How Self-Regulation and Environmental Knowledge Shape Eco-Friendly Attitudes: Insights from Adiwiyata High School Students in Serang, Banten

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Abstract: How Self-Regulation and Environmental Knowledge Shape Eco-Friendly Attitudes: Insights from Adiwiyata High School Students in Serang, Banten. Objective: This study investigates how self-regulation and environmental knowledge influence eco-friendly attitudes among Adiwiyata High School students in Serang, Banten. **Methods:** A descriptive correlational approach was employed to analyze the relationships between environmental knowledge, self-regulation, and attitudes toward environmental conservation. The population comprised students from SMAN 3 Serang City (classes XI-13 and XII MIPA-2) and SMAN 1 Ciruas (classes XI MIPA-6 and XII MIPA-2). Using purposive random sampling, a sample of 150 students was selected. Data collection involved an environmental care attitude survey, an environmental knowledge exam, and a self-regulation questionnaire, all of which were validated and tested for reliability. The analysis included Pearson correlations, linear regressions, and path analysis to understand both direct and indirect effects. **Findings:** The results showed that the average self-regulation score was 76.25, the environmental knowledge score was 64.10, and the environmental care attitude score was 79.40. There is a positive and significant relationship between self-regulation and environmental knowledge with environmental care attitudes. Students with greater environmental awareness and self-control often exhibit more environmentally conscious attitudes. **Conclusion:** The findings emphasize the importance of including comprehensive environmental education programs that convey information and educate students on self-regulation skills to promote sustainable environmental behaviors.

Keywords: self regulation, environmental knowledge, environmental care attitude

▪ INTRODUCTION

Indonesia, the fourth-most populous nation in the world, suffers from severe environmental problems due to its rapid population growth and intensifying utilization of natural resources. Among others, these aspects increase garbage creation and worsen dumping and associated health hazards, especially in towns with insufficient waste management facilities, and people's inadequate knowledge aggravates these challenges (Fazzo et al 2017). Nevertheless, a collective effort is being made to overcome these obstacles. An excellent example of this can be seen in Indonesia's Adiwiyata school program. As of 2022, a staggering 27,169 schools in the country—including ones like SMA Negeri 1 Ciruas as well as SMA Negeri 3 Kota Serang—had taken up this course meant for environmental awareness education within the school systems (Munawar et al., 2019).

These problems notwithstanding, SMA Negeri 1 Ciruas and SMA Negeri 3 Kota Serang have much potential for growth. Many problems exist such as poor facility cleaning in schools, outside food consumption, and trash among others (Atmanti & Kadang, 2022). Through interviews with biology teachers it is shown that there are gaps in student awareness about environmental matters and their actions towards the environment have been seen to be driven by varying levels of environmental knowledge or lack thereof and the absence of adequate guidance on positive environmental

behaviors. Consequently, these issues can only be resolved by improving students' self-regulation capacities concerning thoughts, motivations, and behaviors that facilitate success in environmental goals (Matric, 2018).

Being able to regulate one's actions through thoughtful planning, persistence, and awareness of human actions, as well as considerations for effective decision making is referred to as self-regulation. The educators play a major role in fostering students' self-regulation by incorporating motivation management, behavior and cognition aspects into instruction for improved learning experience (Salleh et al., 2021). This quality allows the learners to have a positive mindset when setting and working towards their goals while avoiding behaviors that can impede them from trying various things or being influenced negatively (Höpfner & Keith 2021). Students who possess mastery over the art of self-regulation are capable of understanding themselves even better and executing pre-set study plans successfully; this method has proved to be most effective in achieving the best educational outcomes as it incorporates all aspects of self-regulation into personal practice. According to Pichardo et al (2014), there are five essential parts of an individual's ability to self-regulate: getting and weighing information, feeling motivated to make positive changes, looking for the best options, making plans, and checking to see if those plans work.

Environmental care is an attitude and action that supports caring for environmental preservation (Bøhlerengen & Wiium 2022). Attitudes that can be carried out by preventing damage to the surrounding natural environment and taking real action in repairing existing natural damage. This attitude dominates more on students' awareness and concern in acting positively in the environment (Wang et al 2023). Planting the character of environmental care that is applied in the world of education is useful so that students have an understanding and self-awareness in actively participating and creating positive changes to environmental problems. Conscious actions to understand environmental conditions and activities carried out by humans on the environment aim to reduce the negative impact of environmental damage (Si et al 2022). Environmental care plays an important role in aspects of efforts to prevent damage to the natural environment around and efforts to repair damage that has occurred (Chu & Karr, 2017). Activities that support the preservation of natural places are examples of attitudes toward environmental care (Kibbe et al., 2014).

