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EFFECTIVENESS OF GREEN ECONOMY EDUCATION IN INCREASING AWARENESS AND HOUSEHOLD WASTE MANAGEMENT BEHAVIOR AMONG THE COMMUNITY OF PEKANBARU CITY: DESCRIPTIVE ANALYSIS AND WILCOXON SIGNED RANKS TEST

Danil Alpito[1], Anto Ariyanto[2], and Anna Juliarti[3]

[1,2,3] Master of Environmental Science Program, Lancang Kuning University

Email: danilalpito@gmail.com

ABSTRACT

This study examined the effectiveness of green economy-based education in increasing community awareness and household waste management behavior in Padang Terubuk Sub-district, Pekanbaru City, using a quantitative one-group pre-test post-test design. Data were collected from 200 respondents selected through proportionate stratified random sampling and processed using IBM SPSS Statistics. Instrument validity was assessed with the Pearson Product Moment correlation on 66 questionnaire items, yielding 60 valid items, while instrument reliability tested with Cronbach's Alpha produced a coefficient of 0.754, indicating that the instrument was reliable. Prior to the difference test, normality of the pre-test and post-test scores was examined using the Kolmogorov-Smirnov and Shapiro-Wilk tests; because the post-test data were not normally distributed, the Wilcoxon Signed Ranks Test was applied to compare the two measurement periods. Descriptive analysis showed that all seven research variables increased from the pre-test to the post-test, with the largest increase occurring in the Green Economy Education variable ($\Delta = 38.0$) and the smallest in Behavioral Control ($\Delta = 13.3$). The Wilcoxon test confirmed that the increase in all variables was statistically significant ($p < 0.001$). These findings indicate that green economy-based education is effective in raising environmental knowledge, attitudes, and 3R (reduce, reuse, recycle) behavior at the individual level, although further reinforcement is still required to translate this awareness into collective community participation.

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* CORRESPONDING AUTHOR. Email: danilalpito@gmail.com

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INTRODUCTION

Waste is one of the most pressing environmental challenges faced by nearly all urban areas in Indonesia, in line with population growth, urbanization, and changing consumption patterns. The brown economy paradigm, which is energy-intensive and gives little consideration to environmental sustainability, has given rise to an alternative idea known as the green economy, namely an economic system that is low-carbon, resource-efficient, and oriented toward social welfare (Merino-Saum et al. 2020). Applying green economy principles in the waste sector is considered capable of reducing waste generation while opening opportunities for the development of more efficient recycling infrastructure (Nurkarim 2024).

One concrete manifestation of the green economy at the community level is waste management based on reduce, reuse, recycle (3R), because this activity directly lowers the environmental burden while creating new economic value. Waste bank programs, for example, have been shown to provide direct economic benefits to participating communities while reducing the volume of waste that ends up in final disposal sites (Purwanti 2021), whereas the development of ecotourism and the processing of organic waste into compost have been shown to open new sources of income for surrounding communities (Rahman et al. 2023).

This phenomenon is clearly reflected in Pekanbaru City. Studies on waste management performance in Pekanbaru City show that the limited capacity of the final processing site (TPA) and low community participation in waste sorting remain the main unresolved challenges (Samat et al. 2024), while the final disposal system at TPA Muara Fajar II is reported to still use an open dumping method that poses a high risk of environmental pollution (Putri & Suriani 2024). A policy evaluation in one of the sub-districts of Pekanbaru City also found that the implementation of waste management programs is still hampered by weak regulatory enforcement, a lack of supporting facilities, and low public awareness of sorting waste at its source (Lestari & Kamaruddin 2023).

Several studies have also found a gap between the knowledge held by the community and the actual practices carried out in daily life (Pitri et al. 2024), and that knowledge, attitudes, and the availability of supporting facilities are closely related to community behavior in applying 3R principles to household waste management (Dwi Setyo Arti et al. 2024). However, the results of previous studies have not been consistent; some show a significant influence of knowledge and attitudes on waste management behavior (Yuyun et al. 2026), while others find that the knowledge and attitudes held do not always correspond to concrete action (Rahmah & Hairuddin 2021). These differing findings underscore the need for further quantitative studies on the extent to which educational interventions can consistently increase awareness and change household waste management behavior, particularly in urban communities such as Pekanbaru City.

Based on the above description, this study aims to analyze the effectiveness of green economy-based education in increasing the knowledge, awareness, and household waste management behavior of the community of Padang Terubuk Sub-district, Pekanbaru City. Unlike structural model analyses that test relationships among variables simultaneously, this article focuses specifically on the stages of statistical analysis using IBM SPSS Statistics software, namely instrument validity and reliability testing, descriptive analysis of pre-test and post-test scores, data normality testing, and a non-parametric difference test to determine the significance of the increase in community knowledge, awareness, and behavior before and after the education was provided.

