International Journal of Multidisciplinary Research of Higher Education (IJMURHICA)
http://ijmurhica.ppj.unp.ac.id/index.php/ijmurhica

Environmental Awareness Education Program for Students in Realizing SDGs 12

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Article Information:
Received Juni 10, 2025
Revised July 18, 2025
Accepted August 28, 2025

Keywords: *Government collaboration, plastic waste management, environmental awareness, adiwiyata, youth generation*

Abstract

Plastic waste in school environments is not just a matter of cleanliness, but also a reflection of how we educate children to care for and take responsibility for the environment from an early age. In one of Indonesia's major urban areas, schools play an important role as learning spaces and places for instilling sustainable living values. Through the Adiwiyata program and the Pancasila Student Profile Strengthening Project, children are encouraged to learn while taking action to manage waste, maintain cleanliness, and understand the impact of their choices on the environment. This study is important to assess how far these efforts have progressed, what has been successful, and what challenges still need to be addressed collectively. This research aims to examine how cross-sector collaboration between the government, schools, communities, businesses, and the media plays a role in plastic waste management at one of Indonesia's senior high schools. Using a qualitative approach and case studies, data was collected through interviews with the Tangerang Selatan Environmental Agency (2 individuals), the Community (2 individuals), students (20 individuals), and teachers (3 individuals). The results of the study show that the active involvement of all parties not only fosters an environmental culture in schools but also provides students with opportunities to act as agents of change. They learn to sort, process, and creatively address environmental issues. However, challenges such as insufficient teacher training, uneven distribution of roles among institutions, and weak integration of programs into the curriculum still need to be addressed. The implications of these findings suggest that consistent active involvement and commitment from all parties can lead to improved plastic waste management in schools, supported by adequate policies and teacher training in the teaching and learning process.

INTRODUCTION

Plastic waste is the biggest enemy for all groups, as it is difficult to decompose and harmful to the surrounding environment (Megha et al., 2025). Plastic waste accounts for the second largest national waste after food waste at

How to cite: Septiaty, E., Fadli, Y., Aditya, T., Chumaedy, A., Nurlukman, A. D. (2025). Environmental Awareness Education Program for Students in Realizing SDGs 12. *International Journal of Multidisciplinary of Higher Education (IJMURHICA)*, *8*(4), 671-683.

E-ISSN: 2622-741x
Published by: Islamic Studies and Development Center Universitas Negeri Padang

39.82%, while plastic waste accounts for 19.19%. In North America, Japan, and Australia, waste grinding practices have caused issues with wastewater drainage systems (Bolzonella et al., 2003). Plastic contaminates soil and groundwater as it decomposes, taking 100 to 500 years to break down, pollutes the air through burning, and damages marine ecosystems The negative impacts can also be seen when a whale a large amount of plastic waste was found in its stomach. Air pollution caused by plastic waste also occurs resulting in black smoke and poor air quality, leading to respiratory issues and exacerbating the already concerning environmental crisis.

