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Green school readiness in schools in Indonesia: Multidimensional assessment in alignment with the environmental SDGs

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ABSTRACT

Green school composite scores can obscure disparities among infrastructure, education, and resource management. This study evaluates documented readiness in six Central Java schools using secondary data from the 2022 UNNES Green School Ranking, reconfirmed in 2026. Methods comprised arithmetic verification, six-dimension normalization, cross-case comparison, weighting sensitivity, and conceptual mapping to Sustainable Development Goal (SDG) targets. Dimension totals were recalculated without independently reassessing school practices. Overall scores ranged from 55.83% to 95.83% (mean 80.83%). Site and infrastructure scored highest on average (91.37%), while transportation scored lowest (71.88%). Education and supporting activities varied most across schools (7.50%–95.00%). At S6, infrastructure reached 89.29% but education only 7.50%, an 81.79-percentage-point disparity. Equal weighting preserved school rankings, whereas excluding waste management erased the difference between the two leading schools. Ranking stability therefore concealed dimensional imbalance and could not establish environmental impact. Reporting composite scores alongside minimum dimension scores, within-school ranges, and sensitivity results can better inform targeted support. Links to SDGs represent conceptual alignment rather than verified target achievement. These findings highlight the need for transparent, dimension-sensitive institutional evaluation. Limitations include purposive sampling, unavailable indicator-level data, and uncertainty about whether observed differences reflect actual practices, documentation quality, or both.

KEYWORDS: green school readiness, composite indicators, sustainability assessment, whole-school approach, UGSR, Sustainable Development Goals

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1. Introduction

Schools bring sustainability commitments into everyday decisions about resource use and into the education of future citizens. Their energy consumption, waste, land use, and travel practices make them settings where environmental responsibilities can be examined directly (Intergovernmental Panel on Climate Change, 2023; Sayed, 2015; UNESCO, 2020). The 2030 Agenda frames these responsibilities, but applying its goals at school level requires evidence that distinguishes program provision from results (United Nations, 2015). Education for sustainable development connects knowledge and skills with values and action, making learning and participation essential to assessment (Rieckmann, 2017; UNESCO, 2021). Green school research accordingly brings facilities, resource management, leadership, and learning into a shared field of inquiry (Akyel et al., 2025; Kocabas & Bademcioglu, 2017; Uline & Kensler, 2021). The measurement challenge is to determine what combining these dimensions reveals about a school's readiness and what it conceals.

Building certification frameworks provide indicators of physical and operational performance, although suitable facilities alone cannot establish the quality of sustainability learning (Akyel et al., 2025). Research on circular waste practices at Universitas Negeri Semarang offers an institutional example whose applicability to secondary schools requires contextual examination (Fathoni et al., 2021). Studies of planning priorities, institutional barriers, and whole-school approaches further show why assessment must consider organizational arrangements alongside infrastructure (Ahn & Chung, 2024; Esmaeili et al., 2025; Karaarslan-Semiz & Sund, 2026). In Indonesia, Adiwiyata research examines school policy and teacher participation (Pambudi et al., 2020), while studies of posters, landscapes, and visual texts explore how environmental identities are communicated (Lestari & Wahyuni, 2026; Pambudi et al., 2020). Ecocritical analysis of Javanese novels also identifies environmental ethics and respect for nonhuman life as potential resources for environmental education (Pamungkas et al., 2019). These contributions identify relevant assessment domains without making their measures interchangeable. Evidence of facilities, participation, or environmental messaging therefore supports different claims about school sustainability.

Financial resources, stakeholder coordination, and institutional support can constrain green school development (Esmaeili et al., 2025). Studies of schools participating in greening programs likewise emphasize the need to examine organizational strengths together with implementation difficulties (Bopape, 2022). Research on classroom environmental quality connects building conditions, ventilation, and comfort with occupants' experiences (Kapoor et al., 2021; Radwan & Issa, 2017). Investigations of thermal comfort and daylighting demonstrate why particular physical conditions require appropriate measures (Adekunle, 2020; Vaisi et al., 2024). Broad administrative scores must retain these distinctions if they are to guide decisions about school improvement. Otherwise, apparently comparable totals may combine evidence of different kinds and obscure whether a school's priority concerns physical provision, everyday operations, or educational practice.