METHOD

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1. Research Design

This study used a quantitative approach with a one-group pre-test post-test design, which takes two measurements on the same group of respondents without a comparison (control) group. The first measurement (pre-test) was conducted to map the initial condition of respondents' knowledge, attitudes, and household waste management behavior before the intervention, while the second measurement (post-test) was conducted after the green economy education intervention was delivered, with an incubation period of approximately one month so that the educational material could be internalized by the respondents.

2. Research Location and Time

The study was conducted in Padang Terubuk Sub-district, Senapelan District, Pekanbaru City, Riau Province, from January to June 2026, covering the stages of instrument development and trial, implementation of the educational intervention, collection of pre-test and post-test data, and data processing and analysis. The study population comprised all heads of households or household representatives in Padang Terubuk Sub-district, totaling 8,359 people according to data from the Pekanbaru City Central Statistics Agency (BPS) as of January 2026. The sample size was determined using the Slovin formula with a margin of error (e) of 7 percent (Antoro 2024), yielding a minimum sample of 200 respondents. The sampling technique used proportionate stratified random sampling across six (6) strata of Rukun Warga (RW) areas, given the relatively different population density and settlement patterns among the RWs.

3. Research Instrument

Data were collected using a closed questionnaire with a four-point Likert scale measuring seven research variables, namely Green Economy Education (X1), Environmental Knowledge (X2), Attitude (X3), Subjective Norms (X4), Behavioral Control (X5), Community Awareness (Y1), and 3R Waste Management Behavior (Y2), consisting altogether of 66 statement items (Pujihastuti 2010). Before being used on the main sample, the instrument was first tested (pilot study) on a small number of respondents outside the main sample. Validity testing was carried out using IBM SPSS Statistics software through the Pearson Product Moment correlation test, with the criterion that a statement item is valid if the calculated r value is greater than the r table value (0.279). Reliability testing was carried out using the Cronbach's Alpha formula, with the criterion that the instrument is reliable if the Alpha value is greater than 0.60. The results of the instrument validity and reliability tests are presented in the Results and Discussion section.

4. Data Collection Procedure

Data collection was carried out in four stages, namely (1) a preparation stage consisting of obtaining research permits and trying out the instrument; (2) a pre-test stage, in which questionnaires were distributed to 220 selected respondents to measure the initial condition; (3) an intervention stage in which green economy education was delivered both face-to-face and through supporting educational media; and (4) a post-test stage, in which the questionnaire was distributed again to the same respondents after an incubation period of one month. The complete pre-test and post-test data were then tabulated using Microsoft Excel before being processed further using IBM SPSS Statistics.

5. Data Analysis Technique

Data analysis was carried out in stages using IBM SPSS Statistics. First, descriptive statistical analysis was conducted to map respondent characteristics and the mean score of each research variable at the pre-test and post-test stages. Second, a data normality test was conducted using the Kolmogorov-Smirnov and Shapiro-Wilk tests as a prerequisite for determining the type of difference test to be used, with the criterion that data are normally distributed if the significance value is greater than 0.05. Third, because one of the data groups (the post-test scores) did not meet the normality assumption, the difference test between pre-test and post-test scores for all research variables was conducted using the non-parametric Wilcoxon Signed Ranks Test rather than the parametric Paired Sample T-Test (Setianingsih & Nelmiawati 2020), with the increase declared statistically significant if the significance value (p) was less than 0.05.

RESULTS AND DISCUSSION

1. Respondent Characteristics

Based on the questionnaire distribution, of the 220 pre-test questionnaires distributed, 200 valid and complete data sets were obtained for analysis, and of the 220 post-test questionnaires, 200 valid data sets were likewise obtained from the same respondents, thereby meeting the minimum sample threshold based on the Slovin formula. The characteristics of the 200 respondents who made up the final research sample, analyzed using a frequency test in IBM SPSS Statistics, are presented in Table 1.

