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Towards Zero Plastic Waste in State *Madrasah Aliyah* For Supporting the *Adiwiyata* Program: Eco-Justice Paradigm

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ABSTRACT

This study explores the implementation of David Orr's eco-justice paradigm in achieving the zero plastic waste objectives at *Madrasah Aliyah Negeri* (*MAN*) *Insan Cendekia*, aligning with the school's commitment to the *Adiwiyata* program. While environmental awareness among students is high, efforts to reduce plastic waste are limited. The main barriers include a lack of supporting infrastructure and the absence of a systematic curriculum integration. Some students support the zero plastic waste policy. However, the main challenge is the limited facilities, such as waste banks, composting units, and plastic alternatives in the school canteen. The study uses a mixed-methods approach, combining quantitative and qualitative data through a parallel convergent design. Quantitative data were collected through structured questionnaires distributed to 70 respondents. Qualitative data were gathered through comprehensive interviews with purposively selected informants. The findings suggest that to achieve Adiwiyata goals, the school needs to improve sustainable infrastructure. It should also strengthen experiential learning and engage the entire school community in sustainability initiatives. This research contributes to understanding how education and sustainable infrastructure interact to support the zero plastic waste policy at schools. It also emphasizes the importance of collaboration between schools and external stakeholders in creating an ecosystem that fosters environmental responsibility.

1. Introduction

The issue of plastic waste has become an increasingly urgent global concern. Indonesia ranks as the second-largest producer of plastic waste in the world after China. This creates significant challenges in addressing plastic pollution, particularly its harmful effects on the environment and marine ecosystems (Hendar, Rezasyah, & Sari, 2022). At the local level, Bengkulu faces a similar situation. Plastic waste is the most commonly generated type of waste. It accounts for 11.49% of the total waste, based on data from BPS in 2023 (BPS Bengkulu Selatan, 2024).

This phenomenon not only poses a severe environmental threat but also affects the quality of life for local communities. Layas Ketaren, Campaign Manager for Anti-Mining at Kanopi Hijau Indonesia, emphasized the urgency for decisive action, urging the Bengkulu regional government to limit the use of single-use plastics. Furthermore, the growing piles of waste in Bengkulu City,

accompanied by unpleasant odors that disturb residents, have exacerbated the situation (Fajri, 2024). Given these challenges, it is imperative to explore practical solutions to reduce plastic waste.

One promising approach is the zero plastic waste initiative. It focuses on reduction, reuse, recycling, and the promotion of environmentally friendly alternatives. Stoett et al. (2024) highlight the link between plastic pollution, sustainable development, and social justice. They emphasize that tackling plastic waste requires integrating environmental responsibility with social equity, especially for marginalized communities. Similarly, Aragaw (2024) advocates for strategic plastic waste management. This includes improving recycling systems and raising public awareness to support the transition toward a zero-waste society.

Educational institutions also play a pivotal role. Wardani et al. (2021) illustrate how initiatives at the University of Indonesia foster sustainable practices and advance zero plastic waste goals. Collectively, these studies emphasize that achieving zero plastic waste requires a multifaceted approach. It involves systemic changes, community engagement, and educational advocacy.

One prominent environmental education initiative in Indonesia that aligns with the zero plastic waste concept is the *Adiwiyata* Program. Managed by Indonesia's Ministry of Environment and Forestry, this program integrates environmental values into school curricula and daily activities. It encourages sustainable practices among students, teachers, and the broader community. Komalasari et al. (2023) highlight the program's role in fostering environmental awareness and cultivating students' sense of responsibility toward environmental issues. Similarly, Rahman et al. (2023) emphasize its holistic approach, which enhances education quality by embedding environmental literacy into school activities. Additionally, Sunarto (2023) underscores the program's importance in shaping environmentally responsible behaviors, particularly among young learners. Utomo et al. (2023) argue that the program nurtures green behavior nationwide, preparing future generations for sustainable development.

The synergy between the zero plastic waste initiative and the *Adiwiyata* program is clear. Both share the goal of promoting environmental sustainability through education. For instance, Elvarisna et al. (2024) show how the *Adiwiyata* Program in Sijunjung integrates waste management practices, such as converting plastic waste into ecobricks. This effort directly supports the zero plastic waste initiative. Similarly, Tariska et al. (2021) highlight schools in Bandung that adopt a zero plastic waste approach. Their practices align seamlessly with *Adiwiyata*'s emphasis on responsible waste management.

