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Analysis of the Role of the Adiwiyata Program on Students' Science Literacy: A Case Study at Adiwiyata Schools in Bogor Regency

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Abstract: The purpose of this study was to analyze the science literacy aspects of junior high school students and to analyze the role of the Adiwiyata Program in the science literacy of junior high school students in Bogor Regency. The study was conducted in three public schools with Adiwiyata levels: Provincial, National, and Independent. The method used in this study was a mixed-method, sequential, explanatory design, beginning with the collection of quantitative data through science literacy tests, followed by qualitative data collected through interviews, questionnaires, observations, and documentation to clarify the quantitative findings. The results showed that the higher a school's Adiwiyata level, the higher its students' science literacy competency. Independent Adiwiyata schools had low science literacy competency, followed by Provincial Adiwiyata schools, with very low competency, and National Adiwiyata schools, also with very low competency. Qualitative analysis revealed that this achievement was influenced by the integration of the Adiwiyata program into learning, particularly in project-based classroom activities; the integration of Adiwiyata into the school curriculum; and a school culture that facilitates environmentally friendly behavior. The Adiwiyata program can improve students' science literacy by integrating project-based learning, school ecosystem management, and contextual scientific practices. The obstacles identified were the lack of integration of the Adiwiyata program into learning and the curriculum, which reflected the limited use of environmental activities as resources. This study recommends strengthening teacher capacity, developing project-based teaching materials, and more systematic curriculum integration to increase the impact of the Adiwiyata Program on student science literacy in the future.

Keywords: Adiwiyata program; Adiwiyata school; Science learning; Science literacy

Introduction

Education plays an important role in shaping knowledgeable, well-characterized human resources with a concern for the environment. The modern era is characterized by the advancement and development of science and technology (S&T), which affects science literacy, one of the competencies students need to master. In PISA, the OECD (2023) explains that science literacy is the ability to use scientific knowledge to formulate questions, draw conclusions from evidence, and understand the role of science in everyday life. This definition emphasizes that students' scientific literacy is not limited to conceptual understanding but also encompasses critical thinking, scientific reasoning, problem-solving, and data-based decision-making. All of these abilities are synonymous with the demands of 21st-century skills.

This view is reinforced by Pertiwi et al. (2026), who state that educators need to have digital

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competencies to support science literacy-based learning. In line with this, Yunita et al. (2025) also emphasize that collaboration, creativity, and problem-solving skills are key in today's science learning, where science literacy serves as the foundation for their development. This opinion is also reinforced by Syahidi et al. (2022), who state that strengthening science literacy, integrated with character education, can produce students who excel academically and possess good morals and scientific attitudes (Arif, 2009; Muliyadi et al., 2026). Thus, schools, as education providers, play an important role in fostering students' science literacy through meaningful, relevant learning that is close to students' real experiences.

One concrete example of the application of contextual learning is the Adiwiyata program. This program is a government effort to provide environment-oriented education while fostering a character that cares for nature. The main objective of Adiwiyata is to create schools with a strong, sustainable environmental culture by involving all school stakeholders in managing a clean, healthy, and sustainable environment (Ministry of Environment and Forestry, 2023). With these characteristics, this program is an appropriate medium for integrating science literacy through activities grounded in real experiences. environment. Its implementation is expected not only to become a routine agenda item but also to serve as a means of contextual learning that connects scientific theory with direct field experience (Doyan et al., 2026). Through field-based science learning activities, such as observing species, documenting findings, and analyzing school environmental conditions through citizen science projects, it is possible to improve students' sustainability literacy in Adiwiyata (green) schools (Hamidah et al., 2020; Coyle, 2005).