UNESCO's Green School Quality Standard addresses governance, facilities and operations, teaching and learning, and community engagement (UNESCO, 2024). Comparative research in Beijing, Sweden, and Türkiye places school sustainability within relationships among institutional arrangements, educational practices, and policy goals (Karaarslan-Semiz & Sund, 2026; Yuan et al., 2024). The UNNES Green School Ranking (UGSR) combines six dimensions: infrastructure, energy, waste, water, transportation, and education and supporting activities. These overlap with green school research on facilities, governance, and learning (Ahn & Chung, 2024; Akyel et al., 2025; Kocabas & Bademcioglu, 2017), but unequal indicator counts give them different effective weights. Aggregation also permits strength in one dimension to offset weakness in another, although learning and participation cannot be inferred from physical provision (Darmody, 2022; Kioupi & Voulvoulis, 2019; Rieckmann, 2017; van Velzen & Helbich, 2023). Analysis of Indonesian senior high school language textbooks similarly identifies gaps between curriculum intentions and support for higher-order learning (Pamungkas et al., 2025). This suggests that the education dimension needs evidence about the learning tasks provided. This creates an interpretive problem: a favorable overall score may leave consequential differences across dimensions unresolved.

This study examines that problem through six documented UGSR profiles from Central Java. It asks how total and dimension scores compare after arithmetic reconciliation, how weighting and index composition affect their interpretation, and how the dimensions relate to SDG targets without equating alignment with impact. The analysis combines totals with each school's lowest dimension score, within-school range, and sensitivity results.

Its contribution is an exploratory account of the information these measures add to the composite score. The purpose is to identify questions for school support while making the assessment's inferential limits explicit. The six cases support contextual comparison, not a national ranking or validation of a new readiness instrument.

2. Methods

Study design and scope of inference

We conducted a descriptive comparative analysis of secondary administrative data from UGSR 2022 that were reconfirmed in 2026, treating each of six schools as a case. Quantitative comparisons were interpreted through principles of documentary analysis and conceptual mapping to the SDGs. Mixed-methods research requires an explicit account of how each form of evidence contributes to the conclusions (Creswell & Plano Clark, 2007; Creswell & Creswell, 2017; Fetters, 2019). Here, the underlying indicator-level evidence was unavailable for reassessment. The study consequently analyzes reproducible patterns in the published scores without claiming independent qualitative validation or a fully integrated mixed-methods design.

Cross-case comparison was used to examine similarities and differences in the schools' profiles rather than to estimate population parameters (Yin, 2018). We use documented readiness to mean attainment recorded within the assessment system. The term does not denote a psychometrically validated latent capacity. Policies, photographs, activity reports, and teaching materials can provide research evidence, but their authenticity, context, and completeness need to be examined before they support claims about implementation (Bowen, 2009; O'Leary, 2009). Administrative scores, the practices that may underlie them, and educational or environmental outcomes are therefore treated as distinct forms of information.

Cases and data sources

The six cases were S1 in Semarang Regency, S2 in Banyumas Regency, S3 in Jepara Regency, S4 in Blora Regency, S5, and S6. All are in Central Java. The sample includes two lower secondary schools (SMP), two general upper secondary schools (SMA), and two vocational upper secondary schools (SMK). Cases were selected purposively to compare different profiles, consistent with the use of cases to develop contextual understanding (Patton, 2014; Yin, 2018). They are neither representative of schools in Central Java or Indonesia nor the six highest-ranked schools in UGSR.

Numerical data came from the official 2022 UGSR Overall Ranking published by Universitas Negeri Semarang and accessed on September 23, 2026. The data used in this analysis were reconfirmed in 2026. The analysis retains 2022 as the assessment reference year and does not treat this reconfirmation as a new wave of school-level measurement. The page lists 44 schools; this analysis is restricted to the six cases identified above. We used school names, locations, six dimension scores, and the published totals (Universitas Negeri Semarang, n.d.). All 36 school-by-dimension cells contained numerical values. This completeness at the aggregate level does not establish that every indicator or supporting document was available to the original assessors.

