

Pro-Environmental Behaviour in an Indonesian Adiwiyata School: Behavioural Profiles and Implications for Place-Based Geography Education

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ABSTRACT

This study examined pro-environmental behaviour among the school community of State Senior High School 11 Yogyakarta, an Adiwiyata-designated school, using two role-specific questionnaires completed by 97 respondents (69 students, 23 teachers, 5 educational staff). Descriptive statistics, correlation, one-way ANOVA, multiple regression, exploratory factor analysis, and cluster analysis were used to address the study aims. The school community's overall pro-environmental behaviour was rated good ($M = 4.16$, $SD = 0.46$ on a 1–5 scale); plant care/maintenance was the weakest reported behaviour in both questionnaires, rather than waste separation as earlier assumed. Environmental knowledge was associated with behaviour ($r = 0.53$, $p < .001$). School support was the strongest correlate of behaviour ($\beta = 0.34$, $p < .001$), followed by family/peer support ($\beta = 0.28$, $p = .002$) and government support ($\beta = 0.26$, $p = .007$), all three statistically significant. Cluster analysis identified three behavioural profiles: Highly Committed (42%), Moderately Engaged (36%), and Need Improvement (22%). These associational findings suggest that good reported behaviour in this Adiwiyata-designated school co-occurred with school-level infrastructure and family engagement, and they point to a place-based geography education opportunity: using the school itself as a learning site for examining how institutional rules, facilities, and everyday routines shape human-environment interaction.

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1. Introduction

Environmental degradation, including pollution, uncontrolled waste, and resource depletion, continues to accelerate in both industrialised and developing regions (Febriani et al., 2020; Nurwidodo et al., 2020). This trend runs counter to the global sustainability commitments set out in the United Nations' (2015) 2030 Agenda, which frames environmental stewardship as inseparable from education and community wellbeing. In Indonesia, the Ministry of Environment and Forestry's Adiwiyata Program asks schools to embed environmental values into daily policy, curriculum, and campus life. State Senior High School 11 Yogyakarta, the school examined here, has taken up this mandate across its governance, teaching, and extracurricular routine.

Certification, however, is not evidence that behaviour has changed (Schelly et al., 2012). Several recent studies report a weaker-than-assumed link between Adiwiyata status and behavioural outcomes: a moderate correlation between program activity and environmental care attitudes in Malang ($r = 0.435$; Mutia et al., 2025), inconsistent attitude gains among senior high school students (Wibowo, N.A., et al., 2023), limited science-literacy gains in Padang City schools (Safrizal et al., 2022), and pre-service teachers' intentions depending heavily on institutional reinforcement (Surjanti et al., 2024). Taken together, this literature indicates that Adiwiyata's promise is conditional on factors that remain underspecified for Indonesian secondary schools.

The Theory of Planned Behaviour (TPB) is the study's guiding framework: behaviour follows intention, which is shaped by attitude, subjective norms, and perceived behavioural control (Ajzen, 1991; Effendi et al., 2020; Zulkepli et al., 2024). The present study adapts rather than fully

operationalises TPB. Environmental knowledge is treated as an antecedent that feeds attitude formation (Liao & Li, 2019; van de Wetering et al., 2022), and school, family, and government support are treated as concrete, context-specific analogues of subjective norms and perceived behavioural control, following the precedent of other extended-TPB studies in similar settings (Lucarelli et al., 2020; Phang & Ilham, 2023). This adaptation is necessary because the school-level supports of interest here are institutional and social conditions rather than individual cognitions, and because the study's second aim is precisely to test whether such external, place-embedded conditions carry predictive weight alongside internal knowledge, in the manner reported for institutional support in higher education (Guan et al., 2025) and for infrastructural conditions in household energy behaviour (Du & Pan, 2021).

A geographical, place-based reading adds a dimension that TPB alone does not capture: the school is not only an institution but a place in which physical facilities, institutional rules, and everyday human-environment interaction jointly shape practice (Israel, 2012; Windsor & Kriewaldt, 2023). Place-based environmental education programmes elsewhere have been shown to strengthen students' attachment to a specific site and, through that attachment, their engagement with its environmental issues (Fu & Komatsu, 2024), and place attachment has itself been linked to adolescents' pro-environmental behaviour and wellbeing more broadly (Bartolo et al., 2023). Waste separation illustrates this well. It is one of the most persistent weaknesses in school environmental programmes internationally, even where general awareness is high (Bahçelioglu et al., 2020; Trihadiningrum et al., 2023; D. Zhang et al., 2023). A gap between knowledge and consistent sorting practice has also been documented among university students in China (Liu & Green, 2024); a meta-analysis of plastic-waste interventions found that convenience-focused, environment-level changes outperformed knowledge-only campaigns (Allison et al., 2022). Wang and Mangmeechai (2021) showed that a gap can persist between stated intentions and actual sorting behaviour when supporting infrastructure, such as labelled bins or accessible collection points, is inconsistent; this is a spatial and material problem as much as a psychological one, and it motivates treating the school grounds as a place-based context for interpreting the survey findings, rather than as a site whose spatial properties this study directly measured.