Widiyono et al. (2024) provide another example. *Adiwiyata* schools in Demak recycle plastic waste into eco-paving blocks. This demonstrates the program's practical contributions to sustainability. Moreover, Guniarti and Paulus (2024) connect broader sustainability practices, like the green office concept, to the *Adiwiyata* Program's goals of waste reduction and resource management. Collectively, these examples emphasize the program's role in fostering sustainable behaviors. They also show how *Adiwiyata* advances the zero plastic waste initiative through innovative, hands-on solutions in schools.

While previous studies provide valuable insights into environmental education and waste management, several research gaps remain. Chandramohan and Bhagwan (2023) emphasize eco-justice principles and environmental justice interventions. However, their focus is primarily on theoretical frameworks, not specific programs like *Adiwiyata*. Similarly, Guevara-Herrero et al. (2024) offer a systematic review of educational practices for environmental justice. Yet, they do not address the practical application of these principles in local contexts, such as Zero Plastic Waste initiatives in schools.

Hindhede (2024) integrates eco-justice pedagogy with social justice in children's literature courses. Still, the study does not examine environmental initiatives like Zero Plastic Waste within school programs. Lin et al. (2023) explore holistic eco-justice pedagogies in higher education. However, they overlook their implementation in primary or secondary schools. There is a strong justification for selecting an Islamic-based school as a case study. The *Adiwiyata* program is implemented across all educational levels in Indonesia (Darmansyah & Susanti, 2023; Heleri & Ismanto, 2021). This program also includes Islamic schools, such as *Madrasah Ibtidaiyah* (MI), *Madrasah Tsanawiyah* (MTs), and *Madrasah Aliyah* (MA) (SIMP2SDM, 2023). There is an

intriguing concept in Islam related to environmental conservation known as eco-fiqh, developed by Fazlun Khalid. Eco-fiqh integrates religious teachings with ecological principles to create a balance between humans and the environment (Foltz, 2021). Here, with the eco-fiqh concept, Chasanah (2022) states that Islamic educational institutions, such as *pesantren*, can play a strategic role in transforming ecological values. This is achieved by comprehensively internalizing the teachings of *tawhid*, *sufism*, and *fiqh* within the educational process. Finally, Anggraini et al. (2024) discuss the effectiveness of the *Adiwiyata* Program. Yet, their study does not focus specifically on eco-justice values or Zero Plastic Waste practices.

Therefore, this study seeks to address these gaps by applying eco-justice principles within the local context of the *Adiwiyata* Program. It evaluates zero plastic waste practices and explores stakeholder perceptions. This research offers a practical and context-specific analysis of environmental education and sustainability initiatives. In doing so, the study contributes to a deeper understanding of how educational programs can foster behavioral change and support sustainable development. To achieve the objectives of this study, the research questions are formulated as follows:

1. How does plastic waste management at *MAN Insan Cendekia* support the *Adiwiyata* program's environmental sustainability goals?
2. What are the challenges and opportunities of implementing zero plastic waste at *MAN Insan Cendekia* through the lens of Orr's eco-justice?

2. Research Method

This study was conducted at *Madrasah Aliyah Negeri* (*MAN*) *Insan Cendekia*. It is located in Renah Lebar Village, Karang Tinggi Sub-district, Bengkulu Tengah Regency, Bengkulu Province of Indonesia. The research duration was carefully determined based on several technical considerations. Here, they consist of the geographical distance between locations, the availability of respondents, and the researchers' capacity to manage data processing. After considering of these factors, the study spanned a period of one and a half months, commencing on September 15 and concluding on October 30, 2024.

The study employed a mixed-methods approach. It integrates quantitative and qualitative data collection concurrently and analyzing them through a parallel convergent design. This methodological framework facilitates the synthesis of data from diverse sources, enabling a comprehensive and nuanced understanding of the research problem (Sugiyono, 2019). Aligned with the theoretical insights of Creswell and Creswell (2017), this approach was adopted to ensure the collection of diverse data, thereby strengthening the validity and reliability of the findings.

The quantitative component of the study focused on assessing the extent of behavioral changes among students and teachers. It also aimed to evaluate the effectiveness of policies associated with the *Adiwiyata* program. In a more specific case, quantitative data were obtained through the distribution of structured questionnaires to 70 respondents, comprising:

Table 1. Respondent Categories and Distribution

Respondent category	Distribution (respondents)
Teachers	10
10^{th}-grade students	20
11^{th}-grade students	20
12^{th}-grade students	20
Total	**70 repondents**

The table above presents the distribution of respondents, categorized into two groups: teachers and students. The sample consists of 10 teachers and 60 students, evenly distributed across grades 10, 11, and 12, with 20 students from each grade. In total, the study involved 70 respondents.