Data were organized in a school-by-dimension matrix to maintain a traceable link between source values, calculations, and interpretation. Matrix displays support consistent comparison across cases and categories (Bazeley, 2021; Miles et al., 2013). We did not reconstruct the 60 indicator scores from dimension totals, since many combinations of indicator values could produce the same aggregate. No missing values were imputed, and no scores were added on the basis of assumptions about school conditions.

Assessment Framework and Effective Weights

UGSR contains 60 indicators with an overall maximum score of 240. Table 1 reports the indicator counts and maximum scores for each dimension, following the assessment structure described in UNNES's conservation publication (Universitas Negeri Semarang, 2023). We use this structure to organize the data without assuming that its use in a ranking establishes measurement validity. Comparisons of green school certification systems and studies of planning priorities show that the selection and weighting of dimensions involve substantive choices (Ahn & Chung, 2024; Akyel et al., 2025; Kocabas & Bademcioglu, 2017).

Table 1. UGSR dimensions, maximum scores, and effective weights.

Dimension	Indicators	Maximum score	Weight (%)	Assessment scope
Site and infrastructure	14	56	23.33	Open space, vegetation, ventilation, and lighting
Energy and climate change	8	32	13.33	Electricity efficiency, renewable energy, and energy management
Waste management	10	40	16.67	Waste sorting, reuse, and treatment
Water management	10	40	16.67	Water sources, efficiency, and conservation
Transportation	8	32	13.33	Travel and vehicle use
Education and supporting activities	10	40	16.67	Curriculum, student activities, publications, and partnerships
Total	60	240	100.00	

Note. Effective weight = dimension maximum / 240. Assessment scope is summarized from the UGSR framework; the table does not replace the 60-indicator rubric. (Universitas Negeri Semarang, 2023)

Summing all indicator scores assigns effective weights of 23.33% to site and infrastructure, 13.33% to energy, 16.67% to waste, 16.67% to water, 13.33% to transportation, and 16.67% to education. These weights follow from indicator counts and maximum scores; they are not empirical estimates of each dimension's contribution to sustainability. We retained these weights in the main calculation and used equal dimension weights as a sensitivity check (OECD et al., 2008).

The published aggregates do not support the assumption that every indicator necessarily receives a minimum score of 1. For example, S6 scored 3 out of 40 in education, a dimension comprising 10 indicators. That total cannot result from ten complete ratings on a scale of 1–4. We therefore make no assumption about the minimum indicator value and do not interpret low scores as conclusive evidence that a practice is absent. Unclear rules for missing indicators and insufficient evidence remain a limitation of the secondary data.

Arithmetic Audit and Score Calculation

Before comparing schools, we recorded published totals separately from the sums of their six dimension scores. Where the values differed, we used the sum of the components in the analysis and retained the published value in the audit table. This procedure makes the calculations reproducible without revising the official ranking or validating the underlying indicator scores. Calculations used unrounded values; results were rounded to two decimal places for presentation.

For school i and dimension d, denotes the dimension score and its maximum. The normalized dimension score was calculated as follows.

The overall percentage was calculated relative to the maximum of 240. The equally weighted index was the mean of the six normalized dimension scores.

These percentages express attainment relative to the instrument's maximum. They are not probabilities of readiness or percentages of SDG achievement. We did not assign categorical readiness labels because the proposed cutoffs lacked a traceable validation basis. Reporting scores continuously also avoids changes in classification caused solely by rounding near a threshold.

Profile Comparison and Sensitivity Analysis

School profiles were compared using normalized dimension scores, the lowest dimension score, and the within-school range. The range was calculated as the difference between a school's highest and lowest dimension percentages. It describes imbalance but cannot establish high attainment: a school could have similarly low scores in every dimension. We therefore interpreted the range alongside the total and minimum. Cross-case comparison used these patterns to clarify substantive differences among schools (Yin, 2018).

Sensitivity analysis had two stages. First, we compared the ordering obtained from R_i with that obtained from E_i. Second, we omitted each dimension in turn and recalculated totals relative to the combined maximum of the remaining dimensions. This leave-one-dimension-out procedure examines how the ordering depends on index composition (OECD et al., 2008). Equal values were treated as ties. The six scenarios were deterministic

checks, not estimates of statistical uncertainty or tests of construct validity.