Three gaps motivate the present study. First, quantitative assessments of Adiwiyata schools rarely combine correlation, regression, and factor analysis within a single model that separates internal and external influences (Su et al., 2025). Second, segmentation methods such as cluster analysis, which could identify which subgroups of a school community need which kind of intervention, are rarely applied to pro-environmental behaviour data in Indonesian secondary schools (Hastuti et al., 2024), even though intervention-design reviews consistently call for audience-matched content (Rau et al., 2022). Third, although place-based education and place attachment have each been linked to environmental engagement elsewhere, as noted above, the literature connecting Adiwiyata or other Indonesian green-school programmes specifically to place-based geography education, rather than treating them only as policy artefacts, remains thin (Windsor & Kriewaldt, 2023).

This study therefore examines pro-environmental behaviour among the full school community, students, teachers, and educational staff, at State Senior High School 11 Yogyakarta, with three aims: (1) to document the specific forms of pro-environmental behaviour practised across the school community; (2) to test how environmental knowledge (an internal factor, analysed through correlation and exploratory factor analysis) and school, family, and government support (external factors, analysed through multiple regression) are associated with that behaviour; and (3) to identify distinct behavioural profiles, through cluster analysis, that could inform differentiated, place-based intervention design. Three hypotheses follow: environmental knowledge is positively associated with pro-environmental behaviour; school support is the strongest correlate of behaviour among the three support sources measured; and the school community can be meaningfully separated into distinct behavioural profiles. The study's contribution is twofold: it extends an adapted TPB model to an Indonesian secondary-school context, and it offers a geography-education reading of the school as a place-based site for examining human-environment interaction.

2. Method

2.1 Research Design

This study used a quantitative, descriptive-associational design based on a single-time-point survey administered online (Google Forms), with an adapted Theory of Planned Behaviour as the guiding framework (Ajzen, 1991; Effendi et al., 2020). Data collection took place within a structured field-study

activity (kuliah lapangan) conducted by Geography students, combining direct observation and informal interviews with school-community members alongside the structured questionnaire; the observation and interview components informed the fieldwork process and the geographical contextualisation, but were not separately coded or statistically analysed, so the quantitative analysis reported in this paper is based specifically on the questionnaire (angket) responses. Because that analysis draws on cross-sectional survey data rather than an experimental design, it supports associational rather than causal claims, consistent with the approach used in comparable Indonesian school-based sustainable-behaviour research (Rahmania, 2024).

2.2 Study Area and Geographical Context

State Senior High School 11 Yogyakarta is a public senior high school in Yogyakarta City, Special Region of Yogyakarta, an urban area characterised by dense settlement, mixed residential and educational land use, and municipal solid-waste services that, as in many Indonesian cities, rely heavily on manual collection and limited source-separation infrastructure; comparable Indonesian secondary schools have specifically reported challenges managing electronic-waste streams (Trihadiningrum et al., 2023), and constrained solid-waste infrastructure more broadly has been reported for schools in other developing-country settings (Espiritu, 2024). Understood geographically, the school functions as a bounded place in which physical facilities (waste bins, water points, green space), institutional rules (Adiwiyata policy, curriculum integration), and everyday routines (class schedules, break-time behaviour) jointly structure how the school community interacts with its immediate environment (Israel, 2012). This framing motivates treating the school as a place-based context for interpreting the survey findings: its physical and institutional characteristics plausibly shape the behavioural patterns reported below, even though those characteristics were not themselves measured in this study.

2.3 Population and Sampling

The questionnaire was administered in person to a convenience sample of the school community during a single field-study visit (29 October 2025), rather than through a formally randomised stratified draw. Responses were collected from 98 individuals in total. After removing one response with no role or name recorded, the analytic sample was 97 respondents: 69 students, 23 teachers, and 5 educational staff. Because participants were those present and willing to take part during the field-study visit rather than a fixed sampling frame, an exact response rate against the eligible population cannot be calculated; the achieved sample represents those who completed the questionnaire during the visit, and is best understood as a convenience sample of the school community rather than a probability sample.

The convenience-sampling approach and the resulting sample size are carried forward as explicit limitations in the Conclusion. The small educational-staff stratum ($n = 5$) in particular limits the precision of any staff-specific estimate.