Source: Ministry of Environment, 2023

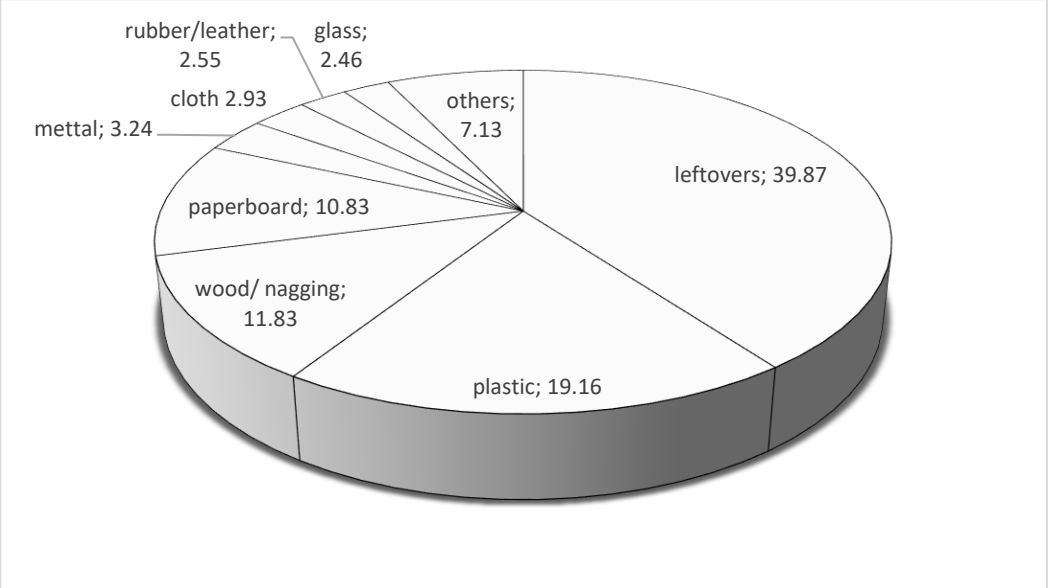

Fig 1. National waste data

With the increasing number of cases involving plastic waste, it has become a global concern, such as the establishment of the organization Avfall Norge Waste Management and Recycling Association in Norway in 1986 (DeLuca, 2009). In Argentina, the Delterra organization was established in 2018, also focusing on plastic waste concerns. The Indonesian government has also taken action through the Zero Waste Indonesia Alliance, Waste4 Change, and the Greenpeace International Campaign, which analyze various international issues such as climate/energy, oceans, forests, toxins, and sustainable agriculture. Meanwhile, the Tangerang Selatan city government has also taken serious action on plastic waste, encouraging residents of Cisauk District to form a waste picker cooperative supported by Danone Aqua as a pioneer in recycling and collecting used plastic bottles In addition, the South Tangerang City government provides education on the three R Reduce, Reuse, Recycle to the community regarding waste, and the city government also provides a Reduce, Reuse, Recycle Waste Processing Facility and a waste bank This shows the government's collaboration with the environment. Waste management in Tangerang Selatan City is not only targeted at the general public but also at school students through the Adiwiyata program. Ministerial Regulation No. 52 of 2019 on the Movement for Environmental Care and Culture in Schools, developed in collaboration with the government, strengthens this program.

The government's collaboration in waste management has resulted in the Adiwiyata program, which is implemented in schools in accordance with South Tangerang Mayor Regulation No. 9 of 2016 concerning the

Implementation of the Adiwiyata Program. One school in Tangerang Selatan is implementing waste management activities through the Pancasila Student Profile Strengthening Project, creating crafts from plastic waste. The activity of making crafts from plastic waste aims to reduce plastic waste in the school environment. The results of these crafts made from plastic waste include piggy banks, pen holders, or pencil holders, and other multi-purpose items.

Discussions on waste management have been conducted extensively, such as community-based waste management strategies (Emynorane et al., 2024; Luh Gede Mita Laksmi Susanti & Arsawati, 2021). Sustainable waste management in urban areas (Pratama & Musthofa, 2019; Puspitasari et al., 2022; Shahreza et al., 2020; Wati et al., 2021). the effectiveness of waste management policies based on the 3R principle. Waste management through the Silampah program environmental communication in waste management at waste banks Modernization and innovation in community-based waste management waste management based on ecopreneurship creating economic value Implementation of the zero-waste program (Pranata & Zibair, 2022). Research on environmental management programs at the educational institution level in the context of policy and governance studies is still rare, and this paper should be a focus for the Indonesian House of Representatives, particularly in the field of the environment, to review plastic waste management and collaborate with several sectors, such as waste communities and educators, to educate the younger generation, starting in schools. Based on the above discussion, the question arises: how does government policy intervention in plastic waste management programs within school environments impact environmental awareness among secondary school students.