Both protecting the environment and acting quickly to stop environmental harm are highly valued in these schools of thought. An ongoing endeavor to protect and manage the environment responsibly will result in a cleaner, more sustainable world if people adopt environmentally conscious habits. Therefore, it will stimulate proactive participation and beneficial advancements in addressing environmental issues (Mkumbachi et al., 2020). By revealing these connections, this study offers vital information for improving instructional approaches that encourage environmental stewardship and sustainability in the next generation in Serang, Banten, schools and communities. Encouraging students to develop strong self-regulation abilities is essential for fostering environmental awareness and responsible conduct. This method encourages improved time management and a higher standard of living while strengthening students' capacity to control their ideas, motives, and behaviors in support of environmental goals.

By identifying these links, this research provides essential knowledge for enhancing teaching strategies that promote sustainability and environmental stewardship in the

future generations of Serang, Banten, schools, and communities. Building good student self-regulation skills is crucial to promoting environmental consciousness and responsible behavior. In addition to raising living standards and promoting better time management, this approach helps students become more adept at regulating their thoughts, feelings, and actions to promote environmental objectives. In addition, fostering positive environmental attitudes and integrating environmental facts are essential components of actively inspiring children to engage in environmental conservation efforts. The research aims to examine the following interconnected subjects among Adiwiyata high school students in Serang, Banten: attitudes toward environmental care, environmental knowledge, and self-regulation. In the end, preparing children for environmental stewardship requires providing them with the skills, information, and attitudes necessary to build a sustainable future for our planet.

▪ **METHOD**
Study Design and Participants

Because of its descriptive correlational methodology, this study represents a substantial investigation of the relationships between attitudes toward environmental care, environmental knowledge, and self-regulation. It offers a new viewpoint by concentrating on students at the Adiwiyata High School in Serang, Banten. The students from SMA Negeri 1 Ciruas and SMA Negeri 3 Kota Serang comprised the study population. They were selected with care due to their active participation in the environmental education aspects of the Adiwiyata program. This thorough screening procedure guarantees that the survey findings are very genuine and relevant to our target audience.

Data Collection Instruments and Procedure

The study employed three standard instruments to gather data: a 40-item questionnaire measuring environmental goal setting, self-monitoring, and self-reflection that was administered online via Google; a 20-item objective test that was modified from environmental education materials for grade X and administered online via Google Forms; and a 25-item Likert scale questionnaire that was administered online and concentrated on behaviors like waste management and environmental conservation. These tools were selected based on their proven validity and reliability in assessing the targeted constructs, their relevance to the study objectives, and their suitability for online administration, which ensured efficient and broad data collection. Over two months, during regular class hours, biology teachers assisted in the data collection process. Before analysis, the data were checked to ensure they fit parametric assumptions using a rigorous statistical analysis technique called the Kolmogorov-Smirnov test. Another reliable technique utilized in the statistical analysis was descriptive statistics to describe the data's variability. Pearson's correlation coefficient, a commonly used statistical tool, was employed to investigate the relationships between the variables at a significance level of $p < 0.05$.

The three instruments used in the study were self-designed and underwent a thorough validation process. Initially, the instruments were reviewed for feasibility by two expert lecturers relevant to the research. The first expert was a Counseling Guidance lecturer specializing in psychology, and the second was a Biology Education lecturer specializing in instructional methods. Following their evaluations, the instruments were

piloted with 75 students via Google Forms. Based on the calculation of the r-value for 75 respondents, the validity test yielded an r-table value of 0.1888 at a 0.05 significance level, meaning the calculated r-value was greater than or equal to the r-table value. Consequently, the items were deemed valid and suitable for use in the study.

Table1. Validation and reliability of research instruments

Variable	Items Before Validation	Items After Validation	Cronbach's Alpha	N of Items
Self-regulation	60	44	0.848	44
Environmental Knowledge	35	20	0.823	20
Environmental Care Attitude	35	28	0.813	28

If the significance level alpha value is ≥ 0.7, it means that the instrument can be considered to have satisfactory reliability, and the data is valid and suitable for use.

Sampling and Ethical Considerations

In compliance with the requirements for correlation research, the sample size was established using simple random sampling, ensuring every institution had at least thirty respondents. The informed permission of participants and school administrations was carefully gathered in compliance with ethical norms to ensure anonymity and confidentiality. Our steadfast adherence to moral principles demonstrates our honesty and careful respect of study participants' rights.

