

Child-Inclusive Governance Signal Architecture: A Conceptual Framework for Translating Children's Visual Expression into Sustainability Governance Data

Avinash G. Jhangiani ¹, 

1. Research, Play2Transform Group, Mumbai, IND

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Abstract

Current sustainability governance frameworks rely on institutional indicators and adult-generated data, creating a structural blind spot: the generation most directly exposed to long-term development outcomes - children - contributes no systematic input to the measurement or prioritization of the Sustainable Development Goals (SDGs). Three relevant bodies of knowledge exist independently without integration: SDG monitoring frameworks, child participation norms grounded in the UN Convention on the Rights of the Child Article 12, and visual semiotic methodologies for systematically analyzing children's creative expression. No existing architecture operationalizes children's naturalistic visual expression as structured, governance-relevant data at scale.

This paper introduces the Child-Inclusive Governance Signal Architecture (CIGSA) - a conceptual framework designed to bridge this gap. CIGSA comprises three sequentially interdependent components: the Visual Governance Coding Framework, a three-layer instrument for coding children's drawings against SDG categories, People-Planet-Prosperity thematic clusters, and representational narrative features; the Independent Convergence Finding, a structural validation instrument that establishes whether observed convergence between children's visual priorities and formal governance deficits arises independently of researcher framing or participant priming; and the Deficit Positioning System, a theoretical proposition that children's aggregate visual output functions as a real-time, community-embedded instrument for locating development deficits - including in domains that formal measurement infrastructure cannot reach.

The architecture draws on embodied knowledge theory to establish a clear epistemological distinction between children's participatory data and the propositional, retrospective, and institutionally filtered knowledge produced by formal governance indices. CIGSA is presented as a replicable, portable architecture applicable across national and sub-national governance contexts, with implications for sustainability governance and SDG monitoring, international development organizations, enterprise Environmental, Social, and Governance materiality assessment, and civil society organizations functioning as distributed governance data infrastructure. At the theoretical level, the architecture advances a reconceptualization of children's participation - from symbolic inclusion to epistemic access.

Categories: Social Innovation, Social systems (economies, governments, industry), Sustainable Economic Development

Keywords: child-inclusive governance signal architecture, visual governance coding framework, independent convergence finding, deficit positioning system, sdg governance, children's participation, uncrf article 12, embodied knowledge, intergenerational governance, participatory governance

JEL Classifications: O35, Z13, J13, I38, D83, O19, M14, O10, H83, Q01

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Introduction And Background

The Sustainable Development Goals (SDGs) have become one of the central organizing frameworks of contemporary development governance. Through national indices, global reports, and indicator systems, they provide states and institutions with a common language for measuring progress, identifying gaps, and guiding accountability. Yet, these systems depend overwhelmingly on institutional data and adult-defined categories of evidence. This creates an important omission: children, who will live longest with the consequences of development choices, are seldom included in any systematic way in how sustainability concerns are identified or prioritized. In India, for instance, the Sustainable Development Report 2025 ranks the country 99th of 167 nations (Sachs et al., 2025), yet the formal instruments producing that ranking remain entirely inaccessible to the children growing up inside the deficits they measure. This exclusion is not unique to India - it is a structural feature of SDG monitoring globally.

This absence reflects a deeper architectural gap between three bodies of knowledge that exist in parallel without integration. First, SDG monitoring frameworks depend on institutional propositional knowledge: verified, sanctioned, and retrospective. Second, child participation norms - grounded in UN Convention on the Rights of the Child (UNCRC) Article 12 and developed through participatory governance scholarship - establish children's right to contribute to decisions that affect them but have produced consultative rather than systematic mechanisms. Third, visual semiotic methodologies provide robust tools for analyzing children's creative expression as structured, analyzable text, but these tools have not been operationalized within formal governance data systems.

No existing framework integrates these three domains. The result is a governance architecture that is simultaneously committed to intergenerational equity in principle and structurally unable to operationalize it in practice. The case for such an architecture rests on more than normative grounds. Children occupy a unique epistemic position: they inhabit development deficits without the institutional filters that mediate adult and administrative knowledge. They carry no data lag, require no ministry submission, and operate beneath no coverage threshold. When their visual expression is aggregated at scale and systematically coded, it constitutes a form of distributed community sensing that formal governance indices are structurally unable to replicate.

This gap has direct implications for business and economics scholarship: the systematic exclusion of children's participatory inputs from SDG monitoring affects the quality of sustainability data on which enterprise Environmental, Social, and Governance (ESG) strategy, public-private development partnerships, and impact investment decisions are based. A framework for integrating children's visual expression into governance data systems is therefore not only a governance design question - it is a business accountability question.

This paper pursues three objectives. First, to identify and characterize the architectural gap created by the mutual isolation of SDG monitoring frameworks, child participation scholarship, and visual semiotic methodology - establishing why each domain is insufficient alone and why their integration requires a purpose-built architecture. Second, to introduce the Child-Inclusive Governance Signal Architecture (CIGSA) and specify its three sequentially interdependent components - the Visual Governance Coding Framework (VGCF), the Independent Convergence Finding (ICF), and the Deficit Positioning System (DPS) - as a replicable, portable system for converting children's visual expression into governance-relevant data. Third, to establish the epistemological basis on which children's naturalistic visual expression constitutes a structurally distinct form of developmental intelligence - grounded in embodied knowledge rather than institutional documentation - and to examine the implications of that distinction for sustainability governance, international development, ESG and corporate sustainability, civil society, and the theoretical reconceptualization of children's knowledge in governance systems.