The limitations of the government's reach in addressing environmental issues by involving several stakeholders –Collaborative governance– such as the community, government, and private sector, which are developed in the form of sustainable public policy consensus (Bianchi et al., 2021). There are several concepts of collaborative governance, such as triple helix, quadruple, and penta helix. The triple helix was developed Etzkowitz and Leydesdorff to describe the relationship between universities, government, and business actors—academic, business, and government The quadruple helix adds the "public" element to academic, business, and government (Leydesdorff, 2012; Park, 2014; Sulikah et al., 2021). Meanwhile, the penta helix involves five sectors: education, business, society, government, and media. developed dimensions of collaboration, consisting of initial conditions, institutional design, leadership, collaboration processes, and outcomes. The initial conditions for collaboration include institutional history, stakeholder interests, and collaboration objectives Facilitative leadership includes establishing clear ground rules, building trust, and facilitating discussions among stakeholders. The collaboration process is based on legality, transparency, and inclusivity, thereby fostering trust and commitment. Once all stakeholders are committed, there will be a strong understanding of what caused the problem, what is desired, and what results are to be achieved.

The collaboration process can be seen in the world of education, where environmental education is very important to be carried out from an early age, especially in schools, so that the younger generation understands how to interact with their environment (Ardoin et al., 2022; Dewi & Atika Anggraini, 2022; Emiru & Waktola, 2018; Nongqayi et al., 2022; Staples et al., 2019). Young people's environmental awareness reflects their knowledge, values, attitudes, and emotional engagement with the environment (Wu et al., 2018).

Effective training programs can increase knowledge, involvement, and caring actions toward the environment among the younger generation (Stevenson et al., 2023). For example, knowledge about waste generated does not only depend on the number of people in the school, but also on the activities and habits of students and school staff (Rada et al., 2016; Saputro et al., 2023). The strategic position of the younger generation in environmental issues can be seen from the 2023 Jakpat survey, where 78% of Generation Z and Millennial respondents expressed high interest in the zero-waste movement, and 16% of them have already implemented it Additionally, the 2024 PPIM survey from the State Islamic University of Jakarta found that 78.5% of Generation Z are more concerned about environmental issues.

This study aims to analyze government policy interventions in plastic waste management in schools and their impact on students' environmental awareness (Dermawan & Sain, 2025; Suprianto et al., 2023). The novelty of this study lies in its examination of multi-stakeholder collaboration based on the penta helix model in secondary education. The findings are expected to provide strategic implications for policymakers in designing effective and sustainable environmental education programs at the school level.

METHODS

This research is a qualitative approach with a case study approach to government collaboration on waste management programs at to explore information about government collaboration on waste management programs in the school environment. The research uses the process of government collaboration according to which consists of initial conditions, institutional design, leadership, collaboration processes, and results.