Instrument Validation and Data Processing Analysis

The first step in the data analysis process was verifying presumptions such as normalcy and linearity. Pearson's correlation analysis was then used to examine the correlations between the variables, and conventional processes were followed in interpreting the results, which had important ramifications. Furthermore, using multiple regression analysis, the study examined how environmental knowledge and self-regulation affect high school students' attitudes toward environmental care in Serang, Banten.

▪ **RESULT AND DISSCUSSION**

Self-Regulation Ability

In the educational setting, student self-regulation integrates motivation, behavior, and cognitive management, fostering engagement in the learning process (Salleh et al., 2021). The assessment of students' self-regulation abilities, with an average score of 76.35, reveals a moderate level. Self-regulation is a multifaceted process encompassing planning, perseverance, and reflective behavior. However, scores varied significantly from a high of 97.5 to a low of 40, underscoring the necessity for individualized approaches to cater to the diverse capabilities among students (Figure 1).

The data highlights that students demonstrate competency in goal-setting, self-monitoring, and self-evaluation to varying degrees. This capacity enables them to complete learning tasks and exhibit appropriate behavior in the school environment, generally avoiding disruptive behaviors. It suggests that students can effectively regulate

their cognition, emotions, and motivation, fostering responsible organizational skills (Mustofa et al., 2019). However, the practical application of self-regulation among students is not fully realized. Observations reveal instances of negative behaviors such as chatting, mobile phone use, and academic dishonesty, indicating a readiness gap in classroom learning environments that requires our attention and support.
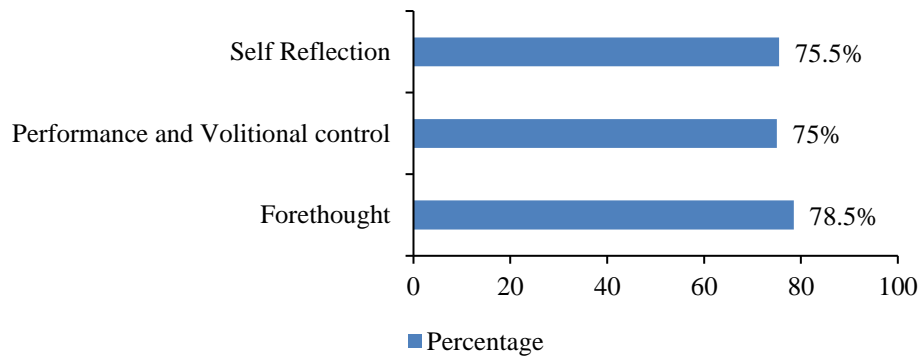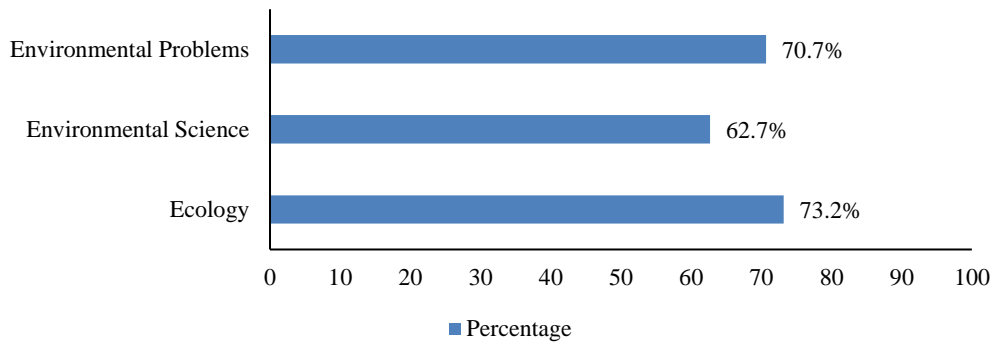

Figure 1. Results of the average value of each self-regulation ability indicator

The challenge lies in students' struggle to adequately control their actions, which hampers effective self-regulation and impedes their ability to monitor and manage behavior (Putrie, 2021). Drawing from Zimmerman's (2015) comparison of students with high and low self-regulation, distinct characteristics emerge. High self-regulation, students exhibit traits such as setting specific goals, focusing on mastery, maintaining confidence, and displaying intrinsic motivation. They employ effective self-instruction, remain performance-focused, and continually monitor progress. In contrast, low self-regulation students lack clear goals, exhibit lower confidence, show less interest in tasks, and may resort to self-handicapping strategies. They demonstrate less structured planning, negative self-attribution, adverse self-reactions, and limited adaptive behavior in self-reflection. These findings underscore the pivotal role of self-regulation in shaping students' goal orientation, motivation, and adaptive behaviors within educational settings.