On the one hand, the quantitative data collected were subsequently analyzed using descriptive statistics to examine patterns and data distribution (Sugiyono, 2022). These descriptive statistics include frequency counts, percentages, means, and standard deviations (Liamputtong, 2010). In

calculation of the data of this reseach, if the frequency valus is clearly defined as $N = 70$, the formula to calculate the *Mean* is:

$$x = \frac{\sqrt{\sum(fi.xi)}}{N}$$

Explanation:

x	:	Mean (average)
fi	:	Frequency of respondents in category *i*
xi	:	Score or value for category *i*
N	:	Total number of respondents

In other side, the standar deviation (SD) is calculated applying the following formula:

$$SD = \frac{\sqrt{\sum fi(xi-x)^2}}{N}$$

Explanation:

x	:	Mean (average)
fi	:	Frequency of respondents in category *i*
xi	:	Score or value for category *i*
N	:	Total number of respondents

These statistical measures offer valuable insights into respondents' perceptions. They also reflect their level of understanding regarding the implementation of the *Adiwiyata* program and the zero plastic waste policy.

On the other hand, the qualitative approach was employed to explore respondents' perceptions and experiences related to the implementation of the *Adiwiyata* program, particularly in the management of plastic waste and the integration of eco-justice values. Qualitative data were gathered through comprehensive interviews with informants selected via purposive sampling, based on criteria pertinent to the research topic (Borgstede & Schloz, 2021). The participants in this study included 6 teachers and 15 students, distributed across 10th, 11th, and 12th grades (5 from each grade). Interviews were conducted over the period from October 1 to October 30, 2024, with the understanding that not all informants could be interviewed simultaneously due to their varying schedules and commitments. Then, the data were analyzed using a thematic approach to identify relevant patterns and themes. To facilitate the analysis process, *Taguette*, a web-based application, was utilized freely to identify key themes, thereby streamlining and simplifying the qualitative analysis.

Ultimately, the results of the descriptive statistical and thematic analysis will be examined in greater depth through the perspectives of David Wesley Orr, a renowned environmentalist and Professor of Practice at Arizona State University, United States. Here, Orr underscores the pivotal role of education in fostering a society that demonstrates greater environmental responsibility (Orr, 1994; Orr, 2002). His theoretical contributions offer a robust conceptual framework for analyzing the integration of eco-justice values within the implementation of the zero plastic waste policy.

Figure 1. Based on David Orr's Eco-Justice Principles

David Orr emphasizes that the environmental crisis is fundamentally linked to the failure of education in fostering ecological awareness (Orr, 1994). He argues that, therefore, curricula must prioritize sustainability by equipping students with the knowledge and skills needed to address pressing environmental challenges. Moreover, education should be community-centered. It encourages students to engage with local ecological issues and collaboratively develop solutions that benefit their surroundings (Orr, 2002).

Schools must also adopt green infrastructure. It incorporates energy-efficient and resource-saving designs that reflect the core values of sustainability (Orr, 1994). His perspective also highlights the importance of fostering stewardship, wherein education instills a deep sense of moral and ecological responsibility in students. Equally important, experiential learning plays a critical role by providing hands-on activities such as gardening, conservation projects, and nature exploration, which deepen students' connection to the environment (Orr, 2011). These principles aim to transform education into a powerful catalyst for addressing environmental sustainability.

3. Results and Discussion

3.1. Plastic Waste Management at *MAN Insan Cendekia* for Supporting the *Adiwiyata* Program

The principles of eco-fiqh are most likely to align with the values embedded in the *Adiwiyata* program at State *Madrasah Aliyah Insan Cendekia*. The school was honored with the Adiwiyata National Award by the Ministry of Education and the Ministry of Environment and Forestry in 2016 (Kemenag, 2016). As a nationally recognized educational institution for its exemplary implementation of the Adiwiyata program, the selected school stands as a compelling case for further academic exploration. This institution offers a representative model of how environmental programs can be effectively integrated within an educational framework, along with their broader impacts on students, educators, and the wider school community.

Fazlun Khalid, who developed *eco-fiqh* through the establishment of the Islamic Foundation for Ecology and Environmental Sciences (IFEES) in 1994, emphasized the importance of aligning Islamic teachings with environmental conservation (Khalid, 2019). Based on his perspective, the principle of *tawhid* emphasizes respect for all of Allah's creation. This aligns closely with the school's efforts in conservation and environmental preservation. The principle of *fitrah* encourages living in harmony with nature. It reflects the sustainable practices applied in the school's waste management system. The principle of *mizan* highlights the importance of maintaining balance in nature. This supports the school's initiatives in waste management and recycling programs. Lastly, the principle of *khalifah* teaches human responsibility as stewards of the Earth. It resonates with the school's efforts to involve students in tree-planting activities.