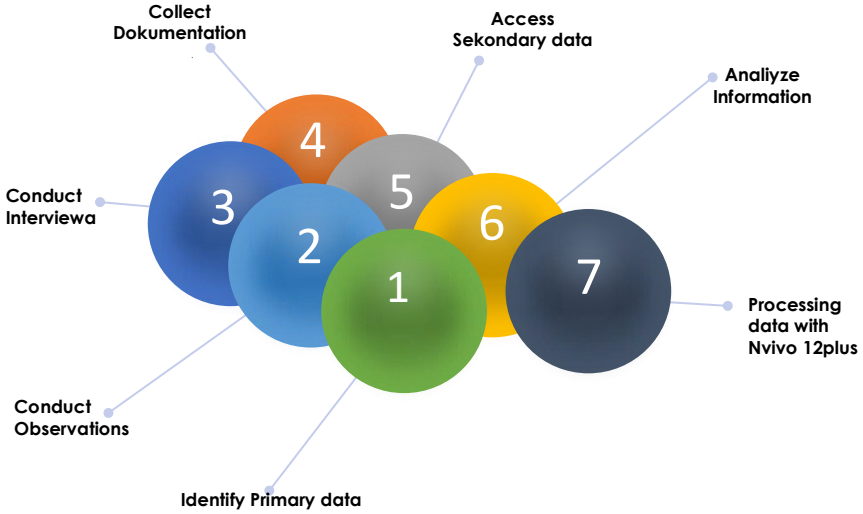

Fig 2. Research flow chart

Data collection techniques were carried out by collecting primary data through observation, interviews, and documentation from informants involved in the processing collaboration and for secondary data through the official website of the South Tangerang government, journal articles discussing waste processing, and government laws or regulations regarding the Adiwiyata program (Engkizar et al., 2018; Mutiaramses et al., 2025; Rahawarin et al., 2025). To ensure data validity, this study employs triangulation by comparing results from various data sources. The sources to be interviewed include: Government South Tangerang Environment Agency Education Agency, Business (Danone Aqua) Community academics Teachers and students, and Media Kompas. In this study, information analysis uses the interactive data

analysis process developed by Miles and Huberman to process the data previously entered into the study to understand the collaboration process among various parties in the plastic waste management program within the school environment. The research data was obtained through interviews, official documentation, and scientific literature and processed using the Nvivo12plus software program.

RESULT AND DISCUSSION

Initial Conditions for Government Collaboration in Plastic Waste Management

The initial conditions for government collaboration in plastic waste management in schools in South Tangerang City were marked by a number of real challenges in the field. Before the collaborative program was implemented, students' awareness of the importance of waste management was still very low. Many teachers and students were not accustomed to sorting waste, and environmental issues were not yet part of school habits or culture.