Given the six purposively selected cases, all comparisons were descriptive. We did not conduct significance tests, causal regression, factor analysis, or statistical clustering. The term profile describes an observed pattern without implying mutually exclusive school types or validated categories. This choice keeps the scope of inference consistent with the research questions, design, and available data (Creswell & Creswell, 2017; Patton, 2014; Yin, 2018).

SDG Mapping and Interpretation Of Evidence

We mapped the six dimensions deductively to the wording of SDG targets and to the framework of education for sustainable development (Kioupi & Voulvoulis, 2019; UNESCO, 2020; Weiland et al., 2021). For each link, we identified the relevant target, the school practices that might relate to it, and the additional measures needed to assess implementation or outcomes. This mapping represents the authors' conceptual interpretation; it was not independently validated by an expert panel. Similar terminology was not treated as equivalence with a global SDG indicator (United Nations, 2015).

Content analysis principles informed the organization of relevant evidence categories rather than the recoding of school documents (Krippendorff, 1996; Schreier, 2014). A water-saving policy, for example, establishes a rule; usage records document consumption; and consumption per student over time supports an assessment of change. Each permits a different inference. Separating sources, categories, and conclusions follows methodological guidance on coding and evidence displays (Miles et al., 2019; Saldaña, 2021). Literature on qualitative reporting and trustworthiness likewise supports an inspectable record of analytical decisions (Liang, 2019; Nowell et al., 2017).

Transparency and Measurement Limitations

The analysis used publicly available institutional aggregates and collected no individual student or teacher data. School names are reported as codes S1–S6. The analytical files record source scores and recalculated totals, while the code specifies the normalization and sensitivity procedures. These materials support computational reproducibility. They cannot establish instrument validity, agreement among assessors, or the authenticity of school documents. A fuller documentary analysis would require the original corpus and a documented assessment procedure (Bowen, 2009; Saldaña, 2021; Schreier, 2014).

Codex (OpenAI) assisted in developing Python code for arithmetic reconciliation, dimension normalization, weighting and omission sensitivity checks, and figure preparation. The code was executed locally using the 36 recorded UGSR dimension scores and the calculations specified in Sections 2.4 and 2.5. Input scores and reproducible scripts accompany the manuscript. AI assistance with drafting and interpretation is described in the declaration below.

3. Results

Reconciliation of total scores

For four schools, the published total matched the sum of the six dimensions. Two discrepancies were identified. The components for S3 summed to 215, compared with a published total of 208. Those for S5 summed to 170, compared with 169. Table 2 preserves both values. All subsequent results use the component sums; the ranking page alone does not establish why the discrepancies arose.

Table 2. Published totals and the sums of the six dimension scores.

School	Published total	Component sum	Difference
S1	230	230	0
S2	227	227	0
S3	208	215	+7
S4	188	188	0
S5	169	170	+1
S6	134	134	0

Note. Difference = component sum – published total. Analyses use the component sums; the causes of the source

discrepancies are unknown. Overall maximum = 240. Source: (Universitas Negeri Semarang, n.d.).

After reconciliation, the mean total was 194.00 out of 240, or 80.83%. S1 had the highest score, at 230 (95.83%), followed by S2 at 227 (94.58%). S6 had the lowest, at 134 (55.83%). The difference between the highest and lowest totals was 96 score points, equivalent to 40.00 percentage points. The mean describes these six cases and is not an estimate of provincial or national readiness.

Differences Across Dimensions

Site and infrastructure had the highest mean score (91.37%), followed by waste management (85.00%), water management (79.58%), energy and climate change (77.08%), education and supporting activities (73.33%), and transportation (71.88%). This ordering of means concealed substantial differences in dispersion. Education showed the widest range across schools, from 7.50% to 95.00%, a difference of 87.50 percentage points. Energy ranged from 21.88% to 96.88%, while water showed a narrower range of 67.50–90.00%. Figure 1 displays the scores by school and dimension; Figure 2 presents the means and observed ranges.