2.4 Instrument

Two role-specific questionnaires were used, distributed via Google Forms, both using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The student questionnaire (69 respondents) recorded demographic information (class, gender, parental occupation and education) and 34 substantive items: 10 on pro-environmental behaviour (e.g., waste disposal, waste separation, energy and water use, plant care, peer reminders), 8 on environmental knowledge and attitude, and 16 on external support (5 school, 6 family, 5 government). The teacher/educational-staff questionnaire (28 respondents with a valid role, plus 1 respondent whose role was not recorded) recorded position (teacher or educational staff) and 26 substantive items: 11 on pro-environmental behaviour, 6 on knowledge and attitude, and 9 on support (3 school-leadership, 3 peer/collegial, used here as the social-support analogue to the student questionnaire's family-support items, and 3 government). Because the two instruments differ in item wording and count, composite behaviour, knowledge, attitude, and support scores (item means, which place both instruments on the same 1–5 metric regardless of item count) rather than raw totals were used for all cross-role comparisons. Using item means equalises scale length but does not by itself establish measurement equivalence in the psychometric sense (i.e., that the same underlying construct is being measured identically across groups), since the two instruments were not co-calibrated or cross-validated against each other; this is why item-level factor analysis was conducted for the student subsample only, why the pooled regression's family/peer-support predictor

is treated explicitly as a social-support analogue rather than an identical construct and why separate role-group regression models are reported alongside the pooled model as a direct sensitivity check on this assumption. Mean composite scores were converted to five ordinal categories using conventional Likert interval boundaries adapted from prior Adiwiyata-school survey research (Wibowo, N.A., et al., 2023): Very Poor (1.00–1.79), Poor (1.80–2.59), Moderate (2.60–3.39), Good (3.40–4.19), and Very Good (4.20–5.00).

Reliability was assessed on the actual collected responses rather than a separate pilot sample, since no separate pilot data were available. Cronbach's alpha was 0.76 for the 10-item student behaviour scale, 0.85 for the combined student knowledge/attitude scale, and 0.83 for the 11-item teacher/staff behaviour scale, all above the conventional 0.70 threshold, computed directly on the analytic sample rather than a separate pilot dataset.

2.5 Data Collection

Data were collected on 29 October 2025 as part of a supervised Geography field-study activity (kuliah lapangan), during which students visited the school in person and combined direct observation and interviews with school-community members with administration of the structured questionnaire (angket) via an online form. Timestamps indicate most questionnaire responses were completed within a single morning session, consistent with on-site completion under the supervision of the field-study instructors.

2.6 Data Analysis

Each study aim was addressed by a specific analysis, run in Python (pandas, scipy, statsmodels, scikit-learn) directly on the cleaned response data. Aim 1 (documenting behaviour) was addressed with descriptive statistics for each behavioural item, computed separately for the two instruments. Aim 2 (testing internal and external associations) was addressed in two parts: Pearson correlation tested the association between environmental knowledge and behaviour across the combined sample, while multiple linear regression tested school, family/peer, and government support as correlates of behaviour; attitude was not entered as a regression predictor because the regression model was designed specifically to test the three external support sources, and its role alongside knowledge was instead examined through exploratory factor analysis. A one-way ANOVA with Tukey HSD post hoc tests compared the three role categories on composite behaviour. Exploratory factor analysis with varimax rotation was applied to the 24 knowledge/attitude/support items in the student subsample only ($n = 69$), since the two instruments' differing items prevented a combined item-level factor analysis across roles. Aim 3 (behavioural profiles) was addressed with k-means cluster analysis on standardised behaviour, knowledge, and attitude composite scores across the full sample ($n = 97$); silhouette coefficients were compared across $k = 2-5$ to check cluster adequacy. Significance was set at $p < .05$ throughout.

2.7 Ethical Considerations

This study did not undergo formal review by a research ethics committee; instead, it was authorised through the institutional research-permission procedure standard for undergraduate thematic field-study (Kuliah Kerja Lapangan) coursework in Indonesia. Permission to conduct the study was requested by the Faculty of Social Sciences, Universitas Negeri Padang (Letter No. 4072E/UN35.6/LT/2025, 20 October 2025) and granted by the principal of SMA Negeri 11 Yogyakarta (Surat Izin Melaksanakan Penelitian No. B/000.9.2/1842/SMA.11, 24 October 2025), covering observation, interviews, and questionnaire administration at the school from 29 to 31 October 2025, on condition that the researcher complied with school rules, upheld academic conduct standards, and did not disrupt teaching and learning activities. This institutional permission operated at the school level rather than through individually signed parental or guardian consent forms: the school administration authorised the activity for its students as a condition of the visit, and participants were informed of the study's purpose before completing the questionnaire, with completion treated as consent to participate. We report this as the actual consent arrangement rather than as a documented individual parental-consent procedure, and note it as a limitation on individually documented consent for minor respondents. No personally identifying information was retained in the analysis dataset; respondent-supplied names were removed before analysis.

3. Results and Discussion

The analytic sample comprised 97 respondents: 69 students (71.1%), 23 teachers (23.7%), and 5 educational staff (5.2%). Gender was recorded for the student questionnaire only (44 female, 23 male, 2 not recorded); the teacher/staff questionnaire did not collect gender, so no combined gender comparison is reported.