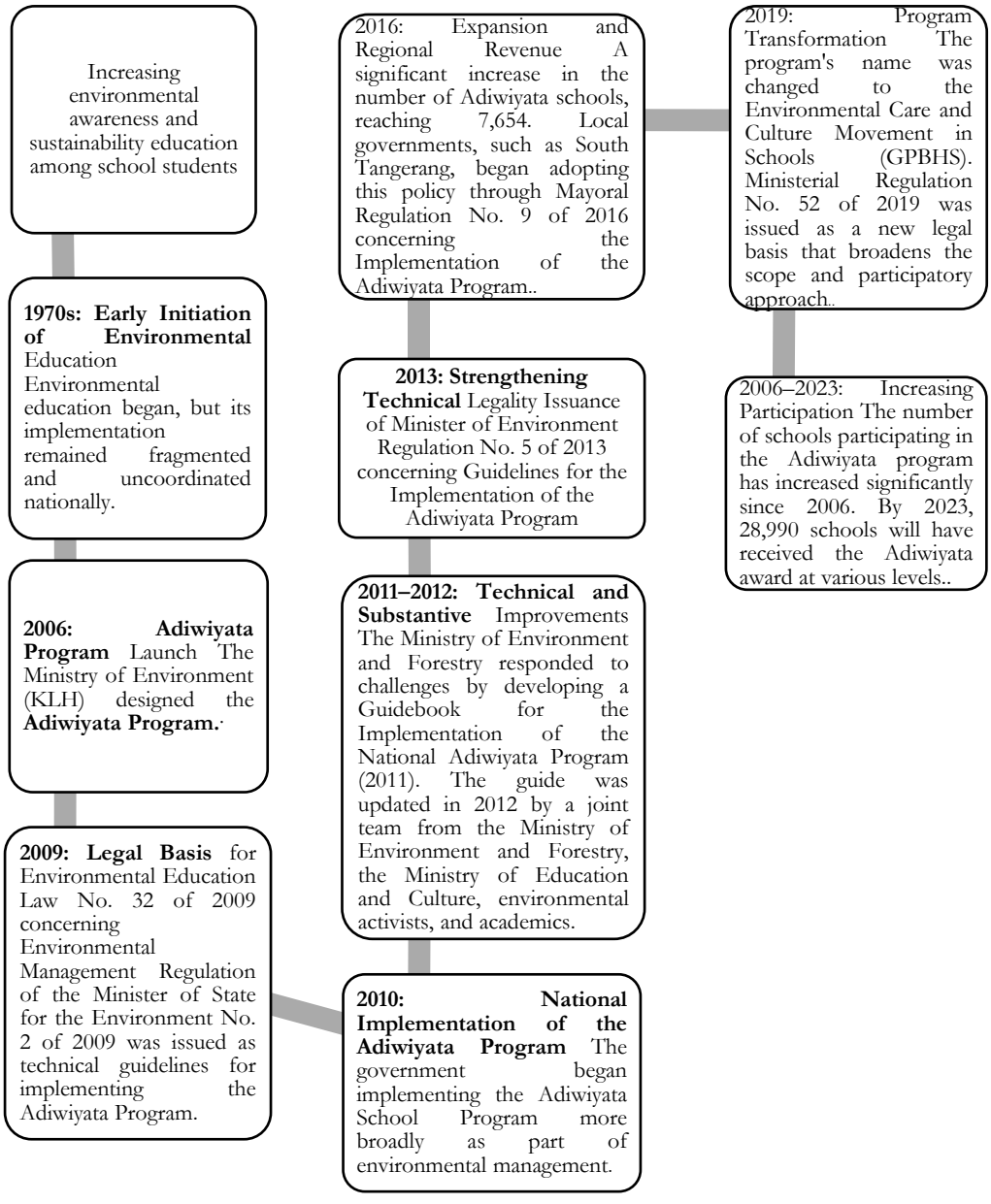

Fig 3. Waste management policy trajectory

However, behind these challenges, there is strong encouragement from

the local government, which has become the starting point for cross-sector cooperation. The South Tangerang City Government has demonstrated its commitment through regulations such as Mayor Regulation No. 9 of 2016 concerning the Adiwiyata Program. Awareness from the community and environmental groups has also become a driving force. In an interview, the Environmental Agency acknowledged that one of the biggest challenges is the limited capacity of schools, both in terms of teachers' understanding and students' passive participation. the initial conditions are marked by resource inequality and low trust among actors, which act as initial barriers to the collaboration process. What is happening in South Tangerang shows that the initial conditions are not yet ideal, but the government is striving to build an open collaboration process, clear role distribution, teacher training in waste management, and plastic waste handling by implementing the Adiwiyata program and the Pancasila Student Profile Strengthening Project within schools to promote sustainable education-based waste management transformation.

Institutional Design and Regulations to Strengthen Collaboration

A strong institutional design is an important foundation for cross-sector cooperation in building collaboration in South Tangerang City, including the government, namely the Environment Agency and the Education Agency; academics, namely teachers and students; business groups, namely Danone Aqua; community groups, represented Recycling Center; and the media, namely Kompas (Fitri & Ferza, 2020; Istirokhatun & Nugraha, 2020; Saleh et al., 2023). Legally and formally, the implementation of environmental programs in the school education sector is based on South Tangerang City Regulation No. 9 of 2016 on the Implementation of the Adiwiyata Program and Ministry of Environment and Forestry Regulation on the Movement for Environmental Care and Culture. The interview results showed that this collaboration is carried out through structured coordination, with the Environmental Agency providing training, schools forming Adiwiyata teams and implementing the Pancasila Student Profile Strengthening Project, and the private sector and community supporting through a circular economy approach and educational guidance. The Environmental Agency stated that "in this Adiwiyata program collaboration, the government from the Ministry of Environment and the Education Agency act as mentors providing guidance and policy-making for the program, as well as providing support to schools in implementing the Adiwiyata program."