Adiwiyata schools have written policies on environmental management, integrate environmental issues across various subjects, involve the entire school community, and implement programs to support environmentally friendly facilities and infrastructure (Acu, 2011). The Adiwiyata school title is based on an assessment given by the Ministry of Environment in the form of a tiered and selective award to Adiwiyata schools, starting from the lowest level, which is the district Adiwiyata category, then the provincial Adiwiyata, then the national level, and the highest level, which is the independent level. According to Minister of Environment Regulation No. 53 of 2019 concerning the awarding of Adiwiyata schools, it refers to the points of the Movement for Environmental Care and Culture in Schools (GPBLHS) as stated in Minister of Environment Regulation No. 52 of 2019, which contains the following four components: (1) environmentally-friendly school policies, (2) environment- based curriculum, (3) participatory school activities, (4) management of environmentally friendly facilities and infrastructure. Awards are given to schools that have successfully implemented the school environmental awareness and culture movement (GPBLHS), which consists of conscious, sustainable actions taken by schools to promote environmentally friendly behavior. The difference in levels can be seen in the school's assessment results: the district-level award is given if the school has met 70% of the four components, and the provincial Adiwiyata award is given if the school has achieved 80% and has been a district/city Adiwiyata school for at least 1 year. Furthermore, the national award category is obtained if the school has successfully achieved a 90% assessment and has been a provincial Adiwiyata school for at least 1 year. Finally, the independent Adiwiyata school award (the highest level) will be obtained if the school has previously achieved the national category and has successfully fostered 5 impact schools to become district/city Adiwiyata schools.

The implementation of environmental awareness and cultural movements in schools includes the application of Environmentally Friendly Behavior (PRLH), energy conservation, water conservation, programs integrated into subjects, extracurricular activities, co-curricular activities, sanitation and drainage, greening of the school environment such as planting and maintaining trees, and innovations related to PRLH (Regulation of the Minister of Environment Number 53 of 2019).

However, several studies show that the implementation of the Adiwiyata program in schools has not been fully effective in supporting the learning process, especially in science. Suprapto et al. (2023) found that many schools still emphasize administrative and physical aspects, but this has not been followed by real integration into science learning. This was also found by Sunarto (2023), who stated that the integration of environmental activities and science concepts in the classroom is still limited. Furthermore, Rizalie (2022) found that Adiwiyata is often positioned as an additional program, rather than a strategic part of learning planning aimed at strengthening students' science literacy (Wibowo, 2009). The results of a study by Pahleviannur (2024) also indicated that the contribution of the Adiwiyata program to improving students' science abilities remains low due to suboptimal implementation of environment-based learning innovations by teachers.

Bogor Regency is one of the regions in West Java Province with a large number of schools with Adiwiyata status, both at the regency, provincial,

national, and independent levels. These various levels indicate that the implementation of the Adiwiyata program in each school has different characteristics and application quality, while also opening up research opportunities to examine the extent to which these variations in Adiwiyata levels impact the development of students' science literacy at the junior high school (SMP) level (Adisendjaya, 2007; Januarti et al., 2024; Muliyadi et al., 2026). This study focuses on three public junior high schools in Bogor Regency, each with a different level of Adiwiyata achievement, to provide a more complex picture of the role of the Adiwiyata program in improving science literacy.

Based on this description, the main objective of this study is to analyze students' science literacy and analyze how the Adiwiyata program plays a role in natural science (IPA) learning in improving the science literacy of junior high school (SMP) students. The results of this study are expected to serve as a reference and contribute to the development of environment-based science learning, and can be used as a basis for consideration by local governments and schools to strengthen the implementation of Adiwiyata in a more consistent and sustainable manner in the future.

Method

This study used a mixed-methods approach with a sequential explanatory design, a research procedure that begins with collecting and analyzing quantitative data, followed by collecting and analyzing qualitative data to support, clarify, and interpret the initial findings (Creswell, 2014; Creswell & Plano Clark, 2018). In the quantitative stage, the main data was collected through a science literacy test. The instrument used was a multiple-choice test with 10 questions on temperature and heat. These questions were validated by Budiman et al. (2022) and contained three indicators of science literacy competency according to the OECD in 2019, namely: (1) explaining scientific phenomena, (2) evaluating and designing scientific investigations, and (3) interpreting data and evidence scientifically. In 2025, the OECD changed these indicators by combining indicators (2) and (3), so that the current science literacy indicators for 2025 are (1) Explaining scientific phenomena, (2) Designing and evaluating designs for scientific investigations and critically interpreting scientific data and evidence, and (3) Researching, evaluating, and using scientific information for decision-making and action as instruments to measure students' science literacy abilities in the context of science. This instrument was used because it includes indicators aligned with the PISA science literacy framework and relevant to junior high school science competencies (Budiman et al., 2022; Firman, 2007; Scholz, 2011). The research was conducted in public junior high schools in Bogor Regency that have Adiwiyata status at different levels, namely: (1) Public junior high school with Provincial Adiwiyata status (1 school). (2) Public junior high schools with national Adiwiyata status (1 school), and; (3) Public junior high schools with Independent Adiwiyata status (1 school).