3.1 Level of Behaviour

The school community's overall pro-environmental behaviour averaged 4.16 out of 5.00 (SD = 0.46, $n = 97$), in the Good category. Because the two questionnaires used different items, the highest- and lowest-scoring behaviours are reported separately below rather than in one shared table. Among students, water conservation scored highest ($M = 4.86$) and plant care/maintenance scored lowest ($M = 3.17$), a pattern consistent across both questionnaires used in this study, with waste separation in the lower-middle range ($M = 3.68$). Among teachers and staff, water conservation again scored highest ($M = 4.93$) and plant care/maintenance again scored lowest ($M = 3.59$), with combined waste disposal/separation relatively high ($M = 4.55$). The finding that plant care emerged as the weakest behaviour in both instruments, rather than waste separation, is notable given that waste separation is often assumed to be the weakest behaviour in the wider literature. The overall Good rating is broadly consistent with evidence that active student participation in environmental education programmes is associated with a measurable, positive shift in pro-environmental behaviour rather than a merely symbolic one (Handayani & Widodo, 2024).

Environmental knowledge was moderately associated with behaviour across the combined sample ($r = .53$, $p < .001$, $n = 97$; $r^2 = .28$). This is consistent with the Theory of Planned Behaviour's premise that knowledge feeds attitude and behaviour without fully determining it (Liao & Li, 2019; Pan & Liu, 2024); the substantial unexplained variance (72%) indicates that factors beyond knowledge account for a large proportion of the variation in behaviour. Figure 1 plots this association using the actual paired knowledge and behaviour scores for all 97 respondents, together with the fitted regression line and an approximate confidence band.

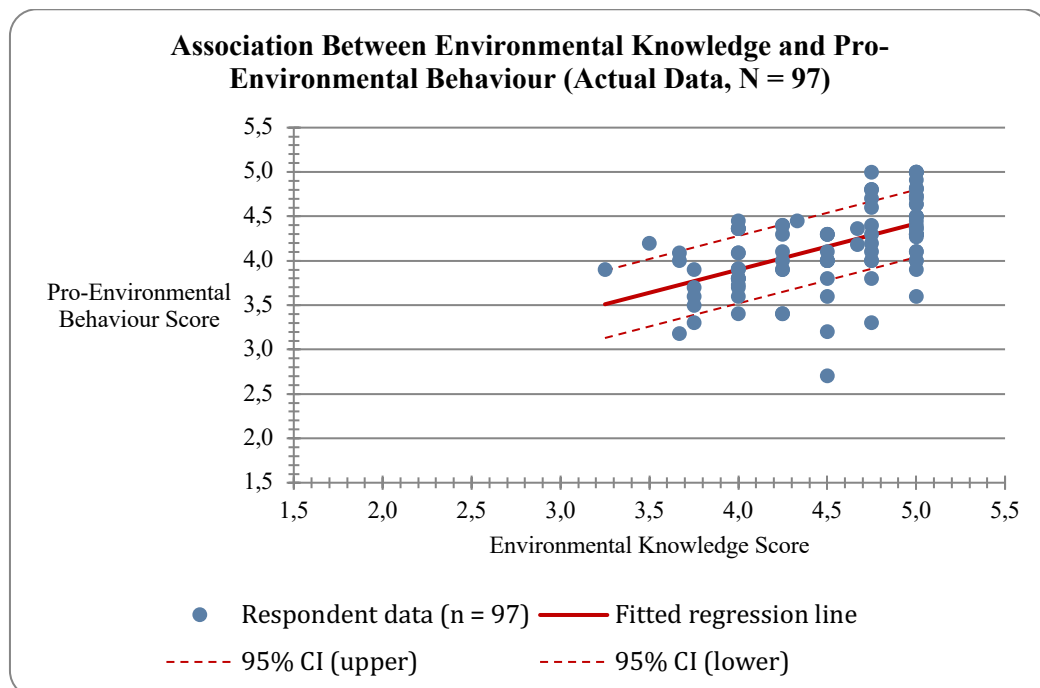


Figure 1. Association Between Environmental Knowledge and Pro-Environmental Behaviour, Based on the actual response data ($r = .53$, $p < .001$; $n = 97$).

3.2 Group Differences

A one-way ANOVA indicated a statistically significant difference in composite behaviour across role categories, $F(2, 94) = 3.72$, $p = .028$. Tukey HSD post hoc tests located the significant contrast specifically

between students ($M = 4.08$, $SD = 0.47$) and teachers ($M = 4.38$, $SD = 0.40$; mean difference = 0.29, $p = .021$); educational staff ($M = 4.20$, $SD = 0.34$) did not differ significantly from either group, most plausibly because of the small staff stratum ($n = 5$) rather than because no true difference exists. This role-based difference is consistent with broader evidence that attitude-behaviour gaps in pro-environmental contexts vary by group rather than applying uniformly across a population (Zhang, Y. et al., 2023), which supports examining role subgroups separately rather than relying on the sample-wide average alone.