Table 1. Respondent Characteristics (n = 200)

Characteristic	Category	n	%
Sex	Male	99	49.5
	Female	101	50.5
Age (years)	17–25	38	19.0

	26–35	71	35.5
	36–45	46	23.0
	46–55	31	15.5
	56–65	14	7.0
Occupation	Private Employee	61	30.5
	Student (School/University)	40	20.0
	Self-employed	34	17.0
	Housewife	28	14.0
	Others	20	10.0
	Civil Servant	17	8.5

Source: Results of IBM SPSS Statistics data processing, 2026

Based on Table 1, respondents were dominated by the 26–35 age group, with 71 people (35.5%), which is a productive age group that is generally actively involved in household management, including domestic waste management. The composition of respondents by sex was relatively balanced between males (49.5%) and females (50.5%), while by occupation the largest proportion was private employees (30.5%), followed by students and self-employed persons. This demographic composition is relevant to the research context of household waste management behavior, considering that age, sex, and occupation are demographic factors that have been empirically shown to be related to household waste management practices in the community (Fikriya et al. 2025).

2. Results of Instrument Validity and Reliability Tests

The instrument validity test was conducted at the pilot study stage using IBM SPSS Statistics software through the Pearson Product Moment correlation test, by comparing the calculated r value of each statement item against the r table value of 0.279. A summary of the validity test results for each research variable is presented in Table 2.

Table 2. Summary of Research Instrument Validity Test Results

Variable	Number of Items	Valid Items	Invalid Items
Green Economy Education (X1)	9	8	1
Environmental Knowledge (X2)	9	8	1
Attitude (X3)	9	9	0
Subjective Norms (X4)	9	8	1
Behavioral Control (X5)	9	8	1
Community Awareness (Y1)	9	8	1
3R Waste Management Behavior (Y2)	12	11	1
Total	**66**	**60**	**6**

Source: Results of IBM SPSS Statistics data processing, 2026

Based on Table 2, of the 66 statement items tested, 60 items (90.9%) were declared valid and 6 items (9.1%) were declared invalid, so the invalid items were removed from the subsequent research instrument. The reliability test using the Cronbach's Alpha formula on the 66 statements produced a coefficient of 0.754, which is above the threshold of 0.60, so the research instrument was declared reliable and suitable for data collection on the main sample.

Results of Descriptive Analysis of Pre-test and Post-test Scores

Descriptive analysis was conducted to map the level of knowledge, awareness, and waste management behavior of the community before and after receiving the green economy education intervention, by calculating the mean score of each research variable based on pre-test and post-test data from 200 respondents using IBM SPSS Statistics. The descriptive analysis results are presented in Table 3.

Table 3. Summary of Mean Scores of Research Variables

Variable	Pre-test (%)	Category	Post-test (%)	Category	Δ
Green Economy Education	50.5	Moderate	88.5	Very High	38.0
Environmental Knowledge	61.3	High	86.9	Very High	25.6
Attitude	70.2	High	88.4	Very High	18.2
Subjective Norms	60.0	Moderate	74.9	High	14.9
Behavioral Control	50.8	Moderate	64.1	High	13.3
Community Awareness	63.2	High	85.7	Very High	22.5
3R Waste Management Behavior	45.1	Moderate	61.9	High	16.8

Source: Results of IBM SPSS Statistics data processing, 2026

Based on Table 3, all research variables showed a consistent increase in scores from the pre-test to the post-test stage, with the highest increase occurring in the Green Economy Education variable (Δ = 38.0), followed by Environmental Knowledge (Δ = 25.6) and Community Awareness (Δ = 22.5), while the lowest increases occurred in Behavioral Control (Δ = 13.3) and 3R Waste Management Behavior (Δ

= 16.8). The largest difference in the Green Economy Education variable can be explained by the fact that this variable is the direct target of the intervention provided, so its impact is most immediately reflected in the measurement results. Conversely, the Behavioral Control and 3R Behavior variables showed more moderate increases because changes in these variables are indirect, as knowledge and attitudes must first be internalized into awareness before being manifested as real behavioral change in the field. This pattern is consistent with previous research findings showing that educational interventions based on behavior change communication consistently increase community knowledge and attitudes significantly, whereas changes in actual practice or behavior tend to require a longer habituation process (Yudiana & Setyono 2026).

3. Results of Data Normality Test

Before conducting the difference test between pre-test and post-test scores, a data normality test was first carried out using the Kolmogorov-Smirnov and Shapiro-Wilk methods as a prerequisite for determining the type of statistical test to be used. The results of the normality test on the total pre-test and post-test scores using IBM SPSS Statistics are presented in Table 4.