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Review

SDG monitoring frameworks and their structural limits

The 2030 Agenda for Sustainable Development, adopted by the United Nations General Assembly in 2015, established 17 SDGs comprising 169 targets and an indicator framework intended to track national progress toward those targets (United Nations, 2015). This architecture represented an unprecedented ambition in global governance: a common framework through which all 193 UN member states would measure, report, and be held accountable for their development trajectories. National indices such as the NITI Aayog SDG India Index operationalize this framework at the country level, translating global targets into domestically measurable composite scores (NITI Aayog, 2018). The annual SDG Index and Dashboards extend this logic globally, producing cross-national rankings and gap analyses that anchor international accountability discourse (Sachs et al., 2025).

Yet the architecture through which SDG performance is measured carries structural limits that are intrinsic to its design rather than incidental to its implementation. National development indices are products of institutional process: before a score can appear, an indicator must clear ministry consent, survive a data coverage threshold, be drawn from an official statistical source, and pass through normalization and averaging procedures that produce a composite. The result is what this article terms as propositional knowledge - verified, sanctioned, and retrospective: it describes conditions in domains that states have agreed to be measured on, from sources that already exist, characterizing circumstances from years prior to publication. Scholarship on the politics of indicator-based governance has documented that this process is not neutral - indicator selection carries value judgments, theoretical assumptions, and political considerations that shape which dimensions of development become visible and which remain outside the measurement frame (Fukuda-Parr and McNeill, 2019). The measurement of extreme inequality in SDG 10 provides a documented instance: distributional measures capable of capturing the sharpest inequalities were displaced in favor of less sensitive proxies during the indicator negotiation process (Fukuda-Parr, 2019).

Beyond political distortion, the framework faces compounding technical constraints. With an average of approximately 1.5 indicators per target and 62% of targets measured by a single indicator, the framework is structurally under-specified - creating conditions in which indicators come to overpower the targets they were designed to measure (Kim, 2023). Data currency compounds this problem: analysis across OECD countries finds that over 40% of SDG data points are more than 3 years old, with environmental and governance indicators suffering the greatest lags while economic indicators remain more current - an unintended structural bias that favors what is easiest to measure over what is most governance-relevant (OECD, 2025). The system's reliance on official statistical sources means that domains where administrative data infrastructure is absent or underdeveloped - precisely the domains characterizing the deepest development deficits - fall systematically outside its measurement reach (MacFeely, 2019). A comprehensive assessment by 61 scholars found that the political impact of the SDG framework has been largely discursive, with policy coherence and structural governance reform lagging substantially behind rhetorical commitment (Biermann et al., 2022).

These limits are not arguments against SDG monitoring - they are structural features of any large-scale institutional measurement system. But they have a direct implication for governance design: if formal indices cannot reach what is experienced rather than documented, and cannot measure what lies beyond administrative data infrastructure, then the governance systems they inform will carry a systematic blind spot toward precisely the developmental conditions most acutely felt by the communities living inside them. It is this structural gap - between the propositional knowledge that formal indices can produce and the embodied knowledge that communities already carry - that the present paper addresses.

Children as absent stakeholders in sustainability governance

Sustainability governance is inherently intergenerational. Policies enacted today shape environmental systems, economic structures, and institutional arrangements that children will inhabit over decades. Intergenerational equity frameworks argue that those most exposed to long-term outcomes hold legitimate stakes in contemporary decision-making

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(Colglazier, 2015). Children's right to express their views in matters affecting them is firmly established under Article 12 of the UNCRC (United Nations, 1989) - the most widely ratified human rights treaty in history. SDG 16 itself calls for responsive, inclusive, participatory, and representative decision-making at all levels (Colglazier, 2015).

Participatory governance scholarship has developed this normative foundation. A foundational framework on children's participation cautions against tokenistic engagement and distinguishes between symbolic consultation and meaningful civic inclusion (Hart, 1992). Building on this, meaningful participation requires not only voice but structured space, audience, and influence within governance systems (Lundy, 2007). Guidance on child-responsive governance has further operationalized these principles at the institutional level (UNICEF, 2020).

Despite these frameworks, large-scale mechanisms for systematically capturing, structuring, and integrating children's perspectives within national sustainability frameworks remain limited. In India, Bal Sabhas - village-level children's assemblies formally linked to gram panchayats and operating across multiple states with UNICEF and government support - represent among the most institutionalized forms of this participation globally (UNICEF, 2019) (Ministry of Panchayati Raj, 2019). Children in these assemblies raise issues spanning sanitation, education, child marriage, and environmental conditions that map directly to SDG domains. Yet independent assessment finds they are still largely seen as messengers rather than independent problem identifiers, and issues raised struggle to gain traction against competing governance priorities (IDR, 2025). Across national contexts, similar patterns hold: Bal Bhela consultations in Nepal - including child clubs and community consultations - enabled children to identify community-level priorities related to education, sanitation, gender equity, and protection, with these inputs in some cases informing local development planning processes (UNICEF, 2019). Such examples demonstrate that children are capable of expressing structured, governance-relevant concerns - and that where institutional frameworks exist to receive them, children engage with civic and developmental issues of direct relevance to national sustainability priorities.