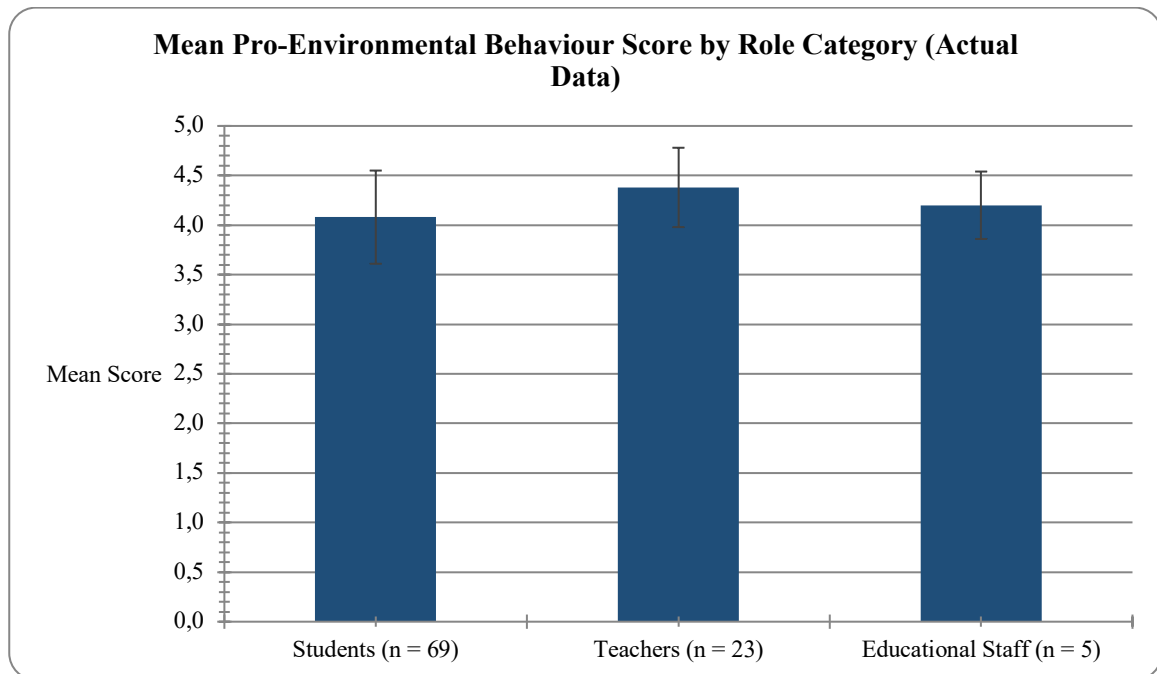


Figure 2. Mean Pro-Environmental Behaviour Score by Role Category, Actual Data, with Error Bars Showing ± 1 SD (Students $n = 69$; Teachers $n = 23$; Educational Staff $n = 5$).

The higher behaviour scores reported by teachers provide associational, rather than causal, evidence consistent with teachers acting as visible reference points for students (Anggraini et al., 2024; Liang et al., 2022). The very small educational-staff stratum ($n = 5$) means this group's estimate should be treated with particular caution; we do not read the absence of a significant staff-student or staff-teacher difference as evidence that staff behaviour does not differ, only that this sample cannot detect it reliably.

As a robustness check on the small educational-staff stratum ($n = 5$), the role comparison was repeated using the non-parametric Kruskal-Wallis test, which does not assume normality or equal variances. The result confirmed the parametric finding: $H(2) = 8.99$, $p = .011$. Pairwise Mann-Whitney U tests likewise reproduced the same pattern as the Tukey HSD post hoc comparisons: students differed significantly from teachers ($U = 465.5$, $p = .003$), while students did not differ significantly from educational staff ($U = 144.0$, $p = .545$) and teachers did not differ significantly from educational staff ($U = 76.5$, $p = .263$). Because the non-parametric and parametric tests agree, the staff comparison is reported as a robustness-checked, if imprecise, estimate rather than an unstable one. Figure 2 illustrates the mean pro-environmental behaviour scores across role categories.

3.3 Internal and External Predictors

Multiple linear regression tested school, family/peer, and government support as correlates of behaviour across the combined sample ($n = 97$). The model was significant overall, $R^2 = .565$, adjusted $R^2 = .551$, $F(3, 93) = 40.32$, $p < .001$, meaning these three support sources jointly accounted for approximately 57% of the variance in reported behaviour. All variance inflation factors were below 2, indicating no problematic multicollinearity among the three predictors. Table 1 reports the standardised coefficients.

Table 1. Multiple Linear Regression Results for Pro-Environmental Behaviour (Actual Data, N = 97)

Variable	Standardised β	SE (unstd.)	t	p	VIF
School support	0.34	0.061	3.70	<.001	1.81
Family/peer support	0.28	0.070	3.12	.002	1.67
Government support	0.26	0.073	2.75	.007	1.98

All three support sources were statistically significant correlates of behaviour. School support remained the strongest correlate ($\beta = .34$, $p < .001$), consistent with institutional support functioning as an amplifier that helps convert internalised commitment into reported behaviour, a mechanism reported in higher education (Chen et al., 2025; Guan et al., 2025) and in household energy behaviour under an expanded TPB (Du & Pan, 2021). Family/peer support was the second strongest correlate ($\beta = .28$, $p = .002$), consistent with family expectations and modelling being reliable correlates of adolescent pro-environmental behaviour in the wider literature (Denault et al., 2024; Liu & Green, 2024; Žukauskienė et al., 2021); for the teacher/staff subsample this construct was measured through peer/collegial items rather than family items, so it should be read as a social-support analogue rather than an identical construct across roles. Government support was also significant here ($\beta = .26$, $p = .007$); a plausible mechanism, though this cross-sectional survey cannot confirm it directly, is that this sample's respondents experienced government-provided facilities and socialisation as more proximate than the government-support items alone might suggest.