	Site and infrastructure	Energy and climate	Waste	Water	Transport	Education and support
S1	100.00	96.88	97.50	90.00	100.00	90.00
S2	100.00	96.88	90.00	87.50	96.88	95.00
S3	100.00	96.88	100.00	75.00	68.75	90.00
S4	80.36	71.88	90.00	67.50	71.88	85.00
S5	78.57	78.13	60.00	72.50	59.38	72.50
S6	89.29	21.88	72.50	85.00	34.38	7.50

Higher scores = darker shading

0 25 50 75 100

Figure 1. Normalized UGSR dimension scores for the six schools. Values are percentages of the dimension maximum.

Three schools received the maximum infrastructure score. This limits differentiation at the upper end of the six-case distribution, although it does not establish an instrument-wide ceiling effect. The mean infrastructure score exceeded education by 18.04 percentage points and transportation by 19.49 points. These differences draw attention to dimensions that can receive less emphasis in assessments centered on the physical environment.

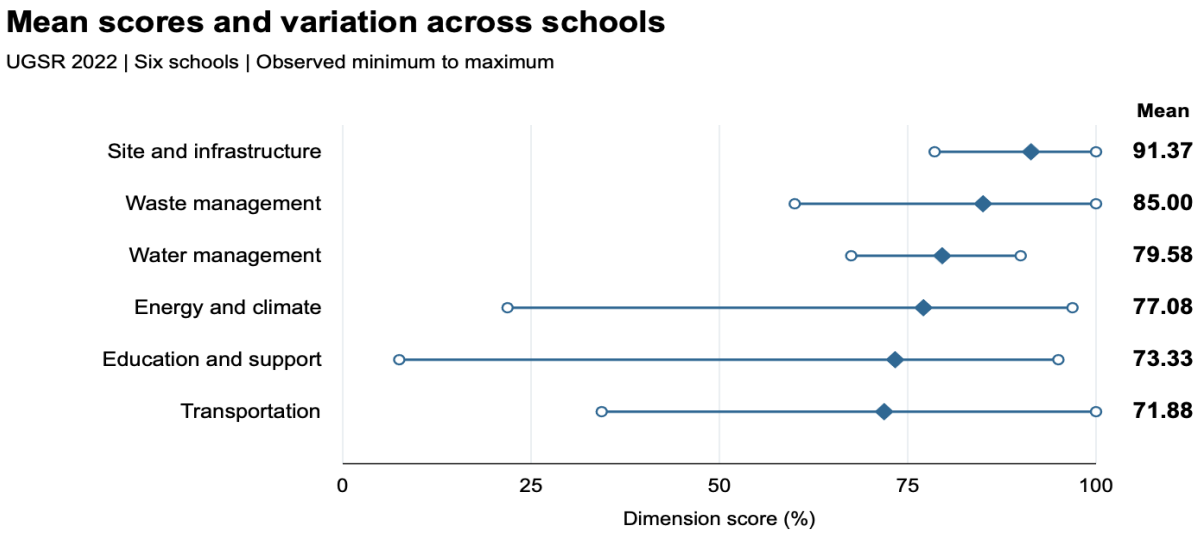


Figure 2. Mean scores and observed ranges across schools by dimension. Diamonds indicate the six-case mean; lines show observed minimum–maximum ranges, not confidence intervals.

Profiles of the Six Schools

S1 and S2 scored relatively highly in every dimension. Their minimum scores were 90.00% and 87.50%, respectively, with within-school ranges of 10.00 and 12.50 percentage points. Their high totals were therefore accompanied by comparatively balanced profiles. The data do not, however, measure program continuity, learning quality, or ecological outcomes, so these profiles cannot establish comprehensive sustainability performance.

S3 had an overall score of 89.58%, including 100.00% in both infrastructure and waste. Transportation scored 68.75% and water 75.00%, producing a within-school range of 31.25 percentage points. Its high aggregate thus coexisted with two more pronounced weaknesses than those of the two highest-scoring schools. S4 showed relative strengths in waste (90.00%) and education (85.00%), with water the lowest-scoring dimension (67.50%). The two cases illustrate why support priorities require attention to individual dimensions as well as overall position.

S5 had a recalculated total of 70.83%. Infrastructure (78.57%) and energy (78.13%) scored above waste (60.00%) and transportation (59.38%). Its within-school range of 19.20 percentage points was smaller than that of S3, but its total and minimum scores were also lower. A more balanced profile alone therefore did not indicate stronger attainment.

