this study not only provides empirical contributions in the context of madrasah ibtidaiyah but also strengthens the global literature on project-based sustainable education.

However, this study has limitations as it was conducted in a single madrasah with a limited sample size. The generalization of results still needs to be tested in broader contexts and with cross-subject integration. Future research could develop PjBL based on water issues with interdisciplinary approaches, for example by integrating green economy aspects as shown by Mulwandani et al. (2024), or linking to climate change issues as studied by Rahmawati et al. (2025) through STEAM-PjBL with design thinking.

Overall, this discussion confirms that the implementation of PjBL based on local water issues can foster students' sustainability awareness holistically, encompassing cognitive, affective, and conative aspects. These findings reinforce both national and international literature while providing new contributions in the context of madrasah ibtidaiyah, with a focus on local water issues that are highly relevant to students' everyday lives.

CONCLUSION

This study demonstrates that the implementation of Project Based Learning (PjBL) based on local water issues has a significant effect on improving sustainability awareness among madrasah ibtidaiyah students. The improvement occurred not only in the cognitive aspect, such as understanding the concepts of water pollution and conservation, but also in the affective dimension through caring attitudes, and in the conative dimension through real actions in daily life. Thus, PjBL with a local water issue context is able to foster sustainability awareness holistically, making it relevant to the needs of the surrounding community.

Conceptually, this study expands the scope of literature on the effectiveness of PjBL by emphasizing affective and conative dimensions that have previously received less attention. The impact of this research lies in its contribution to the development of IPAS learning strategies in madrasah ibtidaiyah that support the achievement of the Sustainable Development Goals (SDGs), particularly Goal 6 on clean water and sanitation. By focusing on local water issues, this model not only enhances the quality of learning but also helps shape young generations with sustainability awareness from an early age.

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