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OPEN ACCESS ARTICLE

Students' Perceptions of Sanitation Conditions and Government Policy on the Kuin Riverbank, Banjarmasin: Instrument Validation and a Higher-Order PLS-SEM Model for Place-Based Science Education

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Abstract
Riverbank sanitation is a socioscientific issue that students in Indonesian river cities encounter first-hand, yet validated instruments for assessing how students perceive it are scarce. This study examined a 22-item instrument and how two dimensions, perceived sanitation conditions (KS; 8 items) and perceived government policy (KP; 14 items), constitute students' overall perception (PM) of sanitation on the Kuin River, Banjarmasin. Seven experts reviewed the items before administration. After screening 300 returned questionnaires and removing 49 duplicated records, 251 responses from students at three universities adjoining the Kuin riverbank were analysed. PM was specified as a reflective–formative higher-order construct and estimated with PLS-SEM (5,000 bootstrap resamples). Internal consistency was acceptable (Cronbach's α = 0.715 for KS, 0.831 for KP and 0.866 for PM; composite reliability = 0.800 and 0.865) and discriminant validity was supported (HTMT = 0.791), but average variance extracted was below 0.50 (0.33 and 0.32). Both dimensions contributed significantly to overall perception: perceived policy (β = 0.725, 95% CI [0.677, 0.774], $p < .001$) and perceived sanitation conditions (β = 0.374, 95% CI [0.327, 0.420], $p < .001$). When the two dimensions were given equal numbers of items, however, their weights converged (0.59 vs. 0.54), indicating that much of the apparent dominance of policy reflects its larger item set. Students' overall appraisal of riverbank sanitation therefore draws on both institutional and physical appraisals, with a modest edge for perceived policy. The instrument offers a starting point for diagnosing such perceptions in place-based science education, pending further validation.

Keywords: Student perception; riverbank sanitation; place-based science education; content validity; higher-order PLS-SEM

INTRODUCTION

The Kuin River is one of the defining waterways of Banjarmasin, the "City of a Thousand Rivers", and has long served riverbank residents as a space for transport, trade, bathing, washing and domestic disposal (Rochgiyanti, 2011; Timmer & Rosbergen, 2021). Sanitation along this river is therefore not only an urban-planning concern but also a public-health and educational one, and has been the subject of local river-management proposals (Angriani et al., 2021). Local evidence shows why. Monitoring of five segments of the Kuin River recorded mean faecal coliform concentrations of 210/100 mL at high tide and 780/100 mL at low tide, exceeding the drinking-water quality standard of 100/100 mL (Arisanty et al., 2017), and spatial water-quality assessments along the same river have identified segments of reduced quality (Harish et al., 2020). In North Alalak, one of the riverbank villages within the present study area, ownership of a healthy latrine was low and was associated with household knowledge, attitudes, education and economic status (Indah et al., 2018). Studies of other river systems indicate that such conditions are linked to water-borne health risks (Tyagi et al., 2013; Anwar, 2025), although no

locality-specific disease-burden data for the Kuin riverbank are currently available.

For science education, riverbank sanitation is a typical socioscientific issue: it combines scientific knowledge (water quality, pathogens, waste) with social, economic and governance considerations that learners must weigh when forming judgements (Zeidler et al., 2005). Place-based education argues that such issues are best learned where they occur, by connecting classroom concepts with the local environment and community (Smith, 2002). In the Social Studies Education programme at Lambung Mangkurat University, the *Susur Sungai* (river-trail) course puts this principle into practice by taking students along the Kuin River to observe riverbank settlements and their sanitation. Community-oriented environmental education programmes on Indonesian rivers report a similar logic (Sapioper et al., 2024; Khairudin Yusuf et al., 2024), and the environmental-citizenship literature regards students' perceptions of local problems as a starting point for informed participation (Smederevac-Lalic et al., 2020; Yadav, 2023). However, educators who wish to diagnose how students perceive such issues, before or after field-based learning, need valid and reliable measures. This study does not evaluate a learning intervention; it provides and examines such a measure.

Students' perceptions of riverbank sanitation are likely to involve two distinct appraisals. The first concerns the physical conditions they observe, such as latrine availability, waste disposal practices and visible water quality. The second concerns the institutional response, namely the regulation, enforcement, infrastructure provision and socialisation undertaken by government. Research in informal and riverside settlements shows that public financing and provision of shared sanitation strongly shape what residents can realistically do (Atika et al., 2024; Pessoa Colombo et al., 2023). Whether students' overall perceptions are anchored more in observed conditions or in perceived policy has implications both for instruction, which may need to link field observation with governance analysis, and for local sanitation communication.