This study was conducted in three public junior high schools with different Adiwiyata categories, allowing the researcher to make comparisons to see the relationship between the Adiwiyata level and the development of students' science literacy (Krnel, 2009; Susilawati et al., 2025). The schools were selected purposively because the three locations were considered capable of representing variations in the implementation of the Adiwiyata program. In its implementation, this research involved several respondents: the school principal, the Adiwiyata program coordinator, science teachers for grades VII to IX, and grade VII students involved in environmental activities during science learning at school.

The collection of qualitative data in this study aims to strengthen the interpretation of quantitative data, as suggested in the design. sequential explanatory, in which qualitative data serve to explain in depth the statistical patterns found in the first stage (Ivankova et al., 2006). The qualitative data collection process included direct observation of the school environment to examine the actual implementation of the Adiwiyata program, in-depth interviews with the principal, and the distribution of questionnaires to Adiwiyata coordinators, teachers, and students to obtain information on their perceptions, experiences, and involvement in a science-based learning environment. Observations are used to observe school culture and how the Adiwiyata program is implemented in daily learning activities. On the other hand, interviews provide a space to explore further the experiences, strategies, and challenges in implementing the program (Sugiyono, 2019).

Table 1. Criteria for Science Literacy Achievement

Score Range (%)	Category
80-100	Very high
66-70	High
56-65	Moderate
41-55	Low
≤ 40	Very low

Quantitative data analysis was conducted using descriptive statistics. According to Sugiyono (2017), descriptive statistics are used to analyze data in their original condition without generalizing. In other words, this study presents information as it is and does

not require inference. The data obtained from the students' science literacy test results will be converted to percentages using the following calculation: the score obtained is compared to the maximum score, then multiplied by 100. Furthermore, the level of students' science literacy achievement is interpreted descriptively using the assessment reference from Arikunto (2021) in Table 1.

Furthermore, the author will analyze the students' scientific literacy test results and refer to the two scientific literacy competencies according to OECD/PISA (2025), as shown in Table 2 (Putri et al., 2025; OECD, 2009; Rustaman, 2011).

Table 2. Science Literacy Competence

Indicators	Science Process Achievement
Explaining phenomena scientifically	Considering, applying scientific knowledge
	Using various forms representing and translating them
	Creating and validating appropriate scientific
	Identifying, building, and evaluating models, and
	Explaining the potential implications of scientific knowledge for society.
Design and evaluate designs for scientific investigations and critically interpret scientific data and evidence	Identify questions in the scientific study provide
	Evaluating the most relevant experimental design to answer the questions.
	Interpret the data presented in various representations, draw appropriate conclusions from the data, and evaluate their relative merits.

In addition, science literacy analysis was conducted using the criteria for science literacy levels from the 2022 PISA framework, with adaptations to the value ranges shown in Table 3.

Table 3. Science Literacy Level Criteria

Score Range (%)	PISA Level
80-100	Level 5-6
61-80	Level 3-4
41-65	Level 1-2
21-40	Below level 1
0-20	Non-Literat

Qualitative data analysis, conducted through interviews, observations, and questionnaires on the Adiwiyata school program, was carried out using four components of the Adiwiyata program indicators, as presented in Table 4 and in accordance with Minister of Environment Regulation No. 52 of 2019.

Table 4. Adiwiyata Program Indicator Components

Number	Adiwiyata School Program Indicators
1	Environmentally conscious policies
2	Implementation and development of an environment-based curriculum
3	Participatory environmental activities
4	Management of environmentally friendly supporting facilities

Furthermore, data analysis was conducted by integrating quantitative and qualitative results using a mixed-methods approach, resulting in a comprehensive understanding of the relationship between the school's Adiwiyata level and students' scientific literacy skills (Creswell, 2014; Arikunto, 2010). The research process included three main stages: (1) Preparation stage, including research permits and the preparation of data collection instruments. (2) Implementation stage, namely collecting data from the three schools through scientific literacy test sheets, interviews, observations, questionnaire distribution, and documentation. (3) Analysis and reporting stage, namely data analysis, preparation of research findings, and preparation of the final report.

Result and Discussion

The results of the analysis of the average science literacy test scores of students from the three Adiwiyata schools are presented in Table 5.