S6 showed the greatest imbalance. Infrastructure scored 89.29% and water 85.00%, compared with 21.88% for energy, 34.38% for transportation, and 7.50% for education. The 81.79-percentage-point difference between infrastructure and education was the most pronounced within-school gap. The very low education score does not establish an absence of environmental learning. Without indicator-level data and evidence-handling rules, this pattern could reflect differences in implementation, reporting completeness, assessment decisions, or a combination of these factors.

Sensitivity to Weighting and Index Composition

Giving the six dimensions equal weights preserved the school ordering obtained from the main calculation. Every equally weighted index was lower than its corresponding main index. The largest change occurred at S6, from 55.83% to 51.76%. In the main index, the greater weight assigned to infrastructure partly offset this school's low energy and education scores. The smallest change occurred at S1, from 95.83% to 95.73%. Table 3 presents both indices together with the minimum dimension score and within-school range.

Table 3. Total scores, equal weighting, and within-school imbalance.

School	Total R_i (%)	Equal weight E_i (%)	Minimum dimension (%)	Range (pp)
S1	95.83	95.73	90.00	10.00
S2	94.58	94.38	87.50	12.50
S3	89.58	88.44	68.75	31.25
S4	78.33	77.77	67.50	22.50
S5	70.83	70.18	59.38	19.20
S6	55.83	51.76	7.50	81.79

Note. R_i = 100 × total score / 240; E_i = mean of the six normalized dimension scores. Minimum is the lowest dimension score within a school. Range = maximum – minimum; pp = percentage points. Schools are ordered by R_i.

No pairwise rank reversals occurred in the six omission scenarios. However, excluding waste management gave both S1 and S2 a score of 191 out of 200, or 95.50%. Their three-point difference in the main total was exactly the difference between their waste scores. The general ordering was thus stable under the scenarios examined, while the distinction between the top two positions depended on index composition. Other weights or corrections to indicator-level data could still produce different results.

Conceptual Alignment with SDG Targets

The six UGSR dimensions could be linked to selected targets under SDGs 4, 6, 7, 11, 12, 13, 15, and 17. The most direct conceptual links concerned sustainability education, water and energy efficiency, waste reduction, and climate awareness. Links to public space, ecosystem conservation, and partnerships required additional

qualification because global targets operate at scales and units of measurement that differ from those of schools. Table 4 sets out the mapping and the outcome evidence still needed. The exercise produced no new SDG score and did not allocate a dimension score across multiple goals.

Table 4. Conceptual links between UGSR dimensions and SDG targets, with evidence requirements.

SDG targets	UGSR dimensions	Conceptual link	Additional evidence required
4.7; 4.a	Education; infrastructure	Sustainability learning and safe, inclusive learning environments.	Implemented curricula, learning outcomes, participation, and facility accessibility.
6.3; 6.4	Water	Water quality, treatment, and efficient use.	Water quality tests and consumption per user over comparable periods.
7.2; 7.3	Energy	Renewable energy and energy efficiency.	Renewable energy share, kWh per student, and changes from baseline.
11.2; 11.7	Transportation; infrastructure	Access to transport and green space. School grounds are not necessarily public space.	Travel mode surveys, safety, accessibility, and conditions of access to green space.
12.5; 12.8	Waste; education	Waste prevention and knowledge of sustainable lifestyles.	Waste mass per user, treatment destinations, and environmental literacy assessments.
13.3	Energy; education	Climate education, awareness, and capacity to act.	Climate learning outcomes and implementation of mitigation or adaptation activities.
15.5	Infrastructure	Habitat and biodiversity protection; tree inventories alone do not measure conservation.	Habitat types and condition, biodiversity change, and maintenance plans.
17.17	Education and supporting activities	Effective public, private, and civil society partnerships.	Agreed roles, resources, continuity of cooperation, and shared outcomes.

Note. The mapping reflects the authors' interpretation of the targets, not an assessment of global SDG indicators. Outcome evidence in the final column was unavailable for the six cases. Target framework: (United Nations, 2015).