Two gaps follow. First, to our knowledge no instrument with documented content validity and measurement-model evidence exists for assessing university students' perceptions of riverbank sanitation in Indonesian river cities. Second, the relative contribution of perceived sanitation conditions and perceived government policy to students' overall perception has not been quantified. Accordingly, this study addresses two research questions: (RQ1) Does the instrument show adequate content validity, reliability and construct validity? and (RQ2) How strongly do perceived sanitation conditions and perceived government policy each contribute to students' overall perception of Kuin riverbank sanitation? Cultural and community norms are relevant to riverbank sanitation but were not measured in the present instrument and are therefore treated as a direction for future research rather than as part of the tested model.

METHODS

Research Design

This study used a quantitative cross-sectional survey design comprising two phases: expert review of the instrument and estimation of a measurement and higher-order structural model using partial least squares structural equation modelling (PLS-SEM). PLS-SEM was chosen for three reasons related to the research objective and the measurement design rather than to sample size or distribution. First, overall perception was conceptualised as a higher-order construct formed by two lower-order dimensions, and PLS-SEM offers established procedures for specifying and validating such constructs (Becker et al., 2012; Sarstedt et al., 2019). Second, the study aims to quantify the relative contribution of each dimension to a composite score, consistent with the composite-based logic of PLS-SEM (Hair et al., 2019). Third, the model contains a relatively large number of indicators per construct. PLS-SEM does not remove the need for an adequate sample or valid measurement; statistical inference was therefore based on nonparametric bootstrapping (Hair et al., 2019).

Research Location

The study was conducted on the banks of the Kuin River, North Banjarmasin District, Banjarmasin City, South Kalimantan, at two observation points used in the *Susur Sungai* course:

(1) the area around the Tomb of Sultan Suriansyah and (2) the Kayuwangi Twin Bridges. The administrative area includes the villages of North Kuin, Pangeran, South Alalak, North Alalak and Sungai Miai (Figure 1).

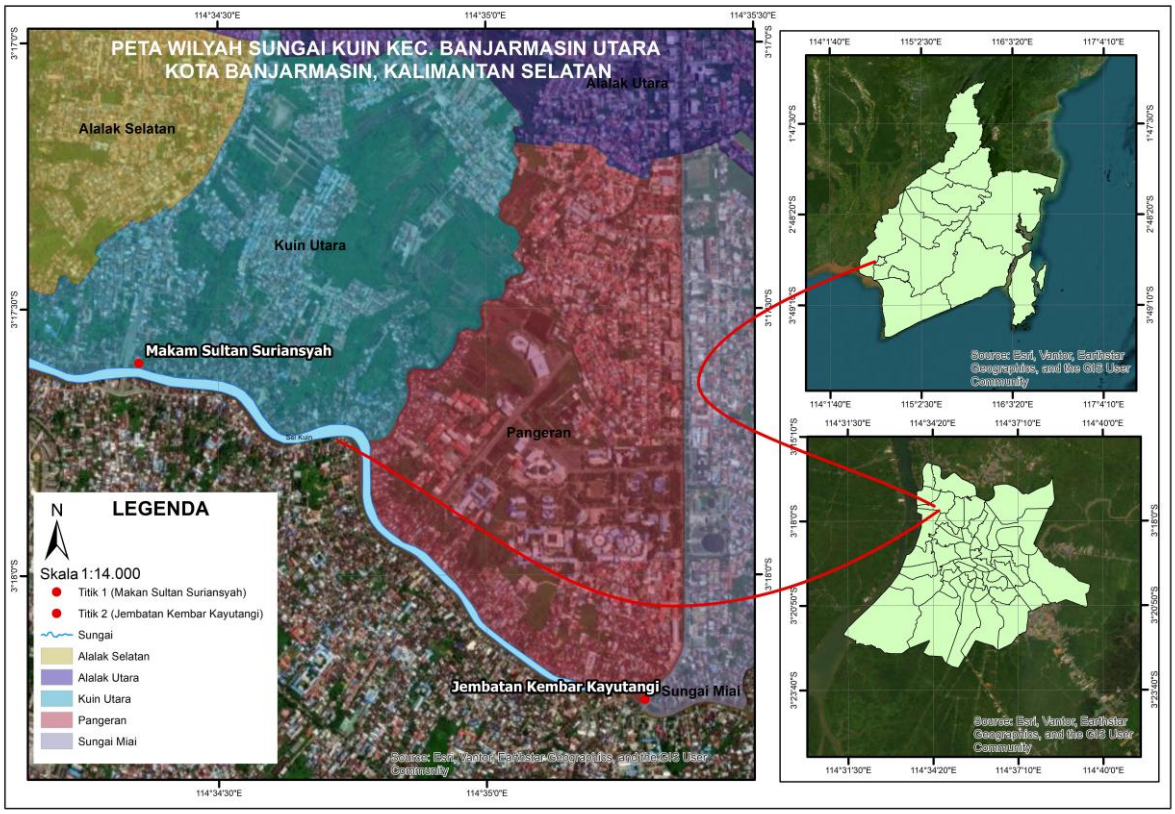


Figure 1. *Map of the Kuin River Area, North Banjarmasin District, Banjarmasin City, South Kalimantan*
Source: Researcher documentation, 2025.