However, such participation remains episodic, dependent on external facilitation, and disconnected from formal monitoring cycles. The gap is not only institutional but epistemological. Existing approaches treat children's contributions as voices to be heard rather than as knowledge to be structured and operationalized. The question this article addresses is therefore not whether children should participate in governance - that question has been answered by the UNCRC, by participatory governance scholarship, and by practice examples across multiple national contexts demonstrating children's capacity for structured civic expression - but what kind of knowledge their consistent, large-scale participation produces, and whether an architecture can be designed to translate that knowledge systematically into governance-relevant data at scale.

Visual expression as structured governance-relevant data

Children's drawings have been studied as indicators of environmental perception and social understanding (Alerby, 2000) (Barraza, 1999) (Payne, 1998). Visual artifacts organize meaning spatially and symbolically, allowing individuals to simultaneously represent actors, environments, challenges, and envisioned outcomes. Visual communication scholars demonstrate that images operate as semiotic systems in which meaning is constructed through composition, symbolism, and relational positioning of visual elements (Kress and Van Leeuwen, 2020). In research contexts, visual materials can be treated as analyzable data when observable features and recurring motifs are systematically coded (Banks and Zeitlyn, 2015) (Rose, 2016).

Studies of children's drawings suggest that visual expression reflects socio-cultural exposure, educational context, and perceived social priorities, shaped by the cultural and social environments in which children live (Cox, 2005). Contemporary approaches to visual analysis emphasize the identification of observable components - problem depiction, relational dynamics, environmental framing, and solution orientation - within visual composition (Rose, 2016). When aggregated across a dataset, recurring representational patterns reveal shared concerns and thematic clustering that survey-based instruments cannot easily surface.

A distinct cognitive dimension strengthens this analytical potential. Positive Constructive Daydreaming (PCD), conceptualized by Singer, describes a form of imaginative engagement in which individuals mentally simulate alternative futures and construct solution-oriented projections rather than unstructured fantasy (McMillan et al., 2013). When

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children are invited to envision improved futures, PCD research suggests they articulate both perceived deficiencies in the present and pathways toward resolution - producing coherent, future-oriented reasoning. Future education scholarship similarly finds that inviting children to imagine future societies provide insight into how they perceive social priorities and emerging challenges (Hicks, 2003).

The analytical implication is significant: children's drawings produced in response to a structured imaginative prompt are not purely expressive artifacts. They are structured representations that organize sustainability concerns through visual narrative elements - problem depiction, causal framing, agency positioning, and solution orientation - that can be systematically extracted, coded, and aggregated into governance-relevant data. This is the analytical foundation on which the architecture introduced in this paper rests: not that children's drawings are valuable as expressive artifacts, but that they are analyzable as structured visual representations that encode real-world developmental knowledge in a form that systematic coding can make legible to governance systems.

The three-way silo: where integration is missing

The governance gap that this paper addresses arises from the simultaneous existence and mutual isolation of three bodies of knowledge.

The first is the SDG monitoring ecosystem. National development indices are products of institutional process: ministry consent, data coverage thresholds, official statistical sources, normalization procedures, and multi-year lags. These instruments produce propositional knowledge - verified, sanctioned, and retrospective - that describes conditions in domains that states have agreed to be measured on. They are indispensable for accountability and benchmarking, but they cannot measure what is experienced rather than documented, and they cannot reach domains where administrative data infrastructure does not exist.

The second is child participation scholarship. The frameworks of Hart, Lundy, UNICEF guidance, and the UNCRC architecture establish the normative case for children's inclusion. These frameworks have informed consultative approaches in education, urban planning, and community development. But they have largely focused on principles of representation rather than systematic integration of children's inputs into governance data cycles. Participation remains voluntary, episodic, and dependent on institutional responsiveness.

The third is visual semiotic methodology. Rose's visual methodologies, Kress and Van Leeuwen's grammar of visual design, and the children's drawing research tradition provide rigorous tools for treating creative visual expression as analyzable representation. These tools have been applied in environmental education and social research but have not been operationalized as components of a scalable governance data system.

No existing architecture integrates these three domains. The result is that children's participatory visual expression - demonstrably structured, analyzable, and epistemologically distinct from institutional data - is systematically excluded from the governance systems it could most usefully inform. This exclusion is not merely a missed opportunity for symbolic representation. It is a structural data gap. When children living inside development deficits express those deficits visually at scale, governance systems that lack the analytical infrastructure to read that expression are discarding real-time, community-generated intelligence. The CIGSA is proposed as the integrative framework that addresses this gap.

CIGSA: an overview

CIGSA is a conceptual framework designed to operationalize children's expressive participation as structured governance-relevant data. It is not a consultation platform or a community engagement initiative. It is an analytical architecture - a set of sequentially interdependent instruments through which creative expression is translated into signals that formal governance systems can read, validate, and act upon.

As depicted in Figure 1, the architecture comprises three components that operate as a system. The VGCF is the conversion instrument: it takes children's drawings as input and produces SDG-mapped, thematically clustered, and representationally coded governance data as output. The ICF is the validation instrument: it compares VGCF-coded

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priority distributions against formal governance performance scores and specifies the structural conditions under which any observed convergence can be established as arising independently and treated as a genuine signal rather than a methodological artifact. The DPS is the theoretical instrument: it provides the epistemological basis on which the validated signal is interpreted as a community-embedded instrument for locating development deficits, including in domains not adequately captured by existing measurement systems.