In accordance with the observations, *MAN Insan Cendekia* has implemented basic environmental facilities, such as segregated waste bins and an information board, though their availability is limited. Critical infrastructure, including a waste bank, refillable water stations, and composting units, remains absent. This condition is also supported by the interview results with following teacher of Bahasa Indonesia. Here, Indonesian language teachers are included as informants because all school elements must be involved to ensure the success of the Adiwiyata program, including their role in fostering environmental awareness through education.

> **Data 1:**
> "The main challenge I face is changing students' habits that have been formed over a long period of time. Also, there are still limited supporting facilities, such as segregated waste bins, a school waste bank, and an organic waste composter. To overcome this, I keep motivating the students to be more disciplined and consistent in adopting environmentally friendly habits. I've also suggested to the school administration to provide better facilities to support these efforts." (Interview with Mrs. RS, October 10, 2024).

Furthermore, the school canteen still relies on single-use plastics. It reflects a gap in achieving sustainable waste management practices. The provision of more comprehensive and adequate facilities is imperative to support the effective implementation of a zero-plastic-waste policy (Kasavan, Yusoff, & Ali, 2021). A detailed overview of these findings is presented in the table below.

Table 2. Availability of Zero Plastic Waste Facilities

Type of Facility	Availability	Quantity
Segregated waste bins	Available	8 units
Information boards and educational posters	Available	1 unit
School waste bank	Not available	-
Water refill stations	Not available	-
Storage racks or cabinets for student eating utensils	Not available	-
Organic waste composter	Not available	-
Creative recycling tools and materials	Not available	-
Plastic-free canteen	Available (not yet plastic-free)	1 canteen

The school has taken initial steps to support environmental management by providing fundamental facilities. One notable initiative is the availability of eight segregated waste bins designed to facilitate waste sorting by type. This facility reflects the school's commitment to educating students on the importance of waste segregation and maintaining environmental cleanliness (Kihila, Wernsted, & Kaseva, 2021).

Additionally, the school has a single information board and educational posters that serve as tools for delivering environmental messages to students. These media play a crucial role in raising student awareness of environmental issues and encouraging environmentally friendly behavior within the school community (Afrianti, Furqon, & Wulandari, 2024). However, several gaps remain that need to be addressed to achieve more sustainable environmental management. For instance, the school has yet to establish a waste bank as a circular economy-based waste management solution or install refillable water stations to reduce single-use plastic bottles.

Other facilities, such as composters for organic waste processing, creative recycling tools, and storage racks for personal eating utensils, are also absent. Furthermore, while the school canteen has made efforts to reduce plastic use, it is not entirely free of single-use plastics. These shortcomings highlight opportunities for the school to enhance its facilities in a more comprehensive manner. By addressing these gaps, *MAN Insan Cendekia* can strengthen its role in fostering environmental awareness and sustainable behavior among students. It positions itself as a model educational institution for holistic environmental management.

The survey findings are summarized in the following table. They highlight the evaluated aspects with corresponding frequency, percentage, mean, and standard deviation. This detailed overview offers a clearer understanding of the data across each category.

Table 3. Summary of Evaluated Aspects on Plastic Waste Awareness and Actions

Evaluated aspects	Frequency	Mean	Standard deviation
Awareness of the impact of plastic waste	70	2.60	0.66
Importance of reducing plastic usage	70	2.55	0.67
Use of plastic alternatives	70	2.50	0.67
Support for school policies	70	2.60	0.66
Participation in plastic waste reduction activities	70	2.30	0.78
Availability of plastic waste management facilities	70	1.60	0.49
Optimism about reducing plastic waste in schools	70	2.65	0.65
Enthusiasm for participating in waste reduction efforts	70	2.55	0.67
Use of single-use plastics	70	2.00	0.77
Support for the *Adiwiyata* program	70	2.75	0.54

Survey results indicate a high level of awareness among respondents regarding the impact of plastic waste, with a mean score of 2.60 and a standard deviation of 0.66. Here, the results reflect consistent responses across the group. In percentage, 70% of respondents reported being highly

aware, 20% moderately aware, and only 10% unaware. This finding is further supported by the statement of one of the English teachers, who emphasizes the importance of environmental education in fostering such awareness.

Data 2:

"Since this policy was implemented, I have noticed positive changes. Many students now bring their own water bottles and eating utensils. They are also more aware of not littering. I sometimes discuss the impact of plastic waste on the environment with students in English class." (Interview with Ms. NS, October 10, 2024).