Constructs, Model and Hypotheses

Two lower-order constructs were measured reflectively. Perceived sanitation conditions (KS) refers to students' appraisal of the physical sanitation situation on the riverbank and was measured with eight items (X1.1–X1.8). Perceived government policy (KP) refers to students' appraisal of government regulation, enforcement, infrastructure provision and socialisation concerning riverbank sanitation and was measured with fourteen items (X2.1–X2.14). Overall student perception (PM) was specified as a reflective–formative higher-order construct formed by KS and KP and was estimated with the repeated-indicator approach, in which all 22 items are also assigned to PM (Becker et al., 2012; Sarstedt et al., 2019). Under this specification the paths from KS and KP to PM are weights that express the contribution of each dimension, and the R^2 of PM equals 1 by construction; the paths are therefore not interpreted as causal effects. The wording of all 22 items is provided in Supplementary File S1. The model is shown in Figure 2, and two hypotheses were tested: H1: perceived sanitation conditions (KS) contribute significantly to overall student perception (PM); H2: perceived government policy (KP) contributes significantly to overall student perception (PM).

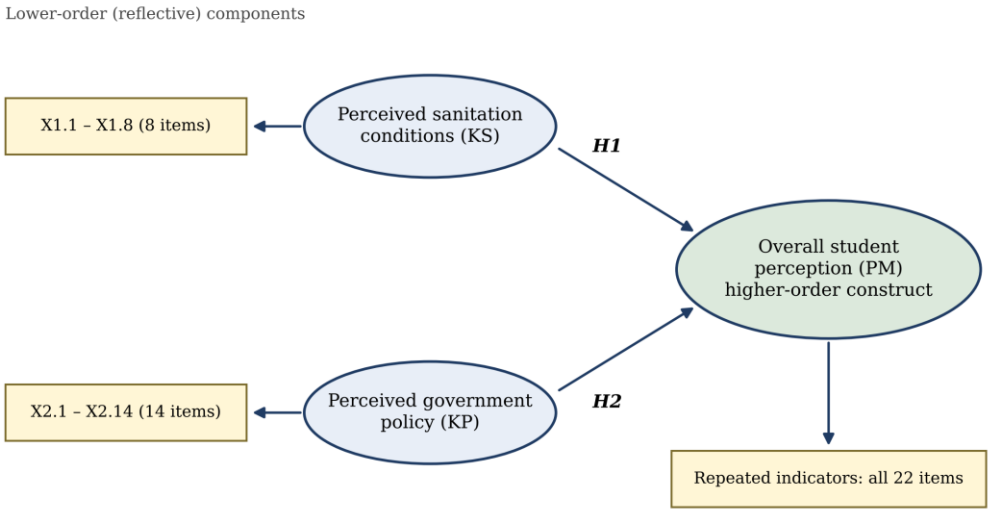


Figure 2. *Conceptual Model: Higher-Order Construct of Students' Perception of Riverbank Sanitation*

Population, Sample and Respondents

The population comprised active students at three universities in Banjarmasin whose campuses and student residential areas adjoin the Kuin riverbank: Lambung Mangkurat University (ULM), STKIP PGRI Banjarmasin and the University of Kalimantan. Respondents were selected by purposive sampling using three inclusion criteria: (1) registered as an active student at one of the three universities; (2) residing near, or regularly interacting with, the Kuin riverbank area; and (3) providing written informed consent. Data were collected in 2025 with a self-administered questionnaire.

Sample adequacy was assessed with the inverse square root method, which estimates the minimum sample required to detect a given path coefficient with 80% power at $\alpha = .05$ (Kock & Hadaya, 2018). Detecting the smaller of the two expected weights ($\beta \approx 0.37$) requires at least 45 respondents, and with n = 251 the study has 80% power to detect coefficients as small as 0.157 ($2.486/\sqrt{251}$). The analysed sample is therefore adequate for the inferential tests reported. The 5,000 bootstrap resamples are computational draws used for inference and are not a sample-size criterion. Of 300 questionnaires returned, data screening identified 49 records that were exact duplicates of other records across all recorded variables; these were removed, leaving 251 responses for analysis. Responses showing identical answers across all items (straight-lining) were retained because uniform agreement is plausible for this topic. Because sampling was purposive, findings describe this population of riverbank-proximate students and should not be generalised to all students in Banjarmasin.