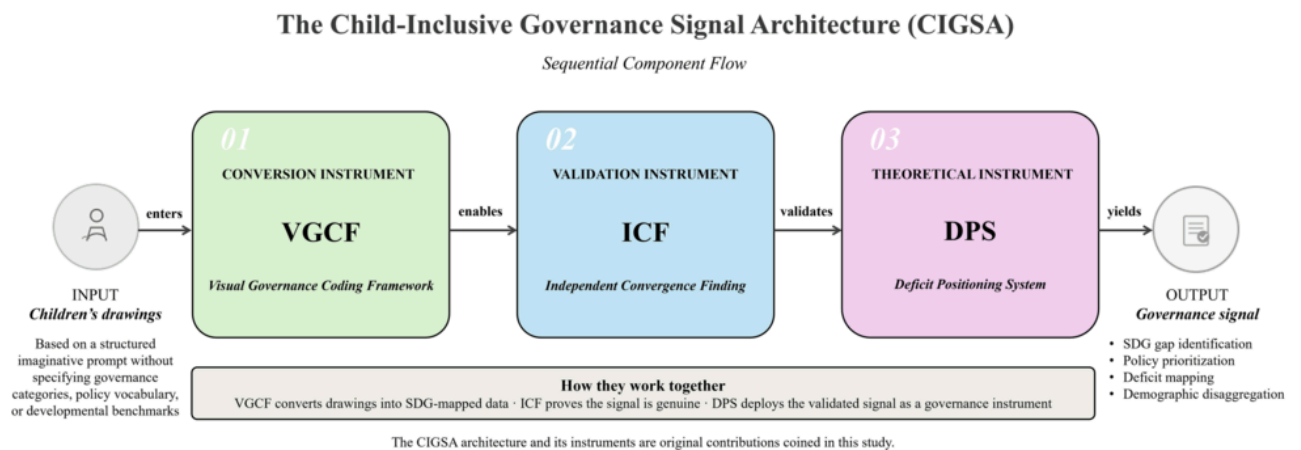


FIGURE 1: The CIGSA: sequential component flow from children's visual expression to governance signal.

Source: Author's original framework.
CIGSA, Child-Inclusive Governance Signal Architecture; VGCF, Visual Governance Coding Framework; ICF, Independent Convergence Finding; DPS, Deficit Positioning System

These three components are sequential and interdependent. VGCF enables ICF: without a systematic coding instrument, no convergence test is possible. ICF enables DPS: without structural validation, any observed convergence could be attributed to coincidence or artifact. DPS gives VGCF and ICF their governance significance: without a theoretical account of what the signal represents, the convergence remains a statistical curiosity rather than an epistemological contribution.

Table 1 summarizes each construct, its type, role within the architecture, and its inputs and outputs.

Construct	Type	Role within CIGSA	Input	Output
Structured Imaginative Prompt	Input condition	Gateway that preserves the uninvited signal pathway by eliciting expression without governance framing	Facilitator invitation to envision a desired future	Children's naturalistic visual expression
Component 1: VGCF - Visual Governance Coding Framework	Conversion instrument	Translates children's drawings into structured governance-relevant data across three layers: SDG mapping (Layer 1), People-Planet-Prosperty clustering (Layer 2), representational feature coding (Layer 3)	Children's drawings	SDG-mapped, thematically clustered, representationally coded data
Component 2: ICF - Independent Convergence Finding	Validation instrument	Specifies the structural conditions under which observed convergence between children's visual priorities and formal governance deficits can be established as arising independently of researcher framing or participant priming	VGCF-coded SDG priority distributions + formal governance performance scores	Validated or invalidated convergence finding
Component 3: DPS - Deficit Positioning System	Theoretical instrument	Provides the epistemological basis on which the validated signal is interpreted as a real-time, community-embedded instrument for locating development deficits, including in domains beyond formal measurement reach	ICF-validated convergence signal	Governance-relevant deficit signal for SDG gap identification, policy prioritization, deficit mapping and demographic disaggregation

TABLE 1: Key constructs of CIGSA.

CIGSA, Child-Inclusive Governance Signal Architecture; SDG, Sustainable Development Goal

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CIGSA is conceptually aligned with child-rights governance systems that institutionalize children's participation within public decision-making (Chawla, 2002). It is operationally compatible with established participatory methods including drawing-based consultations, participatory mapping, and photovoice (UNICEF, 2019) (Wang and Burris, 1997) (Backett-Milburn and McKie, 1999). Existing operationalizations of Article 12 of the UNCRC - most notably Lundy's model of Space, Voice, Audience, and Influence - address the invited participation pathway, in which adults create structured processes for children to be heard (Lundy, 2007).

CIGSA addresses a distinct and previously unaddressed pathway: the systematic extraction of governance-relevant evidence from child expression produced under a civic or creative framing - without SDG briefing, policy vocabulary, or governance analytical intent at the point of expression. The minimum necessary condition for this pathway is a structured imaginative prompt - an invitation to children to envision a desired future state without specifying governance categories, policy vocabulary, or developmental benchmarks. It is this condition that distinguishes CIGSA inputs from both arbitrary creative expression and formal governance consultation, and that preserves the independence the ICF subsequently validates. The integrity of the prompt condition requires that facilitators present it without elaboration or interpretive guidance - adult influence at the point of expression would compromise the independence the ICF is designed to validate. This extends the Article 12 evidence base beyond what structured participation processes can reach. Its distinguishing contribution is architectural: a portable, transparent analytical core designed to translate children's expressions into governance-relevant data objects that can enter routine planning, budgeting, monitoring, and reporting cycles (UNICEF, 2018) (Brown et al., 2019).