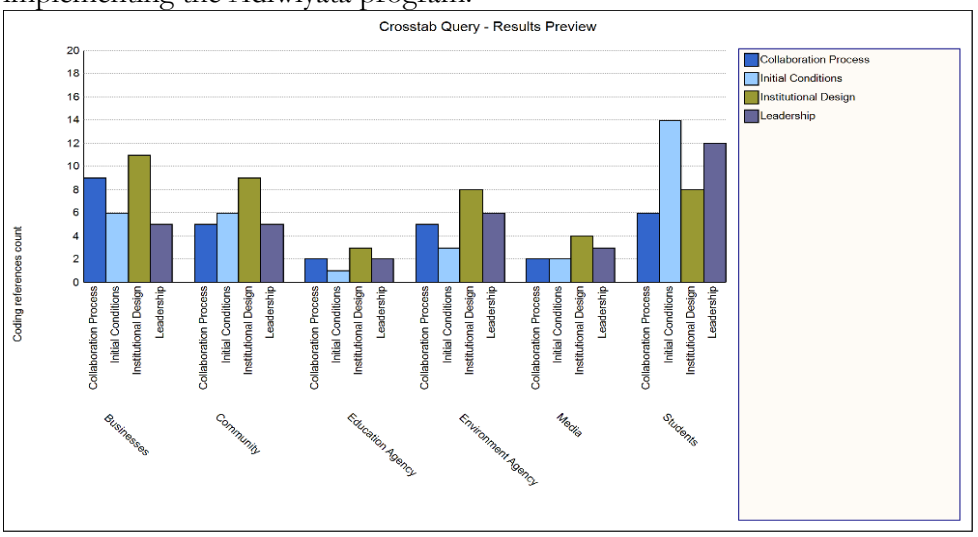

Fig 4. Crosstab analysis of collaboration

This cooperation structure reflects the importance of inclusive institutional design, opening space for all actors involved to contribute, thereby creating equitable and adaptive participation that is able to adjust roles to conditions and challenges in plastic waste management. Local governments do not dominate but act as intermediaries between parties. This aligns with the theory of Collaborative Governance (Ansell & Gash, 2008). which emphasizes the need for an institutional framework that promotes openness, accountability, and equal participation. With the right institutional design, reinforces this theory by stating that institutional design must mediate power imbalances and provide clear procedures for all parties. Collaboration in South Tangerang has been able to deliver effective, participatory, and sustainable governance practices because it has successfully bridged the interests of various actors such as schools, communities, businesses, and civil society organizations within a focused, transparent, and accountable framework.

The Role of Facilitative Leadership in Encouraging Collaboration

Facilitative leadership plays a key role in encouraging cross-sector collaboration, especially in waste management in schools. In South Tangerang, the success of programs such as Adiwiyata depends not only on rules or policies but also on actors who are able to bridge various interests.

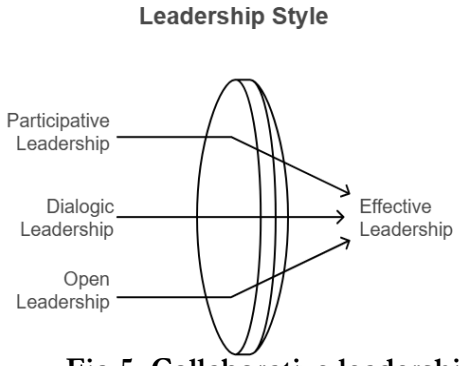

Fig 5. Collaborative leadership style

Documentation and interview results show that the leadership style used is participatory, involving all actors in waste management and actively participating in the decision-making process in the implementation of the adiwiyata program. By involving teachers and students as implementers of the adiwiyata and programs in the school environment, the Environmental Agency and the Education Agency as technical advisors for the program, collaboration forums, and communities, the private sector, and the media as spaces for sharing experiences and ideas.

This leadership also creates a sense of shared responsibility in designing and implementing environmental programs, so that each party feels involved and has a role to play. Open leadership involves the transparent communication of program objectives and regulations that support the program. Dialogic leadership prioritizes dialogue or the establishment of discussion forums with stakeholders to discuss program development and evaluate the plastic waste management process. These leaders not only provide direction but also create space for everyone to participate, share ideas, and feel ownership of the change process (Kamarud din et al., 2023; Satrial et al., 2024). As stated by "collaborative leaders are those who can transcend sectoral boundaries and build trust." Facilitative leadership is the primary driver in creating integration among stakeholders and promoting the coherence of the collaborative process," said (This approach has proven successful in South Tangerang, where leadership is present at various levels, from bureaucrats and teachers to the community.