Instrument and Data Analysis

The final instrument consisted of 22 closed statements rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree): eight KS items and fourteen KP items. The measurement model was evaluated against criteria specified before analysis: indicator loadings ≥ 0.70 (indicators between 0.40 and 0.70 retained only if their deletion did not raise composite reliability or AVE above threshold), composite reliability (ρc) between 0.70 and 0.95, average variance extracted (AVE) ≥ 0.50, and heterotrait–monotrait ratio (HTMT) < 0.85 (Hair et al., 2019; Henseler et al., 2015). For the higher-order construct, collinearity between the lower-order components was assessed with VIF (< 3), and the significance of their weights was tested by bootstrapping with 5,000 resamples, two-tailed, $\alpha = .05$, with percentile 95% confidence intervals (Sarstedt et al., 2019). Two robustness checks were run: re-estimation without indicators loading below 0.50, and re-estimation with equal numbers of items for the two components (300 random subsets of eight KP items), because the repeated-indicator approach can favour the component with more indicators (Becker et al., 2012). The model was estimated with the path-weighting scheme; estimates on the full data set reproduced the SmartPLS 4.0

output exactly.

Content Validity

Before field administration, the draft items were reviewed by seven experts: two Social Studies Education lecturers specialising in environmental curriculum, two specialists in river ecology and urban sanitation, one psychometrician experienced in scale development, one environmental-education practitioner and one public-policy communication expert. The experts judged each item for (1) relevance to the intended construct, (2) clarity of wording, (3) appropriateness of language for students, (4) consistency with the construct definition and (5) suitability for the riverbank context, and item wording was revised on the basis of their comments. Expert review supports the relevance and clarity of the items but does not by itself establish construct validity, which was examined separately through the measurement model (Polit et al., 2007).

RESULTS AND DISCUSSION

Results

Field observations made during the *Susur Sungai* course provide context for the survey (Figure 3). The photographs show stilt houses and kiosks built on wooden piles directly above the river, with little vertical distance between floors and the water surface, and stands of water hyacinth (*Eichhornia crassipes*) along the bank. These images are contextual observations only. Turbid water, water hyacinth and stilt housing cannot by themselves establish contamination, the prevalence of particular sanitation practices or residents' exposure; measured evidence on water quality for this river is reported elsewhere (Arisanty et al., 2017; Harish et al., 2020). The observations do, however, illustrate the type of setting on which respondents based their perceptions.



(a) (b)

Figure 3. Settlements on the Banks of the Kuin River Observed During the Susur Sungai Course

Note. (a) Stilt houses on the river edge; (b) kiosks on piles and water hyacinth along the bank. *Source:* Field documentation, *Susur Sungai* course, Social Studies Education Study Program, 2025.

Regarding RQ1, the measurement model of the two lower-order components was evaluated first (Table 1). All loadings fell below the 0.70 benchmark, ranging from 0.524 to 0.654 for KS and from 0.413 to 0.640 for KP; the strongest indicators were X1.4 (λ = 0.654) and X2.9 (λ = 0.640), and the weakest were X2.10 (λ = 0.413), X2.6 (λ = 0.454) and X2.13 (λ = 0.469). Internal consistency was nevertheless acceptable: Cronbach's α was 0.715 for KS, 0.831 for KP and 0.866 for the 22-item PM, and composite reliability was 0.800 for KS and 0.865 for KP (Table 2). Discriminant validity between the two components was supported by HTMT = 0.791, below the 0.85 criterion (Henseler et al., 2015). The Fornell–Larcker criterion was not met (latent correlation = 0.618 versus √AVE = 0.578 and 0.563), which is expected when AVE is low; HTMT is the more sensitive criterion (Henseler et al., 2015). Convergent validity, however, was weak, with AVE values of 0.334 for KS and 0.317 for KP, below the prespecified 0.50 threshold. Because

CR exceeded 0.60, Fornell and Larcker (1981) would regard convergent validity as marginally adequate, but this criterion is debated, and we therefore treat it as a substantive limitation. Removing the three KP items loading below 0.50 (X2.6, X2.10 and X2.13) raised the AVE of KP only to 0.358 (CR = 0.859) and changed the weights little (KS = 0.414; KP = 0.693), so item deletion does not resolve the problem. These items were therefore retained, because each covers a distinct aspect of riverbank sanitation policy and their removal would narrow content coverage without achieving AVE ≥ 0.50.

Table 1. Outer Loadings of the Lower-Order Components

KS indicator	Loading (λ)	KP indicator	Loading (λ)
X1.1	0.600	X2.1	0.543
X1.2	0.605	X2.2	0.635
X1.3	0.530	X2.3	0.603
X1.4	0.654	X2.4	0.556
X1.5	0.524	X2.5	0.621
X1.6	0.564	X2.6	0.454
X1.7	0.577	X2.7	0.577
X1.8	0.558	X2.8	0.532
		X2.9	0.640
		X2.10	0.413
		X2.11	0.542
		X2.12	0.629
		X2.13	0.469
		X2.14	0.608

Note. Standardised outer loadings; n = 251.

Table 2. Reliability, Convergent Validity and Discriminant Validity

Construct	Items	Cronbach's α	ρc (CR)	AVE	√AVE
Perceived sanitation conditions (KS)	8	0.715	0.800	0.334	0.578
Perceived government policy (KP)	14	0.831	0.865	0.317	0.563
Overall student perception (PM)	22	0.866	–	–	–

Note. n = 251. HTMT (KS–KP) = 0.791 (criterion < 0.85). Latent correlation KS–KP = 0.618. Convergent-validity statistics are not reported for PM because PM is a formative higher-order construct.