Table 5. Percentage of Science Literacy Achievement

Level	Percentage (%)	Adiwiyata Category
Independent	54.5	Low
National	34.5	Very Low
Province	42.5	Very Low

Shows that schools with an Independent Adiwiyata level have the highest achievement percentage compared to the other two schools. Next, the results of the analysis of student science literacy indicators are presented in the following Figure 1.

This study was conducted with 60 students, 20 from each school. Figure 1 shows the percentage distribution of students' science literacy indicators across schools in the three Adiwiyata program categories: Mandiri, Nasional, and Provinsi. Based on Figure 1, the three schools in the Mandiri, Nasional, and Provinsi categories are dominated by indicators of scientific explanation. The highest percentage was found in Adiwiyata Provincial schools, with a score of

68%, which is classified as moderate, followed by Adiwiyata Independent schools, with a score of 65%, while schools with Adiwiyata National status ranked last, with a score of 58%. Next is the analysis of indicators for designing and evaluating scientific investigation, and for critically interpreting evidence. The results obtained were lower than the previous indicators. The highest percentage was achieved by Adiwiyata Mandiri schools at 48%, although this was still in the low category. Provincial schools ranked second after Adiwiyata Mandiri with a percentage of 27%, followed by Adiwiyata Nasional with 19% in last place, in a very low category. This shows that the achievements in Adiwiyata Mandiri schools are relatively good. Overall, Figure 1 shows that students' ability to understand and explain scientific phenomena has developed sufficiently, but the indicators of designing and evaluating scientific investigation designs and of interpreting evidence critically still need attention and reinforcement, as they require a higher level of thinking. Students need to strengthen project-based learning practices, especially environment-based projects in Adiwiyata schools. This aligns with the findings of Hamidah et al. (2025), who found that junior high school students tend to be stronger in factual and conceptual knowledge but weaker in advanced scientific process skills, such as formulating hypotheses, designing experiments, and interpreting data. The data analysis on the science literacy level criteria is shown in Figure 2.

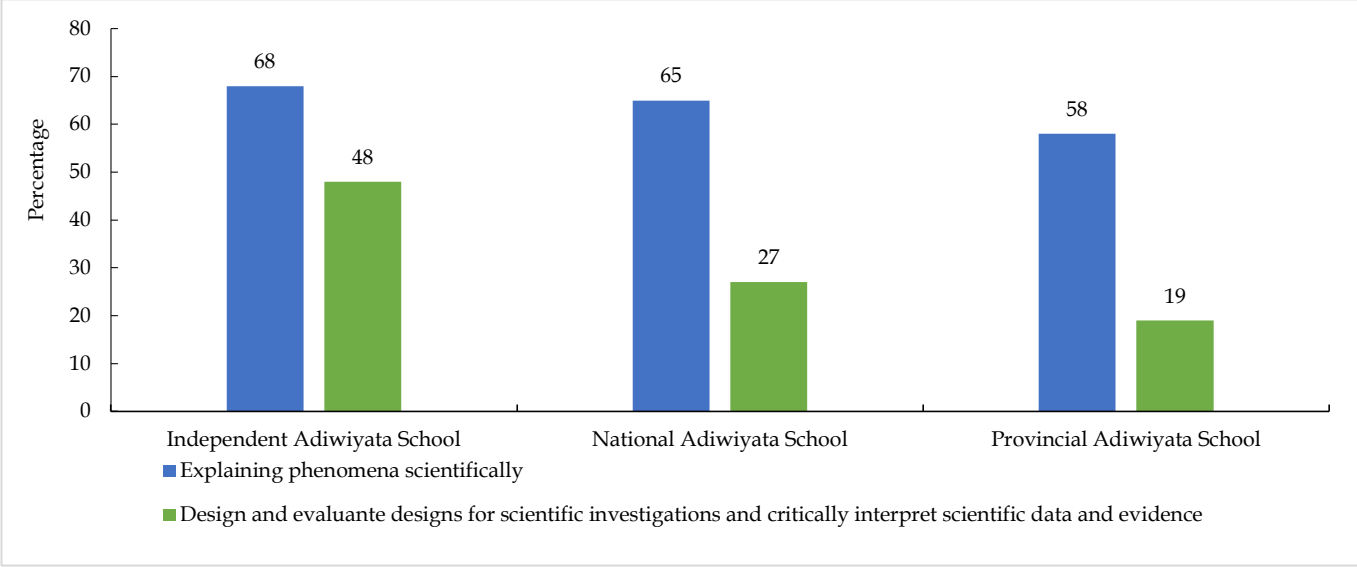


Figure 1. Comparison of science literacy achievement percentages based on science literacy indicators from three Adiwiyata schools

The results of the quantitative analysis of science literacy levels in the three categories of Adiwiyata schools, namely Independent, National, and Provincial, at six achievement levels are shown in Figure 2. In general, Figure 2 confirms that most students are still in the category below level 1, while the middle to high levels are not yet significantly apparent. These results indicate that students' overall science literacy skills are still largely at a basic level.