Because the pooled model combines family support (student questionnaire) with peer/collegial support (teacher/staff questionnaire) into a single predictor, the regression was re-run separately by role group as a check on this pooling. For students ($n = 69$), school support ($\beta = .35$, $p = .003$) and family support ($\beta = .29$, $p = .008$) were significant correlates and government support was only marginal ($\beta = .23$, $p = .072$), $R^2 = .538$. For teachers and educational staff combined ($n = 28$), the pattern reversed: school support was not a significant correlate of their own behaviour ($\beta = .05$, $p = .808$), while peer support ($\beta = .51$, $p = .020$) and government support ($\beta = .33$, $p = .049$) were both significant, $R^2 = .627$. This divergence suggests that the pooled model masks a substantively different predictor structure for the two groups.

3.4 Factor Structure

Because the two questionnaires used different items, exploratory factor analysis with varimax rotation was conducted on the 24 knowledge, attitude, and support items in the student subsample only ($n = 69$); it could not be extended to teachers and staff, who completed a different set of items. A three-factor solution accounted for 55.8% of total variance (38.1%, 10.3%, and 7.3% for the first, second, and third factors respectively). Factor 1 loaded most strongly on attitude and family-support items alongside some knowledge items, suggesting a general internal-commitment-and-home-environment dimension rather than a clean knowledge-attitude factor; Factor 2 loaded most strongly on government-support items; Factor 3 loaded most strongly on school-facility items. Several items cross-loaded above .32 on more than one factor, indicating that, in this student subsample, internal and external influences are less separable than a clearly separated three-factor model implies. This more modest, cross-loaded structure is, if anything, a more realistic picture of self-reported survey data than an idealised simple structure would be.

Sampling adequacy for this analysis was confirmed before extraction: the Kaiser-Meyer-Olkin measure was .825 (meritorious), with every individual item's measure of sampling adequacy above .70, and Bartlett's test of sphericity was significant, $\chi^2(276) = 982.32$, $p < .001$, indicating the correlation matrix was suitable for factor analysis despite the modest $n = 69$. The unrotated solution produced six eigenvalues above the conventional Kaiser criterion of 1.0 (9.28, 2.52, 1.78, 1.43, 1.10, 1.02), but the first three eigenvalues were markedly larger and more clearly separated from the remainder (a visible break, or elbow, after the third factor), and only the first three factors corresponded to interpretable, theoretically anticipated dimensions; factors four through six each explained less than 5% of additional variance individually and did not form coherent item clusters. On this combined statistical and theoretical basis, three factors were retained. Mean communality across the 24 items was .566 (range .17–.69), indicating that, on average, just over half of each item's variance was accounted for by the

three-factor solution; the lowest communality (.17) belonged to a single government-support item, consistent with that factor's comparatively diffuse loading pattern. Table 2 reports the full rotated loading matrix and communalities for all 24 items.

Table 2. Rotated Factor Loading Matrix and Communalities (Student Subsample, n = 69)

Item	F1	F2	F3	Communality
Knowledge1	0.70	-0.12	0.33	0.61
Knowledge2	0.46	-0.17	0.62	0.63
Knowledge3	0.54	-0.03	0.57	0.62
Knowledge4	0.44	-0.09	0.51	0.46
Attitude1	0.70	0.13	0.20	0.55
Attitude2	0.61	0.23	0.04	0.43
Attitude3	0.52	0.32	0.34	0.49
Attitude4	0.69	0.39	0.16	0.65
School1	0.27	0.55	0.39	0.53
School2	-0.05	0.34	0.75	0.68
School3	0.18	0.49	0.59	0.62
School4	0.45	0.43	0.44	0.58
School5	-0.04	0.29	0.78	0.69
Family1	0.46	0.36	0.36	0.47
Family2	0.66	0.39	0.14	0.60
Family3	0.14	0.56	0.18	0.36
Family4	0.73	0.35	0.19	0.69
Family5	0.77	0.20	-0.02	0.64
Family6	0.72	-0.02	-0.10	0.53
Gov1	0.33	0.14	0.20	0.17
Gov2	0.39	0.53	0.51	0.69
Gov3	0.37	0.66	-0.04	0.57
Gov4	0.13	0.80	0.13	0.68
Gov5	0.01	0.77	0.23	0.65