Importantly, CIGSA does not require bespoke infrastructure to function. It is designed to operate through existing educational and civic platforms - schools, community organizations, art programs, and national children's engagement initiatives - treating these as distributed data collection nodes rather than one-off consultation exercises. The architecture's portability means it can be adapted across governance contexts, language groups, and cultural settings without redesign of its analytical core, making it viable for deployment across the range of national and sub-national contexts in which SDG deficits are most acute.

Although CIGSA's initial application is sustainability governance and SDG alignment, the analytical architecture is domain-extensible. The same coding spine is applicable wherever children's naturalistic expression carries evidence value for adult decision-making - including health, education, climate, and justice contexts - making CIGSA a generalizable architecture for child-inclusive evidence, not a framework specific to any single policy domain.

Component 1: VGCF

The VGCF is a three-layer instrument for translating children's visual expression into structured, governance-relevant data. Each layer extracts a distinct dimension of governance-relevant meaning from visual artifacts, with the three layers designed as a sequential analytical system.

Layer 1: SDG Mapping. Each drawing is coded for alignment with one or more of the 17 UN SDGs based on observable visual indicators consistent with SDG targets. Classroom settings signal SDG 4 (Quality Education); gender-based violence imagery signals SDG 5 (Gender Equality) and SDG 16 (Peace, Justice and Strong Institutions); pollution or industrial waste imagery signals SDG 12 (Responsible Consumption and Production) or SDG 13 (Climate Action) depending on context. Drawings may map to multiple SDGs where clearly depicted. Layer 1 produces frequency distributions of SDG priority across a dataset, enabling identification of dominant sustainability concerns and demographic variation in prioritization across geographic zones, age groups, gender, resource context, among other available demographic and socioeconomic parameters. While the VGCF uses the 17 UN SDGs as its default international policy taxonomy, the architecture permits substitution with any recognized national or regional policy framework where SDG vocabulary is not the primary governance instrument, enabling application across diverse governance contexts.

Layer 2: People-Planet-Prosperity Thematic Clustering. Coded SDG issues are grouped under three higher-order sustainability themes derived from the UN 2030 Agenda's triple-bottom-line framework: People (social equity, human dignity, institutional justice), Planet (environmental protection, ecological systems, climate resilience), and Prosperity

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(infrastructure, economic development, technological innovation). Issue-frequency analysis within each dominant theme provides a synthesis layer beyond individual SDG frequencies, enabling identification of broader issue concentration across socio-economic and environmental domains.

Layer 3: Representational Feature Coding. Each drawing is coded for observable structural features - problem depiction, future vision framing, causal triggers, positive resolution, catalyst presence, and self-positioned agency. This layer examines how children visually construct pathways toward change: whether they identify causes, envision solutions, and position themselves as agents of transformation. Coding decisions are based exclusively on observable visual evidence - symbols, labels, narrative sequencing, depicted actors - rather than inferred psychological states, ensuring analytical discipline and reducing interpretive drift. The three layers serve distinct downstream purposes within the architecture: Layer 1 produces the SDG priority distributions that the ICF uses to conduct its convergence comparison, while Layers 2 and 3 enrich the governance signal that the DPS subsequently deploys - providing thematic depth and representational insight that extend the signal's analytical value beyond deficit identification alone.

A structured imaginative prompt does not produce uniform expressive output. Children respond through a spectrum of modes - from purely aspirational expression, in which a desired future is depicted without reference to present conditions, to direct problem depiction, before-after sequencing, and full problem-solution narratives that identify a deficit, attribute its cause, and position an agent of change. Each mode carries governance-relevant signal; what varies is analytical richness rather than validity. The VGCF's three-layer coding structure is designed to receive signal across this full spectrum - recognizing that the aspiration names the absence as reliably as the problem depicts it, and that the most analytically complete expressions reveal not only what children perceive as broken but what they understand about how it might be repaired.

The VGCF is grounded in visual discourse analysis principles (Rose, 2016) and deductive thematic content analysis (Braun and Clarke, 2006). Its three-layer structure is designed to reduce interpretive drift and produce outputs that are portable across datasets and coding contexts. The framework treats drawings as multimodal visual artifacts, since children's drawings may communicate meaning through pictorial representation, embedded text, or both. Inter-coder reliability is built into the VGCF implementation protocol as a minimum standard: a Cohen's kappa of 0.80 or above, indicating substantial agreement (Lombard et al., 2002), is required across coding teams before coded outputs are considered valid for governance signal analysis.

The three-layer coding structure of the VGCF is designed to be compatible with AI-assisted implementation - advances in computer vision and multimodal analysis make automated SDG mapping and representational feature coding increasingly feasible at scale, with human validation retained to preserve the independence conditions the ICF requires.

Component 2: ICF

The ICF is a structural validation test - a methodological instrument that specifies the conditions under which a finding of independent convergence can be established. Its intellectual contribution is not to claim that convergence has occurred, but to define the structural conditions under which, if convergence is observed, it is less readily explained by methodological artifact, framing effects, or coincidence.

The comparison the ICF conducts is direct: VGCF-coded SDG priority distributions - the frequency with which children's artworks map to each of the 17 SDGs - are placed against formal governance performance scores for the same SDG categories. Where children most frequently depicted concerns maps to where formal indices record the deepest deficits, convergence is observed. The structural conditions determine whether that convergence can be trusted as signal or must be treated as artifact.