4. Discussion

Aggregate attainment and balance across dimensions capture different aspects of documented readiness. S5 had a smaller within-school range than S3 but also a lower total and minimum, showing why balance alone cannot indicate stronger attainment. Reading these measures together accords with green school frameworks linking facilities, institutional management, and education (Akyel et al., 2025; Kocabas & Bademcioglu, 2017; Uline & Kensler, 2021). An additive index nevertheless permits strength in one dimension to compensate for weakness elsewhere, making the weighting assumptions consequential (OECD et al., 2008). Equal weighting preserved the school ordering, yet removing waste management eliminated the difference between the two highest-scoring schools. The distinction matters because ranking stability does not establish balanced provision or equivalent educational opportunities. The 81.79-percentage-point infrastructure–education gap at S6 illustrates how a composite score compresses differences that multidisciplinary assessment needs to examine separately (Akyel et al., 2025; Magzamen et al., 2017). These patterns identify dimensions for closer investigation without explaining their causes or establishing whether the gaps arise from practice, documentation, or assessment decisions.

Whole-school approaches emphasize how organizational vision, learning, participation, and community engagement work together (Karaarslan-Semiz & Sund, 2026; Mogren & Gericke, 2017; Mogren et al., 2019). The broadly high scores at S1 and S2 are consistent with extensive administrative attainment, but they do not establish coordination among policies, budgets, teaching, and evaluation. Research in Jakarta madrasahs links institutional support and research-based learning with student research productivity (Hanun et al., 2025); its relevance here concerns the relationship between organizational support and pedagogy, rather than evidence of environmental outcomes. UNESCO's standard makes governance and community engagement explicit (UNESCO, 2024), suggesting that UGSR could make these concerns more visible by identifying relevant evidence across its dimensions. Resource constraints and institutional barriers provide plausible explanations for uneven profiles, although none was measured in these cases (Bopape, 2022; Esmaeili et al., 2025). The same

caution applies to educational outcomes: research on environmental literacy in certified green schools shows that institutional attainment and student outcomes need not develop together (Goldman et al., 2018). Findings from Flanders and Taiwan further caution against inferring behavior or sustainability consciousness from program status (Boeve-de Pauw & Van Petegem, 2013; Olsson et al., 2019). Indonesian Adiwiyata research provides a basis for assessing knowledge, attitudes, and behavior directly (Syah et al., 2021). Together, this literature supports pairing UGSR profiles with observations and learner assessments before interpreting administrative readiness as educational achievement.

Operational evidence could also connect assessment with learning. Critical reading and classroom dialogue offer ways for students to examine electricity bills, evaluate environmental claims, and justify choices (Utomo et al., 2023; Utomo et al., 2026), while food education and sustainability learning objectives emphasize experience, context, and the capacity to act (Darmody, 2022; Rieckmann, 2017). Such applications remain proposals because no classroom observations or student work were available here. The relatively low transportation mean warrants investigation, but recommendations must account for distance, safety, public transport, and disability access; research on environmental justice in school green space reinforces the importance of spatial conditions and unequal opportunities (van Velzen & Helbich, 2023). Evidence from inclusive education in rural Bali also documents geographic exclusion despite formal inclusion policies (Hendrawati et al., 2025), supporting attention to actual accessibility when considering school travel options. Energy and water assessment likewise needs comparable consumption records with consistent periods and denominators. A rural green school energy model illustrates how community learning can support system management, although its setting differs from these schools (Novitasari et al., 2019). For waste, institutional waste research and green school certification studies support examining operational outcomes alongside facilities and programs (Fathoni et al., 2021; Goldman et al., 2018). Linking such records to teaching would allow schools to investigate change while generating evidence that administrative scores alone cannot provide. Literary reading could complement these activities by inviting students to examine human relationships with animals and landscapes. A posthuman ecocritical reading of Heidi interprets childhood through ecological engagement and multispecies relationships (Sadykova et al., 2025). This offers a basis for designing discussion tasks about environmental responsibility; classroom assessment would still be needed to establish what students learn.