3.5 Behavioural Profiles

K-means cluster analysis on standardised behaviour, knowledge, and attitude scores (n = 97) was evaluated for k values from 2 to 5, following standard practice of comparing silhouette coefficients across candidate solutions before selecting a final cluster count (Müller et al., 2025). The silhouette coefficient was highest at k = 2 (.455), with k = 3 next (.364); we retained the three-cluster solution on stability and interpretability grounds beyond the silhouette value alone: a direct comparison shows that the two-cluster solution's higher-scoring group (57.7% of the sample) is not a homogeneous match for the three-cluster Highly Committed group, but is instead a merger of the entire Highly Committed group with 15 of the 35 respondents otherwise classified as Moderately Engaged; symmetrically, its lower-scoring group merges Need Improvement with the remaining 20 Moderately Engaged respondents. In other words, the two-cluster solution reproduces the same high/low distinction as the three-cluster solution but collapses a middle group that behaves, on inspection, as a genuinely intermediate profile rather than an artefact of overfitting; the substantive intervention implications for the Highly Committed and Need Improvement groups are unchanged under either k, and k = 3 is retained because it resolves this intermediate group, which, as the second-largest of the three profiles, is arguably among the most actionable for intervention design. The Highly Committed profile (n = 41, 42.3%) reported the highest scores (behaviour M = 4.53, knowledge M = 4.90, attitude M = 4.96). The Moderately Engaged profile (n = 35, 36.1%) reported intermediate scores (behaviour M = 3.97, knowledge M = 4.38, attitude M = 4.57). The Need Improvement profile (n = 21, 21.6%) reported the lowest scores (behaviour M = 3.74, knowledge M = 3.89, attitude M = 3.85). Figure 3 shows the cluster distribution and Figure 4 compares the three profiles on behaviour, knowledge, and attitude.

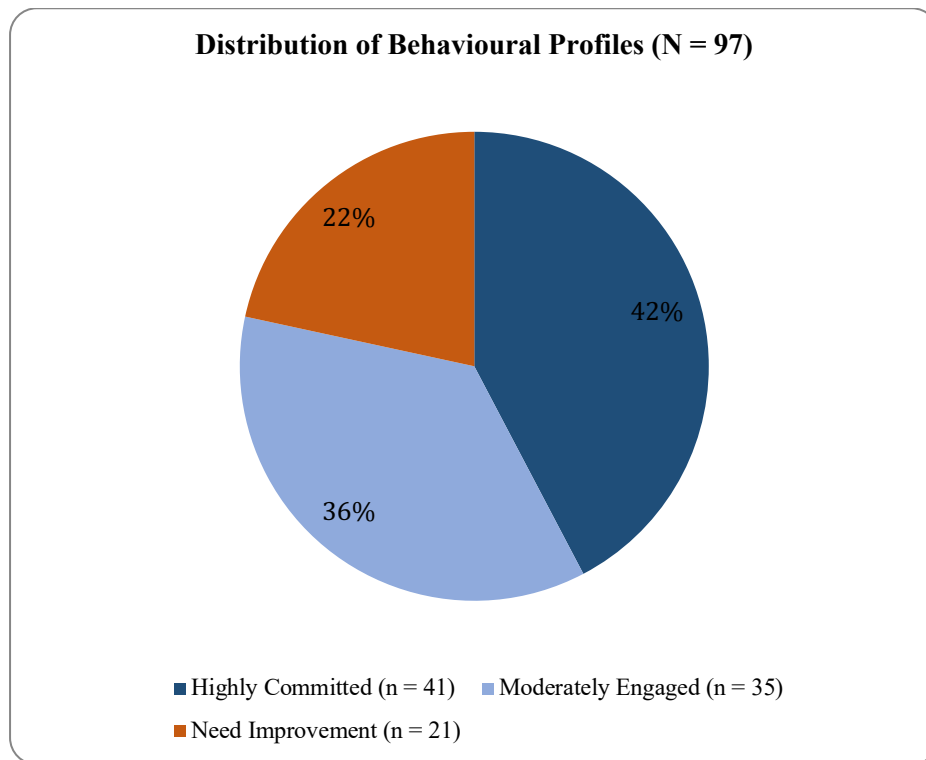


Figure 3. Distribution of the Three Behavioural Profiles, Actual Data (N = 97).