Any observed alignment between children's visual priorities and formal governance data could potentially be attributed to two sources of methodological contamination: participant priming (children were aware of national SDG priorities and reproduced them), or researcher framing (coders had reference to national scores and the coding framework was designed to find certain patterns). The ICF is designed to rule out each of these by requiring that: the children who produced the drawings had no access to the formal governance data being compared; the coders who mapped the

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drawings to governance categories operated without reference to the formal data; the coding framework was developed independently of and prior to any comparison with governance indices; and the convergence is observed across both a curated subset and a broader dataset, establishing that it cannot be an artifact of curation.

If these independence conditions are satisfied and convergence is still observed, the likelihood that the pattern is merely the result of framing or coding bias is reduced substantially. Under those conditions, the convergence may be interpreted as evidence-bearing rather than incidental. The ICF therefore serves two functions: it validates the VGCF's outputs as a genuine governance signal, and it supports the epistemic basis for the DPS. If the signal arises independently, it must be read as information rather than noise.

Component 3: DPS

The DPS is the theoretical proposition that gives CIGSA its governance significance. It proposes that children's aggregate visual output - when produced in response to a structured imaginative prompt and systematically coded through the VGCF - constitutes a genuine, structurally distinct form of developmental intelligence: real-time, community-embedded, and of increasing precision as dataset scale and geographic distribution grow. Where formal governance indices produce propositional knowledge - verified, sanctioned, and retrospective - the DPS theorizes children's visual expression as embodied knowledge, constituted through lived proximity to developmental conditions rather than institutional documentation of them. The governance implication follows directly: a signal of sufficient strength and structural independence can locate development deficits - including in areas that remain weakly captured by formal measurement systems.

The theoretical basis is Merleau-Ponty's account of embodied perception: knowledge of the world is not produced solely through detached observation or institutional documentation, but is constituted through the body, history, and lived position of the perceiver (Merleau-Ponty, 2002). Children embedded within communities experiencing development deficits - inadequate health infrastructure, institutional injustice, gender inequality - do not require survey instruments or administrative data to register those conditions. They inhabit them. Their drawings surface this embodied knowing in analytically tractable form. This embodied knowing is simultaneously structural and affective - children do not merely depict deficits, they register them with emotional weight that is itself a form of proximity evidence. The current VGCF captures the structural dimension of this knowing through observable, codeable representational features; the affective dimension - the emotional register children assign to depicted problems and desired outcomes - represents a theoretical frontier that the architecture acknowledges but does not yet operationalize.

The DPS is distinguished from propositional knowledge - the form produced by national development indices - by three structural characteristics. It operates in real time, carrying no data lag. It requires no ministry submission and applies no coverage threshold, and it can reach domains where administrative data infrastructure does not yet exist. These characteristics position the DPS as a complementary instrument to formal indices, capable of accessing precisely the dimensions of developmental reality that institutional measurement is structurally unable to score.

The Global Positioning Systems (GPS) analogy is instructive. GPS locate physical position in space through distributed, independently operating signals. The DPS locates development deficits in social space through distributed embodied knowledge - reaching coordinates that formal measurement infrastructure has not yet charted. Like GPS, its signal strength increases with the number and geographic distribution of contributors. Like GPS, it does not replace maps - it locates reality on them with greater resolution than maps alone provide.

The DPS is epistemologically analogous to citizen science in environmental monitoring, but operating in the domain of social and developmental experience rather than ecological data. Where citizen science provides real-time environmental sensing that formal monitoring cannot match in frequency or geographic coverage, the DPS provides real-time developmental sensing that formal governance indices cannot match in depth, currency, or domain coverage.

This scalability is a deliberate design feature. The DPS does not require a large sample to function - it produces a governance-relevant signal from the outset and becomes progressively more precise as dataset size and diversity grow. As drawings are collected from increasingly diverse socioeconomic, linguistic, and regional contexts, the signal enables

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three things that aggregate national data cannot: sub-national deficit mapping at city or district level; demographic disaggregation that reveals how different groups - by age, gender, geography, resource context, and language - perceive and prioritize different deficits; and longitudinal tracking of whether children's expressed priorities shift in response to policy interventions, providing a ground-level feedback loop on whether policy is working.

Preliminary Application: Dream On India

In preliminary work conducted by the author, the architecture was applied to a structured secondary analysis of children's drawings from the Dream On India initiative (2018-2019) - a national civic art program in which children across India were invited to visualize the future of the nation and address their drawings to the President of India, producing more than 10,000 submissions from children aged 6 to 18 across diverse geographic zones, school types, and socioeconomic contexts, without SDG briefing, governance vocabulary, or access to national indices. An analytical subset of 212 submissions drawn from this corpus was coded against the VGCF by trained coders working independently of India's formal SDG performance data, with the coded priority distributions subsequently mapped against the NITI Aayog SDG India Index Baseline Report 2018 (NITI Aayog, 2018). The application suggests that the VGCF is operationalizable at scale and that the ICF conditions can be met in practice: children's aggregate visual priorities corresponded with India's formally documented development deficits, arising entirely independently. Full empirical findings, including inter-coder reliability results, statistical convergence analysis, and demographic disaggregation, are being prepared for separate empirical publication.

Implications for governance, practice and theory

CIGSA's contributions carry implications across four stakeholder domains - sustainability governance and policy, international development organizations, enterprise ESG and corporate sustainability, and social enterprises and civic organizations - and extend to a broader theoretical reconceptualization of children's knowledge in governance systems.