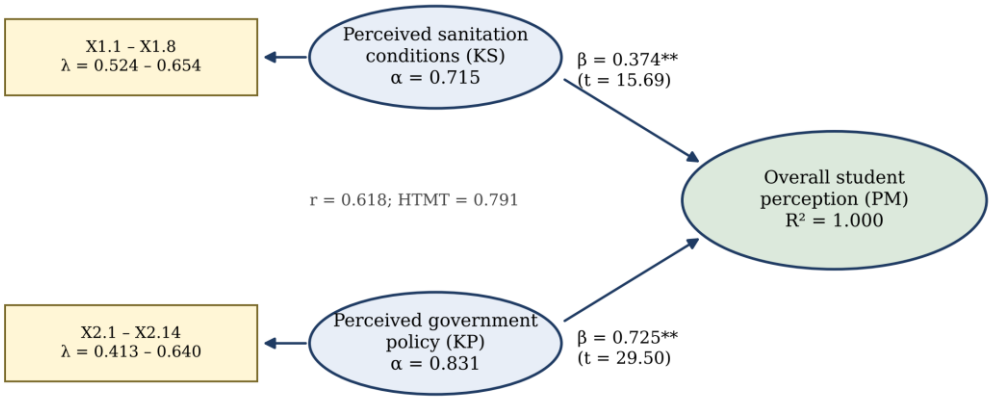


Figure 4. Estimated Higher-Order Model (n = 251)

Note. Values on the arrows to PM are higher-order weights with bootstrap *t* values; ranges are outer loadings of the lower-order components. R^2 of PM = 1.000 by construction under the repeated-indicator approach. $p < .001$.

Regarding RQ2, both lower-order components contributed significantly to overall perception, supporting H1 and H2 (Table 3; Figure 4). Perceived government policy carried the

larger weight (β = 0.725, *SE* = 0.025, *t* = 29.50, *p* < .001, 95% CI [0.677, 0.774]), and perceived sanitation conditions the smaller (β = 0.374, *SE* = 0.024, *t* = 15.69, *p* < .001, 95% CI [0.327, 0.420]); the confidence intervals do not overlap. Collinearity between the two components was low (VIF = 1.62). Because the R^2 of PM is fixed at 1.000, explained variance cannot be used to judge the model; instead, the relative contribution of each component was expressed by Pratt's decomposition (weight × correlation with PM), which attributes 69.3% of the higher-order construct to KP and 30.7% to KS. These figures describe how the overall perception score is composed; they do not mean that policy "explains" 73% of perceptual change, and they do not establish causal influence. The robustness checks qualify this ranking. When KP was represented by eight randomly selected items, matching KS, the mean weights were 0.587 for KP and 0.537 for KS; KP still carried the larger weight in 90% of the 300 subsets, but the gap was much smaller. Estimates on all 300 records, including the duplicates, were virtually identical to the main results (KS = 0.381; KP = 0.714; both *p* < .001; Figure 5).

Table 3. Weights of the Lower-Order Components on Overall Student Perception

Path	β	SE	t	p	95% CI	VIF	Share of PM
H1: KS → PM	0.374	0.024	15.69	< .001	[0.327, 0.420]	1.62	30.7%
H2: KP → PM	0.725	0.025	29.50	< .001	[0.677, 0.774]	1.62	69.3%

Note. n = 251. Bootstrapping with 5,000 resamples, two-tailed, percentile confidence intervals. R^2 (PM) = 1.000 by construction. Share of PM = Pratt's measure, β × r(component, PM).

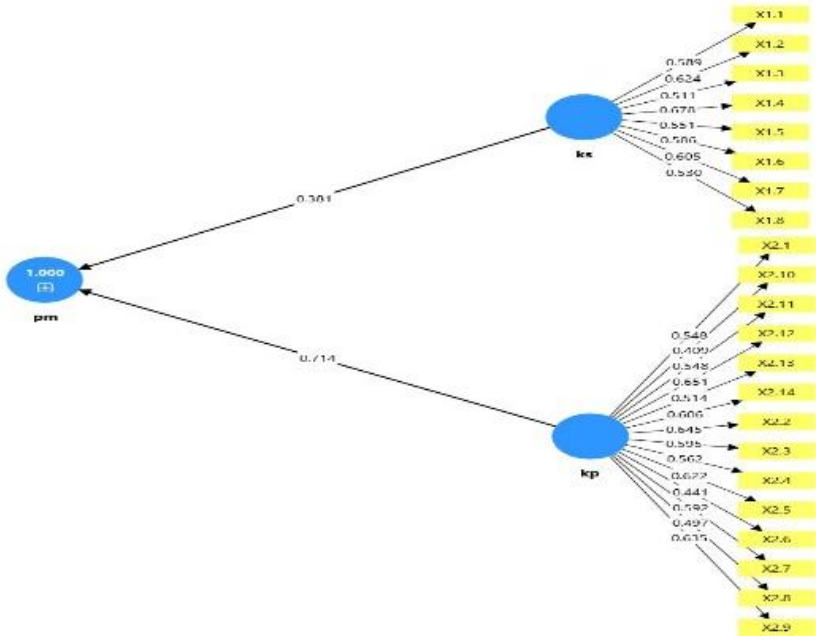


Figure 5. SmartPLS 4.0 Output of the Higher-Order Model Using All 300 Records (Sensitivity Analysis)