Collaborative Process and Program Implementation in Schools

The collaborative process in managing plastic waste in schools in South Tangerang shows that the success of the program does not only depend on rules or the role of leaders, but also on how activities are carried out in practice and involve all parties. The Environmental Agency, schools, communities, and the private sector work together in designing, implementing, and evaluating the program on a regular basis. Planning workshops, creative activities through the P5 Project such as recycling waste into useful items, and the establishment of school waste banks are all part of this process. Most importantly, students are not just participants but active agents of change. They learn directly from experience and begin to develop environmentally conscious habits in their daily lives.

This collaboration not only creates programs but also meaningful learning spaces for all parties, especially students. When they are given the opportunity to directly participate in designing, testing, and solving environmental issues at school, values of care and responsibility naturally grow. This is the essence of true environmental education, as highlighted who emphasize that hands-on experience is the key to fostering sustainable character development. Through policy support such as the Ministry of Education, Culture, Research, and Technology No. 56/M/2022, which includes a ministerial decision regulating the Guidelines for Curriculum Implementation and the Learning Recovery Framework, promoting the development of. This collaboration strengthens the values of the Pancasila Student Profile, particularly in terms of cooperation and environmental concern. In short, waste management in schools is not just about cleanliness, but also about character education that grows and develops alongside students.

The Impact of Programs on Students' Environmental Awareness

Environmental education that involves real action in schools has a significant impact on shaping students' awareness and habits. In South Tangerang City, efforts to manage plastic waste through cross-sectoral cooperation are not just about policies or regulations, but truly touch the daily lives of students. They are invited to participate directly in various activities such as sorting waste, making crafts from used plastic through P5, and managing the school's waste bank. Many students have started bringing their own lunch boxes, actively participating in environmental campaigns, and even voicing the importance of protecting the earth through the school's social media.

Fig 6. Utilization of recycled materials by students

These changes do not happen instantly, but grow through real and enjoyable experiences. When students are given real roles in environmental activities, they feel involved and valued. They not only learn theory, but also see the direct impact, from a cleaner school environment to a sense of pride

in the small contributions they make. Support from teachers, the community, and the government makes this program more widespread and consistent. This approach demonstrates that environmental education closely tied to students' daily lives can foster positive habits and cultivate an environmentally conscious character from an early age. These findings align with (Dewi & Atika Anggraini, 2022). who state that integrating environmental education into school activities can enhance students' environmental awareness and build environmentally conscious habits from a young age. "Taking concrete action on waste management should not be limited to schools but must also be applied in the home environment by practicing the 3R principles: Reduce, Recycle, and Reuse," (Husin et al., 2025).

Challenges and Obstacles to Collaboration

The collaborative plastic waste management program in schools in South Tangerang has indeed brought about positive changes, but it still faces several obstacles that need to be addressed. In the school environment, there are still teachers and students who are not actively involved, due to a lack of understanding about the importance of environmental education. Meanwhile, at the inter-institutional level, differences in objectives and working methods make coordination feel rigid and sectoral. Some agencies, such as the education office and the media, have not played an optimal role compared to the community or the Environmental Agency. Even the results of interviews with the Education Office stated that "the Education Office only acts as a supervisor of the adiwiyata program in schools that participate in the program." This imbalance makes collaboration efforts uneven and incomplete across all lines. To address this, there is a need for strengthened cross-sectoral communication, clarity of roles among actors, and a shared commitment so that the program does not rely solely on certain parties but becomes a collective responsibility integrated into local education policy.

For the program to be sustainable and not merely a short-term project, concrete steps are needed to strengthen the capacity and commitment of all parties. For example, teacher training on environmental education, strengthening the roles of each actor, and integrating the program into the formal school curriculum. This is crucial so that collaboration goes beyond administrative cooperation, but becomes part of a vibrant educational culture and system. As the researchers emphasize, true collaboration requires clarity of roles, the ability to act together, and equality of contributions. Without these, the initial enthusiasm can fade and the program loses its momentum. This method makes collaboration part of the ongoing educational system, not just a temporary project.