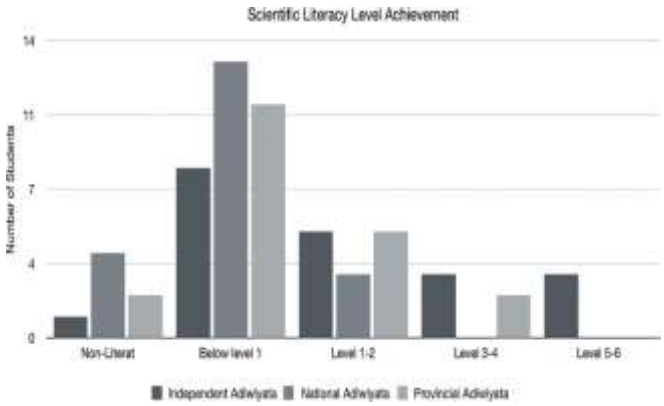


Figure 2. Comparison of the percentage of science literacy level achievement from three Adiwiyata schools

Achievement levels below level 1 are dominated by National Adiwiyata schools, followed by Provincial and Independent Adiwiyata schools. This shows that, even though their Adiwiyata status is higher, it has not

yet reflected an increase in student competence. Furthermore, at the non-literate level, the majority of schools have relatively few students. This indicates that scientific awareness has already been formed but has not yet developed into a more optimal understanding.

Provincial-level Adiwiyata schools showed fewer students achieving levels 1-2, indicating that students at these schools have begun to develop a functional understanding of how to solve simple science problems. However, the number of students declined again at levels 3 and 4. Science literacy levels 3-4 are only achieved by Independent and Provincial Adiwiyata schools. This shows that students' analytical skills at higher levels remain a challenge.

Furthermore, only students from independent Adiwiyata schools achieved science literacy criteria levels 5-6, although the percentage was small. This shows that schools with the highest Adiwiyata status have the potential to improve students' science literacy skills. These results also indicate that the school environment, the Adiwiyata program, and the culture of Adiwiyata Mandiri schools are more effective at encouraging students to develop higher-level thinking skills. Thus, it can be concluded that the data in graph 2 indicate the need to strengthen science literacy among the three Adiwiyata schools, as some students are still at the basic level. One school has reached a high level, so more attention is needed to expand learning strategies and school support, and enable more students to reach a high level.

The results of the study indicate that the level of Adiwiyata implementation significantly affects how students experience the science learning process at school. Findings from three schools in the Independent, National, and Provincial categories through qualitative data also show differences in the integration of environmental education into science learning and its impact on students' science literacy skills, particularly in understanding concepts, sensitivity to environmental issues, and the ability to relate subject matter to real conditions in the surrounding environment.

The following presents qualitative data in Table 6, which compares the Adiwiyata programs of the three schools based on the components of the Adiwiyata program indicators.

Table 6. Program Comparison

Component	Independence	National	Province
Environmentally conscious policies	Vision and mission oriented toward the environment, written policies such as bringing your own eating/drinking utensils, nosmoking, energy conservation, waste management.	Implementation of a clean and healthy, beautiful, green, and enjoyable culture.	Environment- based vision and mission.
Implementation and development of an environment-based curriculum	Integration of environmental education into subjects, environment-based learning methods.	Integration of environmental material into the learning process.	Integration of environmental materials into learning.
Participatory environmental activities participatory	Class duty, cleanliness (class cleanliness competition), clean Friday. Existence of waste bank composting. Recycling oil into soap and candles, coffee soap, etc. Greenhouses & TOGA (growing vegetables, fruits, medicinal plants, and producing crops), student innovations from garden produce.	Forming Adiwiyata cadres (active students), mobilizing the All school members play an active role in caring for the entire school community to get involved.	All school members play an active role in caring for the school environment.
Management of environmentally friendly supporting facilities and infrastructure	Waste sorting (organic and inorganic), TOGA garden, greenhouse, water absorption, water conservation (school gutters turned into ponds), healthy canteen, clean toilets, plastic-free zone.	Planting colorful ornamental plants, greenhouses, and togas. Waste management (3R), laboratory duty, classroom cleanliness, smoke-free areas. Energy (water, electricity) & paper conservation.	There is a healthy canteen, chemical-free food, no plastic packaging, students bring their own eating utensils. Clean toilets, yielded the following waste water is used to water the garden.