The interview underscores the effectiveness of the zero plastic waste policy in promoting sustainable practices among students. In this case, the teacher observed a notable shift in student behavior. Many students have adopted eco-friendly habits, such as using reusable water bottles and utensils, while becoming more mindful of waste disposal. Furthermore, the teacher incorporates discussions on the environmental consequences of plastic waste into English lessons. This approach enhances students' ecological awareness and reinforces their commitment to environmental responsibility (Mpuangnan, Mhlongo, & Govender, 2023).

Then, most respondents also emphasized the importance of reducing plastic usage, with a mean score of 2.55 and a standard deviation of 0.67, indicating a relatively consistent agreement on its significance. Specifically, 65% considered it highly important, 25% important, and only 10% perceived it as unimportant. Regarding the use of plastic alternatives, the mean score was 2.50 with a standard deviation of 0.67, showing a moderate level of adoption. In detail, 60% frequently use such alternatives, 30% occasionally, and 10% never.

Data 3:

"Sometimes, I still face difficulties because some of my friends aren't used to it yet. Also, it's often hard to find food or drinks that don't come in plastic packaging. However, I try my best to bring my own eating utensils and remind my friends to support this policy as well." (Interview with DS, October 14, 2024).

The above interview with the 12th-grade student underscores the complexities involved in fostering environmentally sustainable behaviors, particularly in relation to plastic consumption. The student identifies key barriers: some peers resist adopting these practices, and there is limited availability of food and drinks without plastic packaging. Nevertheless, the student shows resilience by consistently using personal eating utensils. They also actively encourage their peers to adopt the policy, contributing to a collective effort for environmental responsibility.

Support for school policies aimed at reducing plastic waste was notably strong, with a mean score of 2.60 and a standard deviation of 0.66, reflecting a high level of agreement among respondents. Specifically, 70% of respondents fully supported these policies, 20% partially supported, and only 10% did not support them. Participation in plastic waste reduction activities was also encouraging, with a mean score of 2.30 and a standard deviation of 0.78. It shows some variation in participation levels. In percentage, 50% frequently participated, 30% occasionally, and 20% never participated.

Data 4:

"I agree with this policy because it has made me more aware of the importance of protecting the environment. Since the policy was implemented, I have gotten used to bringing my own water bottle and snacks from home. I feel more responsible and no longer want to litter." (Interview with MM, October 15, 2024).

However, challenges persist in providing adequate school facilities for plastic waste management, as only 60% of respondents rated the facilities as sufficient, while 40% deemed them inadequate. This is reflected in the mean score of 1.60 and a standard deviation of 0.49. It indicates a relatively low level of satisfaction with the facilities. This finding is further substantiated by the interview results presented below.

Data 5:

"In my opinion, this policy will be difficult to succeed if it relies solely on teachers. The school needs to be more firm in enforcing the rules and providing adequate facilities. Without that, this policy will remain just a discourse." (Interview with Mr. AM, October 9, 2024).

The interview with the Islamic Religion, or *Pendidikan Agama Islam* (*PAI*) teacher revealed concerns about the policy's success if it depends solely on teachers. He emphasized that the school needs to take a stronger stance in enforcing the rules. Providing adequate facilities is crucial for the policy's implementation (Suasono et al., 2023). Without these measures, the teacher argued, the policy would remain merely a theoretical discourse.

Data 6:

"I don't really feel much support from the school. For example, there are hardly any segregated waste bins near the classrooms, so I'm often confused about where to throw my trash. The school should provide better facilities before implementing this policy." (Interview with QN, October 14, 2024).

The interviewee expressed a lack of sufficient support from the school in implementing the plastic waste management policy. Specifically, the respondent noted the lack of segregated waste bins near the classrooms. The situation leads to confusion about where to dispose of trash. This lack of proper facilities undermines the policy's effectiveness and creates challenges for both teachers and students. The interviewee suggested that the school should prioritize providing adequate facilities before fully implementing the policy.

Furthermore, optimism about the feasibility of reducing plastic waste in schools was high, with 75% of respondents believing it is very achievable, 15% considering it possible but challenging, and 10% viewing it as unfeasible. This is reflected in the mean score of 2.65 and a standard deviation of 0.65. Enthusiasm for participating in plastic waste reduction activities was also evident, with 65% expressing a strong willingness to participate, 25% willing, and only 10% unwilling, resulting in a mean score of 2.55 and a standard deviation of 0.67.

Nevertheless, the habitual use of single-use plastics remains a concern, with 30% of respondents using them frequently, 40% occasionally, and 30% rarely or never, with a mean score of 2.00 and a standard deviation of 0.77. Support for the *Adiwiyata* program was overwhelmingly positive, with 80% of respondents fully endorsing the program, 15% supporting it, and only 5% not supporting it, yielding a mean score of 2.75 and a standard deviation of 0.54.