This condition is in line with research conducted which states that organizational designs that do not take into account disparities in participation and resources will result in unstable and inefficient cooperation. Additionally, (Emerson et al., 2012). emphasize the importance of "capacity for collective action," which refers to the ability of all parties to contribute proportionally toward shared objectives. Without institutional capacity building and consistent cross-sectoral support, collaboration tends to remain a formality without lasting results. Therefore, a long-term strategy, policy commitment from the government, and routine evaluation mechanisms are needed to ensure that collaboration can grow dynamically and have a tangible impact in the long term.

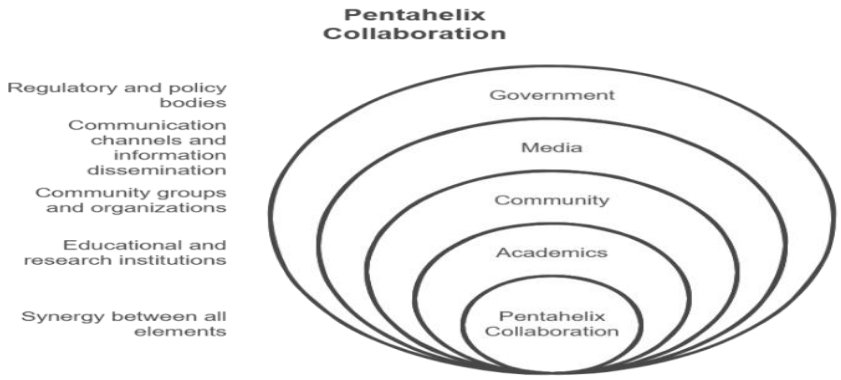

Fig 7. Pentahelix collaboration model in waste management programs

The Pentahelix collaboration model is a relevant and effective approach to managing plastic waste in schools in South Tangerang. This approach involves five key elements: academics, businesses, communities, government, and the media. Each party plays a different but complementary role. Teachers and schools are at the forefront of plastic waste management education, while the private sector, such as Danone-Aqua, supports the effort with logistics and innovation. The community acts as a partner in programs organized by waste management companies, the government oversees the program's implementation, establishes policies for eco-friendly schools, provides necessary facilities such as trash bins, and the media disseminates messages related to environmental issues and waste management within the school environment. This collaboration demonstrates that waste management cannot be done alone; it requires equal and mutually trusting cooperation among various parties.

In South Tangerang, this model is highly suitable for implementation due to the city's complexity and the diverse challenges within the school environment. Cross-sectoral collaboration addresses real-world issues such as low student awareness or insufficient facilities. Projects like P5 serve as a platform for students to learn through hands-on action rather than just theory. Teachers and students are not alone; they are supported by the community, media, and government agencies such as the Environmental Affairs Department and the Education Department. This is the strength of the Pentahelix approach: creating a fair collaborative space, fostering awareness from an early age, and integrating environmental change into the culture of learning. The Adiwiyata program is a long-term and sustainable effort to cultivate a generation of young people who care about the environment.

CONCLUSION

This study found that cross-sector collaboration involving schools, government, communities, businesses, and the media through a pentahelix approach has opened up new opportunities for the growth of environmental awareness among students. One of the key findings of this study is the significant role of students as agents of change, which has emerged thanks to the support of the Adiwiyata program and the Pancasila Student Profile Strengthening Project. They not only learn to sort and manage waste but also begin to practice an environmentally friendly lifestyle in their daily lives. The implications of these results suggest that when all parties are actively involved, share a sense of responsibility, and are given the opportunity to contribute, positive change in schools can truly occur. Therefore, it is essential to continue strengthening policy support, teacher training, and collaboration that goes

beyond administrative measures to foster a sense of ownership and sustainability. Ultimately, living environmental education is education that touches the heart, inspires action, and shapes a caring character from an early age.

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