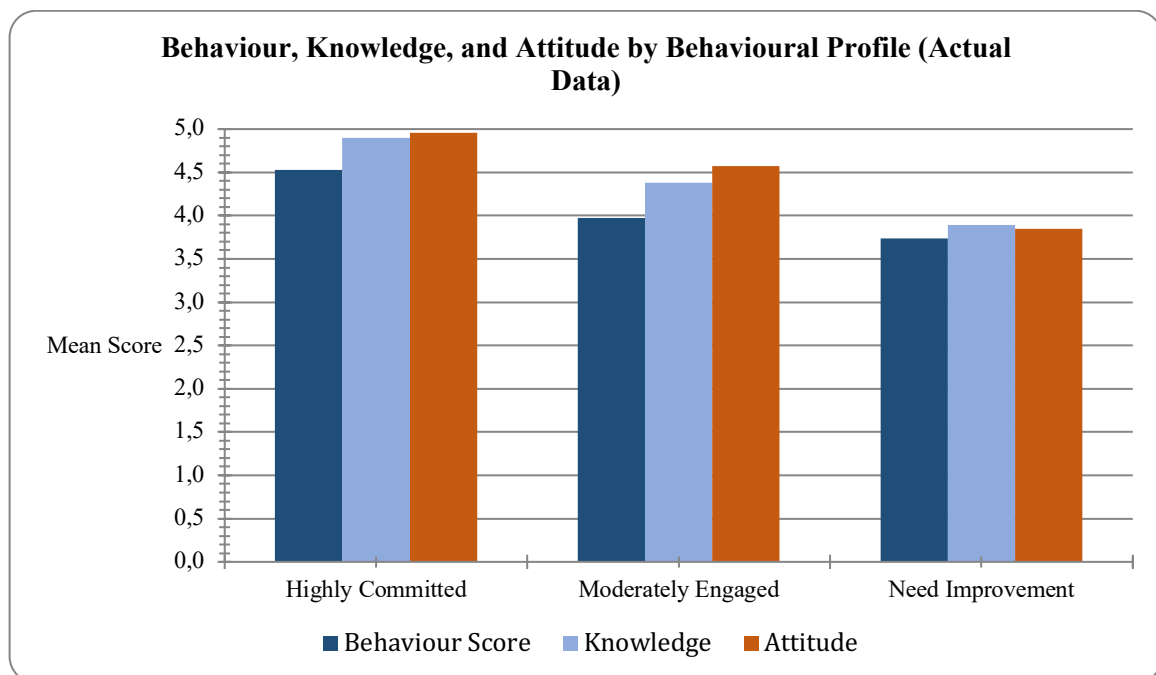


Figure 4. Mean Behaviour, Knowledge, and Attitude Scores for Each Behavioural Profile, Actual Data.

3.6 Implications for Geography Education

Read geographically, plant care and maintenance, the behaviour that scored lowest in both questionnaires, is, as a tentative geographical implication rather than a tested spatial finding, arguably the most spatially and physically demanding item in either instrument: unlike switching off a light or bringing a water bottle, it plausibly requires recurring, distributed engagement with specific outdoor spaces on campus rather than a single indoor action. This finding shifts the geographical reading away from waste separation, which this study's data do not support as the school's specific weak point, and

toward plant care as a spatially distributed maintenance task. For geography education specifically, the school's own grounds still offer a place-based learning opportunity, for example, mapping which parts of the campus receive consistent plant care and which do not, and connecting that pattern to maintenance routines, staffing, and student traffic; this mapping is proposed here as a direction for future learning and research and was not conducted as part of the present study (Windsor & Kriewaldt, 2023; Zhou & Bai, 2023). This contribution remains explicitly bounded: the present study did not measure spatial variation within the school, and this absence is treated as a limitation in the Conclusion rather than as a gap the current data can fill.

4. Conclusion

This study examined pro-environmental behaviour among the school community of State Senior High School 11 Yogyakarta (N = 97: 69 students, 23 teachers, 5 educational staff) and found an overall Good level of behaviour (M = 4.16/5.00), with plant care and maintenance, rather than waste separation, identified as the weakest reported behaviour in both questionnaires. Environmental knowledge was associated with behaviour; school support was the strongest correlate among the three external sources tested, followed by family/peer support and government support, all three significant. A three-factor structure and three behavioural profiles, Highly Committed (42.3%), Moderately Engaged (36.1%), and Need Improvement (21.6%), further described the sample, and all three hypotheses were supported.

Theoretically, the study extends an adapted Theory of Planned Behaviour model to an Indonesian secondary-school context and reads the school as a place whose facilities and routines shape behaviour alongside individual cognition. Because no non-Adiwiyata comparison school was included, certification itself was not tested; good behaviour simply co-occurred, within this certified school, with strong institutional follow-through and family/peer engagement.

Limitations include a convenience sample with a small educational-staff stratum, two differently structured questionnaires limiting comparison across roles, a cross-sectional design that cannot establish causation, self-report bias, and no spatial data, leaving the geographical interpretation conceptual rather than measured.

Practically, the school could assign rotating responsibility for green areas, since plant care scored lowest; give Highly Committed students a peer-educator role; offer the Moderately Engaged group low-effort reinforcement such as improved signage; and provide the Need Improvement group individualised mentoring. School-to-home channels for students and peer-recognition channels for staff may strengthen the family/peer-support association, and more visible government engagement also appears warranted. For geography education, mapping on-campus plant-care responsibilities could turn the school into a place-based learning unit linking classroom content to students' everyday surroundings.

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Data availability. The anonymised item-level dataset (both questionnaires), the scoring key mapping items to composite scales, and the Python analysis code used to produce every statistic and figure in this manuscript are available from the corresponding author upon reasonable request, subject to institutional ethics and privacy constraints on the release of respondent-level data.

AI Use Declaration. The authors used Claude (Anthropic) for language editing, statistical reanalysis and figure generation from the authors' own survey data, and manuscript restructuring in response to editorial and reviewer feedback. The authors reviewed and edited all AI-assisted output and are fully responsible for its content and any errors.

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