Data 7:

"I fully support the zero plastic waste policy. It aligns with the values of the *Adiwiyata* program. This program teaches people to care for the environment. As a teacher, my role is to educate students about the importance of reducing plastic use. I always remind them to bring their own water bottles and snacks from home to avoid using single-use plastics. I also frequently incorporate environmental topics into lessons." (Interview with Mr. AH, October 8, 2024)

The teacher's statement shows support for the zero plastic waste policy. This policy aligns with the *Adiwiyata* program's principles of fostering environmental awareness (Bui, et al., 2023). The teacher also actively educates students on reducing plastic use. He reminds students to bring their own water bottles and snacks from home. Additionally, environmental topics are frequently integrated into lessons to enhance students' ecological consciousness.

Data 8:

"I have noticed some changes in student behavior, particularly in bringing their own water bottles and lunch boxes. However, there are still some students who have not been consistent. I help them understand this policy by providing direct examples and simple explanations." (Interview with RN, October 8, 2024)

The interviewee, a mathematics teacher, noted some progress in student behavior, particularly in the use of personal water bottles and lunch boxes. Nonetheless, there are still students who exhibit inconsistency in adhering to these practices. The teacher aids in reinforcing the policy by offering practical examples and clear, straightforward explanations. Despite these efforts, challenges remain in ensuring full and consistent implementation of the policy.

To enhance clarity and provide a more representative view of the data, the findings are visualized in the following bar chart. This approach highlights key patterns and insights for easier interpretation.

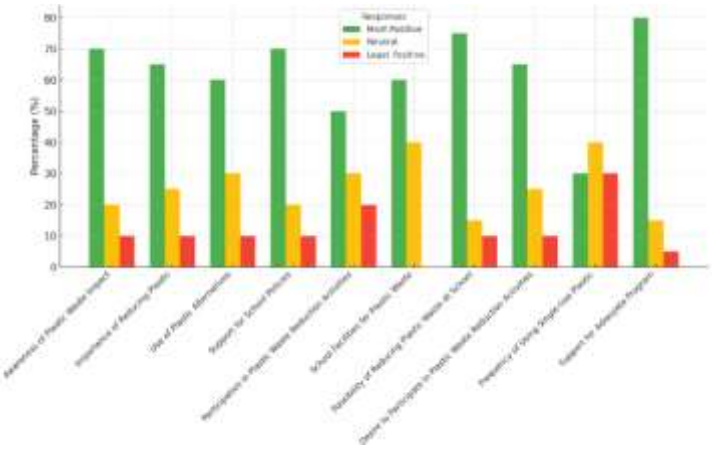

Figure 2. Survey Results on Plastic Waste Reduction and the *Adiwiyata* Program Support

The findings highlight a commendable level of awareness and support among respondents for initiatives aimed at reducing plastic waste and promoting environmental sustainability through programs like *Adiwiyata*. A significant majority recognize the importance of these efforts, reflecting a growing environmental consciousness and a willingness to participate in activities that foster a cleaner and more sustainable future. Such positive engagement underscores the potential for educational institutions to act as catalysts for broader behavioral and cultural shifts toward reducing plastic waste (Yasin et al., 2024). By integrating environmental education with actionable policies, schools can harness this momentum to drive impactful changes within their communities (Silva et al., 2023).

Despite these promising indicators, notable challenges persist. Insufficient school facilities for managing plastic waste remain a critical obstacle, as highlighted by a substantial proportion of respondents who perceive current resources as inadequate (Kihila, Wernsted, & Kaseva, 2021). Additionally, the habitual reliance on single-use plastics continues to undermine progress. It indicates the need for targeted interventions to address behavioral and systemic barriers. Addressing these issues requires a multi-faceted approach, combining improved infrastructure, consistent awareness campaigns, and the promotion of practical alternatives to single-use plastics (Rabiu & Erben, 2024). By tackling these challenges, schools can strengthen their role in fostering sustainable practices and achieving long-term environmental goals.

The findings of this study are further enriched through thematic analysis. Following a series of data analyses, the researcher identified several recurring keywords that emerged during the interviews with both teachers and students. These keywords reflect common themes and provide valuable insights into the implementation of the *zero plastic waste* policy. The results are presented as follows.