Sustainability Governance and Policy

Prior models of child participation in governance have rested on normative foundations - children are future stakeholders, intergenerational equity demands their inclusion, Article 12 of the UNCRC obliges states to seek their views. These arguments are valid but structurally insufficient: they invite acknowledgement while permitting inaction. CIGSA advances a different kind of argument - functional rather than normative, and harder to set aside. Children's expressed priorities are no longer a normative aspiration. They are an epistemological resource. Governance systems that lack the infrastructure to read that resource are operating with a structural data gap in precisely the domains where formal measurement infrastructure is weakest.

The operational implication is direct. Operationalized as a live policy instrument - through structured annual child visual consultations aligned with national SDG reporting cycles - the VGCF could generate aggregated, governance-coded signals at a fraction of the cost of conventional household surveys, while accessing developmental intelligence that those surveys are structurally unable to produce: real-time, embodied, and unfiltered by institutional consent processes (UNICEF, 2018; Brown et al., 2019). Demographic disaggregation of the signal - by age, gender, geographic zone, resource context, and language - enables governance systems to identify not only which populations are signaling which deficits most acutely, but how different demographics frame those deficits and whether they express the civic agency to address them - governance intelligence that aggregate indices cannot provide.

STEM innovation programs represent a particularly significant and underutilized opportunity. In India, NITI Aayog's Atal Innovation Mission has established 10,000 Atal Tinkering Labs across 722 districts, reaching over 11 million students through institutional school infrastructure - making it one of the largest nationally coordinated STEM innovation programs in the world (NITI Aayog, 2025). These programs are designed to train children to develop solutions to defined challenges - a powerful pedagogical orientation (Kelley and Knowles, 2016) (LaForce et al., 2017). Integrating a structured imaginative prompt into this design - inviting children to identify what they believe is broken before they are asked to fix

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anything - would extend that orientation to include the surfacing of lived experience, activating the uninvited signal pathway at the point of greatest institutional reach and generating governance-relevant signal as a by-product of innovation activity that is already happening at scale.

International Development Organizations

For UN agencies, UNICEF, and multilateral development bodies, CIGSA offers a mechanism for operationalizing Article 12 of the UNCRC beyond consultative compliance into systematic, governance-relevant data generation. Existing child participation frameworks - however well-designed - produce episodic inputs that enter governance systems as voices to be noted rather than data to be integrated. CIGSA changes that relationship structurally. By providing a replicable analytical core deployable through existing child engagement platforms across national and sub-national contexts, it enables international organizations to move from facilitating children's participation to institutionalizing children's signal within SDG monitoring and reporting architecture. The DPS proposition - that children's distributed embodied knowledge locates development deficits including in domains beyond the current reach of formal measurement systems - gives international bodies a principled basis for treating child visual expression as a supplementary data layer in Voluntary National Review processes and SDG gap analysis, rather than as a consultation output to be filed separately from the measurement system.

Enterprise ESG and Corporate Sustainability

Corporate sustainability frameworks increasingly acknowledge the limitations of institutional indicators and adult-centered stakeholder consultations - particularly in assessing the social dimensions of ESG where lived community experience diverges from reported performance. CIGSA offers a distinct data source for materiality assessment. Because the DPS operates outside institutional channels - requiring no ministry submission, no coverage threshold, and no corporate facilitation - the signals it generates are unanchored from the social performance effects that structured stakeholder consultations routinely introduce. Children living inside the communities most affected by corporate operations represent precisely the stakeholder group most consistently absent from conventional ESG materiality processes, and most directly exposed to the long-term consequences of corporate decisions. Consider, for instance, a manufacturing company conducting an SDG 3 or SDG 6 materiality assessment in communities adjacent to its operations: CIGSA-coded drawings from children in those communities would surface real-time, unfiltered signal about health and water conditions as lived rather than reported. This provides a community evidence layer that no structured stakeholder consultation, however well-designed, can replicate without activating the social performance effects that compromise its independence. Integrating CIGSA-coded child visual expression into ESG frameworks would not only extend stakeholder reach - it would introduce a category of community evidence that formal indicator systems cannot replicate: real-time, community-embedded, and free from the institutional filters that shape every other data source available to ESG practitioners.

Social Enterprises and Civic Organizations

Schools, NGOs, community organizations, and civic art initiatives are not merely delivery channels for CIGSA - they are its distributed data infrastructure. These organizations already facilitate children's creative and civic expression at scale, in precisely the communities where development deficits are most acute. CIGSA repositions that work: what has previously been understood as community engagement or arts programming becomes, under the CIGSA architecture, a distributed governance data collection network. Social enterprises and civic organizations are uniquely positioned to operationalize this - they hold existing relationships with children, schools, and communities that neither government agencies nor corporations can replicate. Their role within a CIGSA-enabled system is not to facilitate consultation but to generate signal: structured, codeable, governance-relevant expression from the communities that formal data infrastructure reaches last and measures least. This creates a new value proposition for the social sector - one in which programmatic work with children produces not only direct community benefit but independently verifiable governance intelligence that policymakers, ESG practitioners, and development bodies can act upon.

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Ensuring no child is left behind requires CIGSA to address both data inclusion - reaching children outside institutional platforms through modality extension and non-visual expression pathways for children with visual impairment or motor disability - and signal inclusion - ensuring the coding architecture can receive expression from children whose visual vocabulary, trauma history, or developmental profile diverges from the framework's default assumptions. These equity dimensions are proposed as a dedicated research agenda for CIGSA's next development phase.