Table 4. Results of Pre-test and Post-test Data Normality Test

Variable	Kolmogorov-Smirnov	df	Sig.	Shapiro-Wilk	df	Sig.
Total Pre-test Score	0.051	200	0.200*	0.988	200	0.105
Total Post-test Score	0.066	200	0.034	0.976	200	0.002

Source: Results of IBM SPSS Statistics data processing, 2026

Based on Table 4, the total pre-test score data were normally distributed, with significance values of 0.200 (Kolmogorov-Smirnov) and 0.105 (Shapiro-Wilk), both above 0.05. In contrast, the total post-test score data were not normally distributed, with significance values of 0.034 (Kolmogorov-Smirnov) and
0.002 (Shapiro-Wilk), both below 0.05. Because one of the data groups did not meet the normality assumption, the comparison of pre-test and post-test scores for all research variables was carried out using the non-parametric Wilcoxon Signed Ranks Test, as is customary when one or both paired data groups are not normally distributed (Setianingsih & Nelmiawati 2020).

4. Results of the Wilcoxon Signed Ranks Test

The results of the Wilcoxon Signed Ranks Test comparing pre-test and post-test scores for each research variable using IBM SPSS Statistics are presented in Table 5.

Table 5. Results of the Wilcoxon Signed Ranks Test for Research Variables

Variable	Mean Pretest	Mean Posttest	Difference	Z	Sig. (p)
Green Economy Education	20.20	35.39	15.19	-12.290	<0.001
Environmental Knowledge	24.53	34.78	10.25	-12.287	<0.001
Attitude	31.61	39.78	8.17	-12.253	<0.001
Subjective Norms	24.00	29.97	5.97	-12.191	<0.001
Behavioral Control	20.33	25.63	5.30	-12.188	<0.001
Community Awareness	25.29	34.26	8.97	-12.284	<0.001

3R Behavior	24.82	34.03	9.21	-12.292	<0.001

Source: Results of IBM SPSS Statistics data processing, 2026

Based on Table 5, the seven research variables, namely Green Economy Education, Environmental Knowledge, Attitude, Subjective Norms, Behavioral Control, Community Awareness, and 3R Waste Management Behavior, all showed statistically significant increases in mean scores from the pre-test to the post-test, with a significance value of $p < 0.001$ for all variables. The highest increases occurred in the Green Economy Education and Environmental Knowledge variables, while Subjective Norms and Behavioral Control recorded the lowest score differences. The Z values for all variables fall within a close range (-12.188 to -12.292), indicating that the pattern of score increases occurred relatively uniformly among almost all respondents, with a very small number of ties (respondents whose scores did not change). Overall, these findings indicate that the green economy-based education intervention succeeded in driving positive change in the cognitive dimension (knowledge), the affective dimension (attitude, awareness), and the planned behavior dimensions (subjective norms, behavioral control, and 3R behavior). The pattern of higher increases in the knowledge and attitude dimensions compared with the actual behavior dimension is in line with the literature on the effectiveness of environmental education, which shows that educational interventions tend to consistently increase pro-environmental knowledge and attitudes in most studies, while their impact on actual behavior varies far more across individuals, a phenomenon known as the knowledge-attitude-behaviour gap (Koech et al. 2026). Similar findings also confirm that increased environmental knowledge does not automatically lead to direct behavioral change, but must be mediated by previously formed attitudes (Puspitasari et al. 2026). This is theoretically reinforced by the Theory of Planned Behavior, in which perceived behavioral control reflects the availability of real resources and opportunities to act, rather than merely an individual's intention or knowledge (Ajzen 1991), so it is reasonable that the increase in this variable through education is slightly less uniform than in cognitive variables such as knowledge. Thus, the SPSS analysis results of this study statistically confirm that green economy education is effective in increasing the knowledge, awareness, and household waste management behavior of the community of Padang Terubuk Sub-district at the individual level, although the increase occurs gradually and is not uniform across all behavioral dimensions.

CONCLUSION

Based on the results of descriptive analysis and difference testing using IBM SPSS Statistics, it can be concluded that the research instrument was valid (60 of 66 statement items) and reliable (Cronbach's Alpha = 0.754). All seven research variables showed a consistent increase in mean scores from the pre-test to the post-test stage, with the highest increase in the Green Economy Education variable ($\Delta = 38.0$) and the lowest increase in the Behavioral Control variable ($\Delta = 13.3$). The Wilcoxon Signed Ranks Test confirmed that the increase in all variables was statistically significant ($p < 0.001$). These findings demonstrate that green economy-based education is effective in increasing the knowledge, awareness, and 3R-based household waste management behavior of the community of Padang Terubuk Sub-district, Pekanbaru City,

particularly at the level of individual practice. Given that this study is still limited to descriptive analysis and non-parametric difference testing, future research is recommended to analyze the structural relationships among variables in greater depth, for example through a Structural Equation Modeling approach, in order to identify the paths of influence and the mediating role of community awareness in waste management behavior more comprehensively.

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