Note. Values on the arrows from ks and kp to pm are higher-order weights (0.381 and 0.714); values on indicator arrows are outer loadings; the value inside pm is R^2 = 1.000, fixed by the repeated-indicator specification. The estimates are virtually identical to the main analysis (n = 251; Figure 4). *Source:* SmartPLS 4.0 output, 2025.

The somewhat greater weight of perceived policy suggests that when students form an overall judgement about sanitation on the Kuin riverbank, what they believe the government is (or is not) doing, in terms of regulation, enforcement, toilet provision and socialisation, weighs slightly more than what they observe of physical conditions. This pattern fits research showing that access to sanitation in informal and riverside settlements depends heavily on public provision and financing rather than on household effort alone (Atika et al., 2024; Pessoa Colombo et al., 2023). The meaningful weight of perceived conditions indicates that direct observation also matters, which is consistent with arguments that first-hand encounters with local environmental problems shape learners' understanding (Smith, 2002). Two cautions apply. First, in the repeated-indicator approach the component with more indicators tends to receive a

larger weight (Becker et al., 2012; Sarstedt et al., 2019), and our equal-item check confirmed that most of the gap between 0.725 and 0.374 reflects KP's fourteen items versus KS's eight; the substantive conclusion is therefore that both appraisals contribute strongly, with a modest edge for policy. Second, the data are cross-sectional self-reports, so they show how perceptions are composed, not how perceptions change or how students behave.

For science and environmental education, the findings have two implications. First, the instrument separates students' perceptions of conditions from their perceptions of governance, which is the distinction that socioscientific-issue reasoning requires learners to make (Zeidler et al., 2005). Instructors in field-based courses such as *Susur Sungai* could use the two subscale scores diagnostically, for example by pairing riverbank observation with structured analysis of local sanitation regulation when students' policy-related perceptions are vague or unfounded. Second, the instrument can serve as an outcome measure in future pre–post or comparison-group studies of place-based learning, which the present design did not test. For local stakeholders, the results suggest, as a hypothesis for future evaluation, that visible and consistent sanitation measures may be salient to students; whether such measures improve sanitation conditions, or whether students act as intermediaries between government and riverbank communities (Thandayuthapani & Thirumoorthi, 2025), was not examined here.

The study has several limitations. Convergent validity was below the conventional threshold, and the latent correlation of 0.618 between the two components, although acceptable by HTMT, indicates substantial overlap; the item pool should be revised, for example by rewording or replacing the weakest items and conducting an exploratory factor analysis on a new sample. The sample was purposive and limited to three universities, 49 duplicated records had to be removed during screening, quantitative content-validity coefficients were not computed, data were self-reported and collected at a single point in time, and no learning outcomes were measured. Finally, community norms and residents' perspectives, which are relevant to riverbank sanitation, were outside the scope of the present instrument.

Discussion

The present study examined the measurement properties of an instrument assessing university students' perceptions of riverbank sanitation and evaluated how perceived sanitation conditions (KS) and perceived government policy (KP) constitute their overall perception (PM) of the Kuin Riverbank in Banjarmasin. The analysis of 251 valid responses indicated that both dimensions contributed significantly to the higher-order construct, with KP initially exhibiting a larger standardized weight ($\beta = 0.725$, $p < .001$) than KS ($\beta = 0.374$, $p < .001$). However, the robustness analysis revealed substantially narrower differences when the number of indicators was equalized (0.587 versus 0.537). These results indicate that students' overall sanitation perceptions incorporate both institutional and physical appraisals, while the apparent dominance of government policy is partly attributable to measurement specification. Importantly, the coefficients represent formative contributions to a composite construct rather than causal effects or independent explanations of behavioral outcomes.

The measurement findings warrant equally careful interpretation. Internal consistency was acceptable for KS ($\alpha = 0.715$), KP ($\alpha = 0.831$), and PM ($\alpha = 0.866$), while the heterotrait–monotrait ratio (HTMT = 0.791) supported discriminant validity. Nevertheless, average variance extracted remained below the recommended threshold for both lower-order constructs (KS = 0.334; KP = 0.317), indicating insufficient convergent validity. This distinction between reliability and validity is particularly consequential because internally consistent instruments may nevertheless inadequately represent their intended constructs. Furthermore, the sensitivity of higher-order weights to unequal indicator allocation reinforces methodological concerns about measurement specification in PLS-SEM (Becker et al., 2012; Sarstedt et al., 2019). Hair et al. (2024) similarly emphasized that composite-weighting decisions require careful justification and robustness evaluation. Consequently, the current instrument should be regarded as provisionally informative rather than comprehensively validated.