SDG mapping clarifies why these additional measures matter. Frameworks linking education to the SDGs and research on Beijing's green school program support attention to implementation processes and context (Kioupi & Voulvoulis, 2019; Yuan et al., 2024). Curriculum documents establish planned provision, and tree inventories record vegetation; demonstrating learning or biodiversity benefits requires different evidence, consistent with the distinction between policy ambitions and their realization (Kioupi & Voulvoulis, 2019; Weiland et al., 2021). Table 4 therefore functions as an evidence guide rather than a measure of SDG achievement. UGSR reporting could apply the same distinction by presenting all dimension scores, the minimum, and the within-school range alongside each total, while automatically checking totals against their components. An indicator–evidence–score matrix could record document dates, provenance, and rating rationales, with coding and analytical memos making decisions traceable (Bazeley, 2021; Miles et al., 2019; Saldaña, 2021). Access to that evidence would permit reassessment and investigation of discrepancies through transparent documentary analysis (Bowen, 2009; Nowell et al., 2017). School support could then address the gaps identified in the profiles while checking what the underlying records actually substantiate before selecting interventions.

The analysis remains bounded by case selection and measurement uncertainty. Six purposively selected schools in one province cannot support statistical generalization. Although the 2022 data were reconfirmed in 2026, the analysis does not measure changes in school practices or outcomes between these years. Reconciling totals improves arithmetic transparency but cannot verify indicator scores, missing-value rules, or agreement among assessors. Without independent measures of implementation, learning, resource use, or emissions, the study cannot establish causal relationships or the predictive validity of UGSR. Conceptual SDG mapping also involves analytical judgment, while stability under the tested scenarios establishes neither optimal weights nor equivalent measurement quality across dimensions (OECD et al., 2008). Further research should combine indicator audits and multiple-rater assessment with school visits and repeated outcome measurement across more varied settings. Longitudinal comparisons that document school size, level, governance, location, and resources would help distinguish changes in practice from changes in reporting and support stronger investigation of

mechanisms (Fetters, 2019; Yin, 2018). Until such evidence is available, the defensible contribution of profile analysis is to sharpen questions about school improvement and specify what must be measured next.

5. Conclusion

Across the six cases, documented green school readiness was uneven in ways that total scores and school orderings could not adequately convey. Strong physical provision could coexist with weaker educational and operational scores, while a more balanced profile did not necessarily indicate higher attainment. Stability under alternative calculations therefore offered limited assurance that readiness was balanced across dimensions. The findings support interpreting aggregate attainment, minimum dimension scores, and within-school variation together. This approach makes differences relevant to school improvement visible while preserving the distinction between what an assessment records and what schools achieve in practice.

School assessment should consequently report dimension profiles alongside totals and examine the evidence behind identified gaps before determining support priorities. SDG mapping can guide the additional measures needed to connect institutional commitments with educational and environmental outcomes. These implications remain constrained by six purposively selected cases with 2022 data reconfirmed in 2026, unavailable indicator-level evidence, and the inability to separate practice from documentation or establish causal effects. Further research should combine indicator audits, multiple-rater assessment, and repeated outcome measurement across a wider range of schools. Such work would allow readiness scores to guide improvement with stronger evidence about implementation, learning, and environmental change.

Declarations

Ngabiyanto: Conceptualization, Supervision, Project administration, Writing – review & editing.

Asep Purwo Yudi Utomo: Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

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Competing interests

The authors declare no financial or non-financial competing interests.

Ethics approval and consent

This study used publicly available, school-level aggregate data and involved no participant recruitment, intervention, or collection of identifiable personal information. No individual-level data, images, or case details are reported.

Data and code availability

The UGSR 2022 source data are publicly available on Universitas Negeri Semarang's Overall Ranking webpage. The data used in this analysis were reconfirmed in 2026. The supplementary materials provide the six-school dataset, reconciliation records, sensitivity results, and reproducible analysis code. These materials reproduce the aggregate analysis and do not include the 60 indicator-level scores or personal data.

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Declaration of generative AI use

During manuscript preparation, Codex (OpenAI) was used to assist with restructuring, drafting and revision, English translation, literature searches and reference checking, and interpretation of the results. It also assisted with Python code for calculations and data visualization, as described in the Methods. The figures were generated from the recorded UGSR scores using reproducible code; no synthetic school observations were introduced. The authors retain full responsibility for the accuracy and integrity of the manuscript.

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