Student Environmental Knowledge

Zheng et al. (2018) support the integration of various disciplines such as ecology, geology, atmospheric science, earth science, soil science, and biological sciences within environmental knowledge. According to Chang's (2011) further classification, environmental knowledge consists of three key elements. Ecology, first and foremost, is concerned with managing environmental organisms and conserving biodiversity, a task that is becoming increasingly urgent as we face the threat of species extinction. Environmental issues include nuclear power safety, maintaining population hygiene, preventing air and water pollution, managing water resources, and disposing of industrial waste—all pressing concerns that demand our attention and action. Second, science covers many subjects, including waste management, environmental cleanliness, food hygiene, soil pollution prevention, noise pollution control, and sustainable energy methods. All of these topics are critical to our survival on this planet. This comprehensive framework highlights the breadth and complexity of the environmental knowledge

domains students need to learn. A basic understanding of these fields empowers people to actively participate in solving environmental issues and instills a sense of duty. By introducing people to ecological and environmental ideas, we provide them with the knowledge and tools to make a difference.
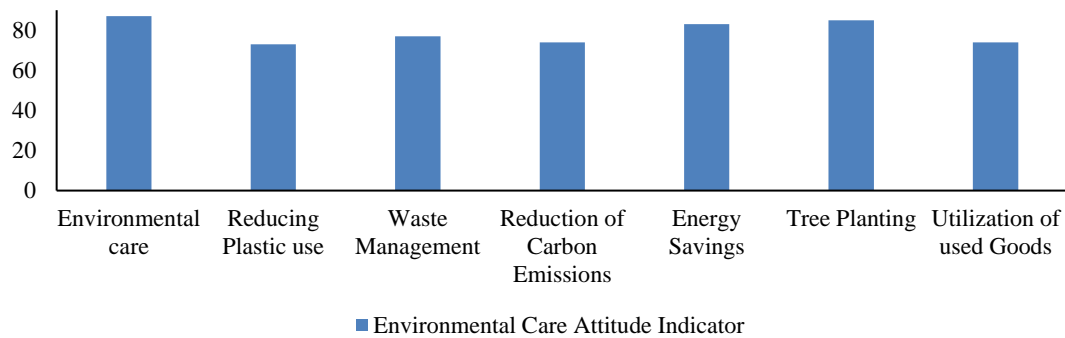

Figure 2. Results of the average value of each student's enviromental knowledge indicator

Figure 2 illustrates the variability in students' comprehension levels across different environmental knowledge categories. Many students need help with higher-order thinking Skills (HOTS) questions, such as 'Explain the impact of deforestation on the local ecosystem' or 'Propose a solution to reduce plastic waste in your community '. They often exhibit limited understanding of environmental topics covered in their curriculum, primarily achieving at the remembering (C1) and understanding (C2) cognitive levels. Differences influence these cognitive disparities in intelligence, memory, and educational experiences (Fetiana et al., 2022).

Furthermore, the impact of misleading answer choices on students' performance must be balanced. These choices often lead to misconceptions, reflecting variations in students' intelligence, memory retention, and concentration levels (Little et al., 2019). In addition, enhanced teaching strategies tailored to diverse learning needs are needed. Such strategies should foster a deeper and more comprehensive understanding of environmental knowledge among students, thereby mitigating the adverse effects of these misconceptions.

Environmental Care Attitude

Care consists of behaviors and attitudes that promote environmental conservation (Sujana et al., 2018). Behaviors include efforts to avoid harming the environment and a readiness to undertake specific actions that help sustain environmental quality. Self-awareness, or how our actions affect the environment, is essential. Mindful actions to comprehend environmental conditions and human activities try to lessen the adverse effects of environmental damage (Gabriella & Sugiarto, 2020), teaching us about the significance of our decisions.

Figure 3. Results of the average value of each environmental care attitude indicator

The data, collected through a series of surveys and observations, indicate that students have been able to apply environmental care attitudes in their daily lives. For instance, we found that 85% of students reported properly disposing of waste, 90% of students were involved in maintaining school facilities, and 80% of students adopted a healthy lifestyle by bringing breakfast and tumbler bottles to reduce plastic waste. This higher pro-environmental behavior reflects a strong environmental care attitude (Ismail, 2021).