Qualitative data analysis reveals that at the Mandiri Adiwiyata school, the implementation of the Adiwiyata program is more mature and systematic than at the other two schools. The school has a written policy, in the form of a principal's rule, requiring students to bring their own eating utensils to reduce plastic waste and save energy. Program integration is also found in the school curriculum in the form of integrated science learning (an integrated Adiwiyata learning design was found). Student activities can also be seen in active, project-based participation, such as composting, turning used cooking oil into candles, and cultivating herbs, fruits, and hydroponic plants in greenhouses for harvest. This school has a fairly high level of productivity and has had a direct impact on the school community. This is evidenced by the sales of hydroponic vegetables and educational visits from partner schools. These participatory activities provide students with opportunities to observe, experiment, and think scientifically through contextual learning.

These results align with the research by Amini et al. (2020), which found that students' science literacy increases significantly when learning integrates inquiry and problem-solving activities grounded in the environment. This is evident in the science literacy test scores, which show that Mandiri School has better results than the other two schools, even though the average score remains in the low range at 54.5. The distribution of scores ranged from very low (45%) to very high (15%), indicating that although some students had high competence, the overall consistency of science literacy mastery still needed improvement. Documentation of these activities is shown in Figures 3 and 4.



Figure 3. Student activities: planting medicinal plants



Figure 4. Student activities making organic fertilizer



Figure 5. A gazebo on a terraced location called ngopi (smart chat)



Figure 6. Simple greenhouses

At the National Adiwiyata level school, the implementation of the Adiwiyata program has been consistent, although on a smaller scale compared to the Independent level. The school has also implemented a clean, healthy, and green culture, as well as policies to maintain a comfortable environment. The integration of environmental education materials is already underway, but has not yet reached the depth of the scientific process as seen in Adiwiyata Mandiri schools. Learning activities are more focused on simple activities, such as waste management, practicing

healthy habits, and using certain plants to make simple products, such as butterfly pea flower juice. These activities are assisted by Adiwiyata cadres as drivers of environmental activities. These activities can support environmental awareness, but they do not yet provide a comprehensive scientific practice experience, such as interpreting experimental data or developing scientific arguments. This is reflected in students' average science literacy score, which is very low at 34.2, with 50% at a very low level and only 5% at a moderate level. These results reinforce the findings of Fatmawati et al. (2023), who stated that the success of the Adiwiyata program in improving science literacy is greatly influenced by schools' role in providing space for students to conduct scientific exploration, critical discussion, and data-based analysis. Several supporting facilities for science literacy activities in national Adiwiyata schools are shown in Figures 5 and 6.

Adiwiyata schools at the provincial level have already implemented the Adiwiyata program. This implementation can be seen at the basic level, namely the availability of environmentally friendly facilities. Other aspects can also be seen in school policies, such as an environment-based vision and mission, waste sorting, and healthy canteens that are free of chemicals and plastic. The integration of the Adiwiyata program into learning is still in its early stages, such as encouraging students to keep their classrooms clean, and there are no products or projects resulting from waste management. Therefore, provincial Adiwiyata schools still need to develop or innovate project-based learning products to support the integration of the Adiwiyata program into the learning process. Activities to cultivate a clean, healthy environment are very important for shaping a culture of environmental awareness, but they have not yet affected the development of students' scientific skills. This condition aligns with the opinion of Azrai et al. (2017), who state that a strong positive attitude towards the environment does not necessarily affect students' understanding of scientific concepts or thinking skills if the school has not integrated environmental issues into planned scientific activities. This is supported by the findings of student science literacy tests, which received an average score of 42.5 in the low category, with 65% scoring very low. It can be concluded that the Adiwiyata program has not had a significant impact on conceptual mastery, the ability to conduct simple investigations, or the ability to relate science material to everyday problems. The following are the findings of several observations of the vision and mission of schools and green parks in the school environment, as shown in Figures 7 and 8.