From an international perspective, these findings are consistent with scholarship

emphasizing the contextual and multidimensional character of place-based environmental learning. Yemini et al. (2025), in a systematic review of 149 studies, demonstrated that place-based education connects learning processes with geographical settings and community experiences. Similarly, Chan (2023), examining environmental citizenship among Taiwanese students, demonstrated that meaningful environmental learning incorporates institutional knowledge, community relationships, environmental understanding, and pluralistic civic values. The present study extends these educational perspectives by distinguishing perceptions of observable sanitation conditions from perceptions of institutional responsibility. Unlike intervention-based investigations, however, this research does not establish whether participation in riverbank learning activities changes students' knowledge, environmental attitudes, or civic engagement.

Further international evidence supports the educational relevance of direct engagement with environmental problems. Araújo et al. (2022) demonstrated that participation in coastal water-quality citizen science can strengthen conceptual and procedural learning in chemistry. McClain et al. (2022) likewise highlighted how place-based discussions surrounding community water systems support scientific reasoning and connections between formal knowledge and local experience. Meanwhile, Yevenes et al. (2022) emphasized the importance of integrating community participation with water-quality monitoring. These studies suggest that environmental observation becomes educationally valuable when combined with scientific investigation and critical interpretation. Nevertheless, Wichmann et al. (2022) showed that participation in environmental citizen science does not necessarily produce substantial behavioral changes. This contrast underscores the importance of distinguishing perceptual understanding from demonstrated environmental action, particularly because the present study measured students' appraisals rather than their actual sanitation practices.

The distinction between physical conditions and institutional responses is also supported by international sanitation-governance research. Eugenio et al. (2024), examining community-based waste management in the Philippines, demonstrated that public perceptions and socioeconomic circumstances are relevant to collective environmental-service participation. Such evidence suggests that environmental judgments emerge through interactions among service accessibility, institutional arrangements, and community expectations. Nevertheless, perceptions of government effectiveness may not correspond directly with objectively measured service performance. Students may form institutional assessments through public communication, personal observation, media exposure, or accumulated community experiences. Consequently, the relationship between perceived policy effectiveness and physical sanitation conditions should be understood as context-dependent rather than universally hierarchical.

Within Indonesia, the results resonate with evidence highlighting the interaction between infrastructure, governance, and community-level sanitation practices. Gusmiati et al. (2024), investigating riverbank settlements in Bima, demonstrated that sanitation decisions are shaped by economic constraints, available facilities, cultural practices, and household preferences. Similarly, Cecilia et al. (2024b) reported that the sustainability of community-managed wastewater facilities in Jakarta depends on technical, institutional, financial, and participatory arrangements. Their subsequent analysis of wastewater-service preferences further emphasized the relevance of infrastructure improvement and institutional coordination (Cecilia et al., 2024a). These findings support the importance of examining both physical environmental conditions and perceived government responsibility. However, unlike these household- and stakeholder-centered investigations, the present study focuses on university students' interpretations of an environment with which they interact.

Research conducted in Bandung provides additional contextual evidence. Mujahidah et al. (2024) demonstrated that public support for sanitation infrastructure is closely related to perceptions of services, communication, and community engagement. This finding helps explain why government policy may constitute a prominent dimension of students' overall assessments. Nevertheless, the substantially reduced difference between KP and KS after equalizing indicator

17 numbers suggests that the initial statistical ranking should not be interpreted as definitive evidence that students prioritize governmental action over visible sanitation conditions. Rather, their assessments incorporate both dimensions, with the observed difference remaining sensitive to instrument composition. This qualification is particularly relevant in Banjarmasin, where the river simultaneously functions as an environmental resource, settlement space, transportation corridor, and component of local cultural identity (Rochgiyanti, 2011; Timmer & Rosbergen, 2021).

Indonesian educational studies further demonstrate the value of incorporating environmental issues into contextual learning. Nurdiansyah and Komalasari (2023) emphasized community-based environmental education as a means of strengthening ecological citizenship, while Artina and Amin (2024) identified place-based learning, socioscientific inquiry, and participatory action as relevant approaches to ecological citizenship education. Mayasri et al. (2025) similarly demonstrated the potential of river-microplastics-based learning materials for developing science competencies and environmental awareness. These studies reinforce the pedagogical relevance of the Kuin River as a locally meaningful learning environment. However, the present research contributes primarily an assessment framework rather than evidence of instructional effectiveness. Its principal educational value lies in identifying whether students' appraisals concentrate on observed environmental conditions, governance responsibilities, or both.