While it's true that some students exhibit low environmental care attitudes, it's crucial to recognize that this could be a result of low self-awareness and a lack of implementation of environmental understanding in their daily lives. Baroroh & Roshayanti (2022) echo this, pointing out that students' understanding of the environment is relatively good, but the development of positive attitudes related to environmental care is not yet optimal. This presents a clear opportunity for improvement. The disparity between the program's objectives and students' attitudes in Adiwiyata schools underscores the need for a concerted effort to bridge this gap (Agustin & Maisyaroh, 2020).

It is theoretical but also honest and practical that the Adiwiyata program is being implemented at these schools. The school's vision and purpose statements underscore its commitment to environmental consciousness, which goes beyond words to include concrete actions that prioritize fostering a culture of environmental stewardship. According to Nurhafni et al. (2019), the schools also incorporate participatory environmental activities and an environmental-based curriculum. These are all real-world examples of how the Adiwiyata program is being used. Green open spaces, waste segregation techniques, greenhouses, and water sanitation facilities are real, functioning facilities and activities. Prearranged sustainable and participative activities, such as routine cleanups, help further implement initiatives (Pradini et al., 2018).

On the other hand, there are variations in how environmental stewardship-related facilities are managed. Facilities at SMAN 1 Ciruas, which also has greenhouses and a wholesome cafeteria but lacks proper maintenance of these facilities and distinct organic and inorganic waste bins, contrast with those at SMAN Kota Serang, which has school gardens and well-maintained waste disposal areas (Hadi, 2020). Statements from Fajar & Putra (2021) and Bahrudin (2017), who highlight the integration of environmental learning across courses, support the idea that the Adiwiyata program's adoption in these schools may have a good impact on students' attitudes toward the environment. It's

important to remember that despite these initiatives, significant obstacles still need to be overcome to complete integration and influence students' environmental views (Iswari & Utomo, 2017). Thus, to develop a truly environmentally conscious school culture, incorporate environmental values into the curriculum, and encourage sustainable behaviors, it is imperative to stress the significance of comprehensive participation across all school elements (Darmawan, 2022; Schutter & Bhullar, 2017).

Correlation between variabel

The relationship between self-regulation and environmental care attitudes was examined using correlation analysis. The normality test produced a significance value (Sig. (2-tailed)) of 0.200, indicating that the data is normally distributed. The deviation from linearity test yielded a Sig. value of 0.628, confirming linearity. Using correlation analysis, the null hypothesis (H0) is rejected if the computed correlation coefficient (r) is greater than the table value (rtabel) at the 5% significance level and the Sig. (2-tailed) value is less than 0.05. The results show a Sig. (2-tailed) value of 0.000 and a Pearson correlation of 0.298 for self-regulation, which is greater than the rtabel value of 0.1348. Thus, H0 is rejected, and H1 is accepted, indicating a significant correlation between self-regulation and environmental care attitude.

The strength of the relationship between self-regulation and environmental care attitude is low, with a correlation coefficient of 0.298. The positive correlation indicates that higher self-regulation in students is associated with higher environmental care attitudes. However, the coefficient of determination (R^2) is 0.089, meaning self-regulation accounts for only 8.9% of the variance in environmental care attitudes, with the remaining 91.1% influenced by other factors. This suggests that while self-regulation is important, other factors also play a significant role in shaping environmental care attitudes.

Environmental Knowledge and Environmental Care Attitude were examined using correlation analysis (figure 4). The normality test, using the Kolmogorov-Smirnov test, yielded a probability value of 0.2, confirming that the data is normally distributed. The linearity test produced a Sig. linearity value of 0.81, indicating linearity. The correlation analysis shows a Sig. (2-tailed) value of 0.019, which is less than 0.05. Thus, H0 is rejected, and H1 is accepted, indicating a significant correlation between environmental knowledge and environmental care attitude. The correlation coefficient (r) is 0.191, indicating a very low but positive correlation. This suggests that higher environmental knowledge is associated with slightly higher environmental care attitudes. However, the low correlation coefficient implies that environmental knowledge alone has a limited impact on fostering eco-friendly attitudes, suggesting the need for comprehensive environmental education programs that integrate practical and behavioral aspects. As stated by Liefländer & Bogner (2018), higher environmental knowledge correlates with lower environmental utilization attitudes in schoolchildren, suggesting that well-rounded environmental education programs can help improve environmental attitudes.