Table 4. Results of Thematic Analysis

Category	Keywords
Teacher	Education, facilities, awareness, collaboration
Student	Habit, water bottle, challenge, creativity

Education plays a central role in the implementation of the zero plastic waste policy (Chauhan & Punia, 2022). Teachers actively contribute to fostering understanding and awareness among students, both through formal instruction and the integration of environmental values into teaching and learning activities. Through consistent educational approaches, students are expected to comprehend the importance of this policy and apply it in their daily lives. Thus, education serves as a foundational step in cultivating positive habits aligned with the *Adiwiyata* program (Utomo et al., 2023).

However, a lack of facilities often poses a significant challenge to the implementation of this policy. Insufficient segregated waste bins and the absence of water refill stations hinder efforts to reduce plastic usage. Without adequate supporting facilities, the policy's implementation becomes less effective and unsustainable. Therefore, the provision of infrastructure such as waste banks,

organic composters, and additional specialized waste bins is an urgent necessity (Abubakar et al., 2022). These supporting facilities will enable students and teachers to adopt environmentally friendly practices in a more structured manner (Hajam, Kumar, & Kumar, 2023).

On the other hand, increased student awareness has emerged as one of the noticeable positive outcomes. Some students have demonstrated behavioral changes, such as bringing their own reusable water bottles and eating utensils from home. However, these changes have not been evenly distributed, as old habits remain difficult to break for some students. This challenge underscores the importance of collaboration with external stakeholders, such as the Department of Environment. Support through education, mentoring, and collaborative programs can accelerate behavioral change and strengthen the effectiveness of the zero plastic waste policy in schools (Solekah & Jumriyah, 2023).

Many communities or students do not fully understand the dangers of plastic waste or how to contribute to the program. Education often does not reach communities or students in remote areas or with low literacy levels. Obstacles such as the difficulty of finding food and beverages without plastic packaging further complicate efforts to reduce plastic usage. Nevertheless, concrete efforts are visible, particularly through habits like bringing reusable water bottles and eating containers. Additionally, creativity emerges as an engaging solution, with initiatives such as plastic recycling competitions and art projects made from waste materials (Yulianto & Sulistyo, 2020). These activities not only raise awareness but also motivate students to actively participate in supporting the zero plastic waste policy. With sustained education, adequate facilities, and support from various stakeholders, this policy can be implemented more effectively and sustainably (Shamsuddoha & Khasem, 2024).

3.2. The Implementing David Orr's Eco-Justice: Challenge and Opportunities in Achieving Zero Plastic Waste

The study highlights the key steps taken by *MAN Insan Cendekia* to achieve a zero plastic waste environment. This effort aligns with the school's commitment to the *Adiwiyata* program. However, challenges show the need for a more comprehensive approach. David Wesley Orr's eco-justice paradigm emphasizes education as a tool for environmental sustainability and justice. Orr's principles provide a framework to analyze the school's efforts, identify gaps, and enhance the implementation of the zero plastic waste policy (Orr, 1994).

First, Orr identifies the failure of education as a root cause of the environmental crisis, advocating for curricula that prioritize ecological literacy and sustainability (Orr, 2002). At *MAN Insan Cendekia*, awareness of the impacts of plastic waste is relatively high among students, reflecting initial success in fostering environmental consciousness. Teachers have incorporated environmental themes into subjects like English and Islamic Studies. Here, they create opportunities for students to connect their learning to real-world environmental challenges. However, this integration remains fragmented and lacks systematic inclusion across the curriculum. To truly support the *Adiwiyata* program, a structured and interdisciplinary curriculum focused on sustainability is essential (Susilawati et al., 2020). Aligning with Orr's view, education must equip students with the knowledge and skills necessary to address plastic waste issues while fostering a moral obligation to protect the environment (Orr, 2011; Anokye et al., 2024).

Second, the principle of green infrastructure underscores the importance of creating a physical environment that embodies sustainability values (Orr, 1994). The absence of essential facilities such as waste banks, composting units, and water refill stations at *MAN Insan Cendekia* highlights a significant gap in the school's ability to achieve its zero plastic waste goal. Orr argues that green infrastructure serves as both a practical solution and a symbolic commitment to sustainability. Without these facilities, efforts to reduce single-use plastics are undermined, as students face barriers to adopting eco-friendly behaviors (Umoh et al., 2024). For the *Adiwiyata* program to succeed, the school must prioritize investments in sustainable infrastructure that supports waste segregation, composting, and the reduction of plastic consumption.

The findings also align with Orr's principle of community-centered education, which emphasizes the importance of local engagement and collaborative problem-solving (Orr, 1994).