Figure 7. Environmentally aware policies in the school's vision and mission



Figure 8. Park conditions around the school environment

Qualitative data findings from the science teacher questionnaires for grades 7 to 9, student questionnaires, open questionnaires for Adiwiyata coordinators, and principal interviews all reinforce the previous data interpretation. Teachers from all three schools agreed that science learning outcomes were not as expected and that teachers did not have teaching materials specifically designed to support students' science literacy development. Another point found was that there are no teaching materials that integrate Adiwiyata content, such as steps for activities that support the integration of subjects with the school environment. According to Kurdaningsih et al. (2025), science literacy and character education are very important and can be integrated into science learning in the 21st century. Furthermore, qualitative data on the condition of school laboratories indicated that they were not functioning optimally, as some were being temporarily used as classrooms. Other schools stated that their constraints were the excessive number of students (40 to 45 students per class) and the fact that the rooms were shared with student council activity rooms, resulting in a lack of equipment and difficulty in managing students in the laboratory. Only one school had a functional laboratory.

Several teachers also admitted that they want to use innovative technology-based learning media,

especially in science learning, such as Augmented Reality (AR), as long as they are easy to use. This condition is also supported by students' statements, most of whom have devices they can bring when needed for learning. The school has also received government assistance in the form of Interactive Flat Panels (IFPs) that students can use together.

Augmented Reality (AR) is a technology that can be integrated into science teaching materials because it combines virtual objects with real environments, making science learning more contextual. According to Billinghurst et al. (2021), AR can visualize scientific phenomena that are difficult to observe directly (abstract), such as natural phenomena and microscopic processes. This can help overcome the limitations of laboratory functions while also assisting in the integration of the Adiwiyata program into project-based learning.

In addition, interviews with school principals revealed that the implementation of the Adiwiyata program at the Mandiri level appears to be more comprehensive and complex. This is clearly evident in the school principals' policies through school regulations, curriculum strengthening, environmentally friendly policies outlined in the vision and mission statements, morning activities, and posters throughout the school environment. Programs based on participatory activities have also been widely implemented, including programs for developing and implementing an environment-based curriculum through the integration of science learning with a context that remains limited to certain materials and is not yet comprehensive. This is very different from schools in the National and Provincial categories, where the majority of integration remains limited to a healthy environmental culture in learning and does not specifically address the context of learning materials. These activities can be used to develop students' science literacy because they align with 21st-century skills, namely the ability to understand concepts, interpret data, understand environmental phenomena, and communicate evidence-based arguments (OECD, 2023).

Based on the above description, the overall results of this discussion show that schools with higher Adiwiyata categories have greater opportunities to create learning environments and learning resources that support the development of science literacy through the integration of the Adiwiyata program into science learning, especially through project/practical activities.

However, the fact that most students' science literacy scores are still in the low category indicates that the Adiwiyata program has not been maximally effective in supporting the development of science literacy without comprehensive and structured learning support, such as the unavailability of Adiwiyata project-based teaching materials, including science literacy context materials, teacher training to facilitate effective scientific learning in a laboratory setting or with the help of technology such as Augmented Reality (AR).

Based on the research conducted, this study has limitations in terms of sample size, as the sample consisted of only 60 students from three schools with different Adiwiyata categories. This may affect the results, which may not be generalizable to a larger population. In addition, there are limitations in the answers to the teacher and student questionnaires, as respondents' responses can be subjective, meaning these results do not comprehensively describe the actual conditions. This may be due to differences in understanding or honesty when filling out the questionnaire. Therefore, it is hoped that future studies will increase the number of samples and research participants and complement the research instruments through interviews with teachers and students.

Conclusion

The results of this study conclude that the Adiwiyata Program at the junior high school level in Bogor Regency improves students' science literacy, but this impact is highly dependent on the implementation and extent of program integration into the science learning process. Independent Adiwiyata schools make the most significant and prominent contribution, as seen in project-based environmental activities and learning activities that directly utilize the real school environment. These activities create students accustomed to scientific practices such as observing, formulating problems, developing hypotheses, and drawing conclusions. However, the overall science literacy test results are still not optimal, as evidenced by the majority of scores still in the low category, indicating that the Adiwiyata program needs to be continued and continuously improved, supported by teachers and teaching materials that facilitate a consistent scientific integration learning process.

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