Complementary studies in educational media provide additional opportunities for applying this framework. Ngololo et al. (2025) emphasized the contextual and developmental nature of meaningful biology education, whereas Handoko et al. (2026) demonstrated how digital biology learning can connect scientific understanding with everyday environmental awareness. Jumakulova and Kushieva (2025) further highlighted the importance of critical media literacy and participatory learning. Within Indonesian higher education, Kamsir et al. (2025) examined the integration of environmental themes through eco-theological visual learning materials. Although these investigations involve different disciplines and learning outcomes, they illustrate potential ways of integrating locally grounded environmental content into educational experiences. Their relevance to the present study is therefore pedagogical rather than confirmatory: none establishes that the sanitation-perception instrument independently improves learning outcomes.

Theoretically, the findings support conceptualizing riverbank sanitation perception as a multidimensional higher-order composite comprising physical-environmental and institutional-governance appraisals. This approach extends place-based learning and socioscientific-issue perspectives by providing separate diagnostic dimensions, while recognizing that convergent validity and composite specification require further refinement. Pedagogically, educators could integrate riverbank observations, water-quality investigations, policy-document analysis, community interviews, and reflective discussions within courses such as *Susur Sungai*. Digital media literacy could complement these activities through critical evaluation of online sanitation information, interpretation of environmental data, and verification of government policy claims. Such participatory learning may also encourage student engagement and environmentally responsible identity formation, although these outcomes require direct evaluation. Educational activities should support constructive engagement with environmental problems without unnecessarily intensifying students' emotional distress. At the policy level, transparent sanitation information, accessible infrastructure, community consultation, and stronger coordination among educational institutions and local authorities may improve public understanding of environmental governance. Fardiansyah and Fikri (2026) similarly emphasized institutional coherence in preventive environmental governance. Nevertheless, implications concerning digital behavior, emotional well-being, and policy effectiveness remain recommendations rather than outcomes established by the present survey.

This study contributes to environmental and science education research by developing an instrument that distinguishes perceived sanitation conditions from perceived governmental

responses within a locally situated socioscientific context. Its methodological contribution lies in specifying overall sanitation perception as a reflective–formative higher-order construct and examining the sensitivity of its component weights to unequal indicator representation. The comparison between the original and equal-item specifications demonstrates why apparently dominant dimensions should not be interpreted without evaluating measurement-related influences. Conceptually, the framework connects environmental observation with institutional appraisal, offering a potentially useful diagnostic approach for place-based science education in Indonesian river cities. Unlike research primarily evaluating sanitation infrastructure or environmental learning interventions, this study emphasizes how students organize their perceptions of environmental problems. Its contribution is therefore best understood as an initial measurement-development and model-evaluation effort rather than the establishment of a fully validated instrument or causal explanation of environmental behavior.

25

Several limitations restrict the interpretation and generalizability of these findings. First, both lower-order constructs exhibited inadequate convergent validity, requiring substantive item revision rather than reliance on satisfactory internal consistency alone. Second, the repeated-indicator specification was sensitive to unequal indicator allocation, highlighting the need for alternative higher-order estimation procedures. Third, the purposive sample comprised students from only three universities near the Kuin Riverbank, limiting generalization to other populations and geographical contexts. Fourth, the cross-sectional self-report design is susceptible to common-method bias, social desirability, and perceptual inaccuracies. Although duplicated records were excluded during screening, future studies should also implement transparent procedures for distinguishing duplicate submissions from legitimately identical response patterns. Additionally, the study did not directly measure sanitation conditions, policy implementation, knowledge acquisition, behavioral change, or mental health outcomes. Future investigations should refine the instrument through cognitive interviews, exploratory and confirmatory measurement analyses, and independent validation samples. Comparative studies across Indonesian river cities, longitudinal evaluations, and mixed-method approaches incorporating environmental measurements, policy analysis, community perspectives, and educational interventions would strengthen construct validity and clarify the practical relevance of students' sanitation perceptions.

CONCLUSION

This study examined an instrument for assessing students' perceptions of sanitation on the Kuin riverbank and how two dimensions compose students' overall perception. In 251 screened responses, internal consistency and discriminant validity (HTMT = 0.791) were acceptable, but AVE values below 0.50 show that convergent validity is not yet adequate. Both perceived government policy ($\beta = 0.725$) and perceived sanitation conditions ($\beta = 0.374$) contributed significantly ($p < .001$) to overall perception; once item numbers were equalised, their contributions were similar (0.59 vs. 0.54), so students' judgements of riverbank sanitation draw on both institutional and physical appraisals, with a modest edge for policy.

The instrument offers science and environmental educators a starting point for diagnosing students' perceptions of a local socioscientific issue and for evaluating place-based courses such as *Susur Sungai*, provided that its convergent validity is strengthened. Future research should refine the weaker items, document content validity quantitatively, confirm the factor structure in a new sample, add community-norm and knowledge constructs, and use pre–post designs to test whether field-based learning changes students' perceptions.

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