Some students at *MAN Insan Cendekia* have demonstrated leadership by encouraging their peers to support the zero plastic waste policy. However, challenges persist, such as the reliance on single-use plastics in the school canteen and the limited availability of alternatives. The author acknowledges that eco-friendly product alternatives are often more expensive than conventional plastics. This can discourage their widespread use, especially in schools with limited budgets. However, schools can adopt creative solutions to address this issue. Gradual transitions to eco-friendly practices and collaborations with local suppliers can help reduce costs. Additionally, raising awareness among students and staff about the long-term environmental and health benefits of reducing single-use plastics can shift the focus from short-term expenses to long-term sustainability. Similarly, addressing these issues requires collaboration with external stakeholders, including local vendors, the Department of Environment, and community-based organizations (Sedtha et al., 2022). By fostering partnerships, the school can create a supportive ecosystem that aligns with the *Adiwiyata* program's goal of promoting environmental responsibility at both the school and community levels.

Orr's concept of stewardship is also reflected in the study's findings. The behavioral changes observed among students—such as bringing reusable water bottles and utensils—indicate the emergence of a sense of responsibility toward the environment (Shutaleva et al., 2022). However, these changes remain inconsistent, as some students struggle to break long-established habits. Orr asserts that stewardship must be cultivated through sustained education, role modeling, and mentoring. Teachers at *MAN Insan Cendekia* play a crucial role in fostering this responsibility by integrating environmental ethics into their teaching and providing practical examples of sustainable behavior. To strengthen stewardship, the school can implement structured programs such as peer mentoring, environmental clubs, and competitions that reward eco-friendly initiatives (Aasa et al., 2020).

The principle of experiential learning, as emphasized by Orr, highlights the importance of hands-on activities in deepening students' connection to the environment. While *MAN Insan Cendekia* has made progress in raising awareness, the lack of experiential learning opportunities—such as recycling projects, composting initiatives, and nature-based activities—limits students' ability to translate knowledge into action. Experiential learning allows students to engage directly with environmental issues, fostering a deeper understanding of the consequences of plastic waste and the importance of sustainable practices (Shutaleva, 2023). By incorporating practical projects aligned with the zero plastic waste policy, the school can empower students to become active participants in achieving the *Adiwiyata* program's objectives (Bui et al., 2023).

Critically, the findings also underscore the interconnectedness of education and infrastructure in achieving zero plastic waste. Orr argues that education must go beyond theory to address systemic barriers that hinder sustainable behavior (Orr, 2002). In the context of *MAN Insan Cendekia*, the lack of adequate facilities and plastic-free alternatives highlights a systemic challenge that cannot be resolved through education alone. The school's commitment to the *Adiwiyata* program requires structural reforms. These include providing comprehensive waste management systems and promoting sustainable consumption practices within the school community (Nada, Fajarningsih, & Astirin, 2023).

While the study demonstrates promising progress, it is important to recognize its limitations. The research focuses on a single educational institution, which may limit the generalizability of the findings. Future studies could adopt a comparative approach to evaluate the implementation of zero plastic waste policies across multiple schools participating in the *Adiwiyata* program. Additionally, longitudinal research is needed to assess the long-term impact of experiential learning and community engagement on student behavior and ecological awareness.

In conclusion, this study highlights the role of Orr's eco-justice paradigm in guiding *MAN Insan Cendekia* toward zero plastic waste under the *Adiwiyata* program. The school must address infrastructure gaps, strengthen experiential learning, and promote community-based education. These steps can make the school a model for sustainable environmental management. Education should become a catalyst for eco-justice. This approach not only supports the zero plastic waste initiative but also prepares students to be responsible environmental stewards.

4. Conclusion

This study explores the application of David Orr's eco-justice paradigm in achieving the zero plastic waste objectives at *MAN Insan Cendekia*, in line with the school's commitment to the *Adiwiyata* program. While student environmental awareness is high, efforts to reduce plastic waste are hindered by a lack of supporting infrastructure and the absence of a systematic integration within the curriculum.

Some students have shown active support for the zero plastic waste policy, but key challenges remain. These include the limited availability of essential facilities such as waste banks, composting units, and plastic alternatives in the school canteen. To meet the *Adiwiyata* goals, the school must improve its sustainable infrastructure, strengthen experiential learning, and engage the entire school community in sustainability activities. These include greening programs, waste management, and more structured environmental education initiatives.

This research contributes to understanding the relationship between education and sustainable infrastructure in supporting zero plastic waste policies, which are central to the *Adiwiyata* program. It also highlights the importance of collaboration between schools, communities, and external stakeholders in fostering environmental responsibility. Due to the study's focus on a single institution, further research using a comparative approach across multiple schools with similar policies is essential. Longitudinal studies are also needed to evaluate the long-term impact of experiential learning and community involvement on students' behavioral changes and ecological awareness.

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