The multiple correlation test results Between Self-Regulation and Environmental Knowledge with Environmental Care Attitude show a Sig. F Change value of 0.000 ($\leq$ 0.05), indicating a significant relationship between self-regulation, environmental knowledge, and environmental care attitudes (Figure 4). The correlation coefficient (R) is 0.345, classified as low. The R square value of 0.119 indicates that 11.9% of the variance in environmental care attitudes is explained by self-regulation and

environmental knowledge, while the remaining 88.1% is influenced by other factors. The positive correlation suggests that higher self-regulation and environmental knowledge are associated with stronger environmental care attitudes. This indicates that enhancing self-regulation and environmental knowledge can positively influence student behavior and foster environmental care values. However, the relatively low contribution of these factors underscores the need for comprehensive approaches in environmental education that address various influences on students' attitudes and behaviors. Enhancing students' environmental attitudes and self-efficacy through targeted interventions and rewards may increase the likelihood of pro-environmental behaviors in the community (Shafiei & Maleksaeidi, 2020).
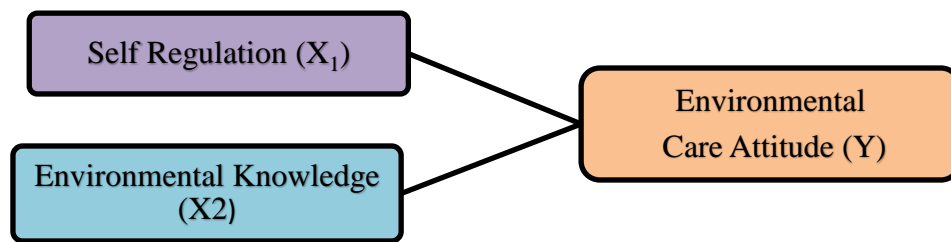
Figure 4. Correlation result

Based on the study, students at Adiwiyata High Schools in Serang, Banten, had notable but limited predictors of their attitudes toward environmental care: self-regulation and environmental knowledge. Although these characteristics contribute to developing eco-friendly attitudes, they are not the only factors, according to the low correlation coefficients. Pro-environmental attitudes are greatly influenced by elements like excellent ecological knowledge and relationships with people who share these values. It has been discovered that these views are greatly aided by involvement in local politics, obtaining higher education, and retaining a good community orientation (Rokicka, 2002).

The significance of providing children with useful coping mechanisms to control their thoughts, feelings, and behaviors is underscored by the role that self-regulation plays in forming attitudes toward environmental care. Through focused programs that improve self-regulation, kids may set and achieve environmental objectives more effectively, which leads to a more consistent adoption of eco-friendly habits. Although attitudes toward the environment are positively correlated with environmental knowledge, the relationship is not very strong. This implies that significant behavioral change cannot be effected only by information. Arlinghaus and Johnston (2018) contend that encouraging behavior change requires comprehensive education that includes instruction in general knowledge, self-awareness, and skill development. Therefore, in addition to imparting knowledge, environmental education programs should prioritize developing marketable skills and forging close emotional connections with the natural world—a vital but frequently disregarded component.

The combined impacts of environmental knowledge and self-regulation can only account for 11.9% of the diversity in attitudes toward environmental care. This low proportion highlights the need to consider a range of other elements, such as societal

influences, school policies, and community engagement, all of which have the potential to impact how children regard the environment. Future research should examine these additional components to offer a more thorough comprehension of how to encourage environmentally conscious actions in students.

▪ **CONCLUSION**

According to our correlation analysis results, we found a strong and positive link between self-regulation, environmental knowledge, and attitudes toward environmental care among students at Adiwiyata High School in Serang, Banten. This study highlights the significance of self-regulation and environmental knowledge in influencing students' attitudes toward environmental care. For this reason, to guarantee the long-term consistency of their objectives, schools classified as Adiwiyata must keep up their efforts and carry out efficacy assessments.

Subsequent investigations must delve into other factors, such as learning motivation, self-efficacy, and self-concept, that may impact attitudes toward environmental care. Comprehensive insights into these processes can only be obtained through comparing research between Adiwiyata and non-Adiwiyata High School pupils in Serang, Banten. Analysis based on age, gender, and grade level should be included in this research. This research needs to be carried out to test the effectiveness and commitment of the school towards the Adiwiyata Awards previously achieved program is implemented sustainably.

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