Theoretical Reconceptualization

CIGSA makes a claim that extends beyond methodology: that children's participation in governance is not primarily a matter of representation but of epistemological access. Governance systems that exclude children's inputs are not merely less equitable - they are less epistemically complete. Drawing on Merleau-Ponty's account of embodied perception (Merleau-Ponty, 2002), the DPS theorizes children's aggregate visual expression as a structurally distinct knowledge form - constituted through lived proximity to development deficits rather than through institutional documentation of them. This reconceptualization has direct consequences for participatory governance scholarship: it shifts the evaluative question from whether children are included in governance processes to whether governance systems are epistemically equipped to receive the knowledge children already carry. Children's visual narratives are not expressions of feeling to be noted at the margins of governance - they are structured articulations of developmental reality that formal measurement systems would do well to read alongside their own.

Limitations

Several limitations of the CIGSA framework as currently proposed warrant acknowledgment.

First, interpretation bias remains a residual risk even within a coding protocol designed to minimize interpretive drift. The VGCF requires coders to make judgements about visual indicators that are not always unambiguous. A depicted figure in a classroom may signal SDG 4, but contextual elements could plausibly support alternative mappings. Inter-coder reliability protocols with documented agreement thresholds are built into the implementation design to manage this risk, but coder training, codebook precision, and ongoing calibration remain necessary conditions for consistent implementation.

Second, cultural variation in visual expression poses a challenge to the framework's portability claims. Drawing conventions, symbolic vocabularies, and the relationship between visual representation and meaning are not culturally universal. Color symbolism, spatial conventions, and figurative representation carry different meanings across cultural contexts, and a coding framework developed and initially applied in one national context may require adaptation before transferring reliably to others. Cross-cultural validation of the VGCF's SDG visual indicators is a necessary condition for the replication agenda the ICF proposes.

Third, educational and social influences on children's drawings may introduce systematic biases into the signal. Children's visual expression reflects not only lived experience but also what they have been taught to draw, what their peers draw, and what their social environment signals is appropriate to express. Curriculum influence operates at the level of socialization rather than governance framing and therefore sits outside what the structured imaginative prompt is designed to address. The extent of this influence across different educational contexts and school types remains an open empirical question that the forthcoming replication agenda will need to investigate.

Fourth, implementation challenges at scale are not trivial. Deploying a three-layer coding framework across large, diverse datasets requires trained coders, documented protocols, quality assurance procedures, and institutional coordination. While CIGSA is designed to operate through existing educational and civic platforms, the analytical infrastructure required for governance-grade output, including inter-coder validation, demographic disaggregation, and convergence comparison, demands sustained institutional investment that may be difficult to mobilize in resource-constrained contexts.

Advances in computer vision and multimodal large language models offer partial mitigation for several of these limitations. AI-assisted implementation of the VGCF can improve coding consistency across large datasets, reducing individual interpreter bias and enabling pattern detection at a scale beyond human coder capacity, including the

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identification of culturally specific visual vocabularies and the flagging of drawings whose compositional uniformity may suggest socialization influence rather than independent expression. In resource-constrained implementation contexts, AI-assisted coding also substantially reduces the logistical barriers to governance-grade output. These capabilities do not eliminate the limitations identified above - culturally diverse training data, human oversight for quality validation, and sustained institutional coordination remain necessary conditions - but they materially improve the architecture's feasibility at the scale its governance claims require. The VGCF's structured, observable coding criteria are specifically designed with this AI-compatibility in mind, positioning the framework for increasingly automated deployment as multimodal analytical capabilities continue to mature.

Directions for future research

Three directions define the research agenda ahead. First, the ICF should be replicated across BRICS economies, Global South settings, post-conflict societies, and least-developed countries - testing whether the DPS represents a universal principle of participatory governance or a context-specific finding. Second, alternative modality variants - beginning with oral and play-based frameworks - should be developed and validated, progressively extending CIGSA's reach to children excluded by visual or literacy barriers, including those with visual impairment or motor disability, fulfilling the architecture's foundational equity commitment; structured child outputs produced in problem-oriented educational contexts - including, for example, STEM-based artifacts such as design prototypes, engineering constructions, and computational solutions - represent a particularly promising extension, given their inherent problem-solution framing and direct compatibility with the CIGSA coding spine, subject to methodological protocols that account for format constraints and adult mediation. Third, longitudinal research should examine whether children's visual SDG priorities at ages seven to eighteen predict adult civic behavior, consumption patterns, and political engagement - testing whether the DPS is not only a real-time sensing instrument but a predictor of future civic identity. The national infrastructure for intergenerational sustainability governance is waiting to be built. CIGSA provides the architectural specification.

Conclusions

This paper has proposed the CIGSA as a conceptual framework for integrating children's visual expression into sustainability governance data systems. Its core contribution is architectural: it bridges three bodies of knowledge - SDG monitoring frameworks, child participation scholarship, and visual semiotic methodology - that have until now existed in mutual isolation, none operationally connected to the others. The consequence of that isolation is not merely theoretical. It is a real-time data gap in which the distributed embodied knowledge of millions of children living inside development deficits goes unread by the governance systems designed to address those deficits. By providing a systematic, replicable pathway from children's visual expression to governance-relevant signal - through the sequential interdependence of VGCF, ICF, and DPS - CIGSA closes that gap at the architectural level, repositioning children not as voices to be heard at the margins of governance but as sensors whose distributed, embodied knowledge constitutes a structurally distinct and previously inaccessible form of developmental intelligence.

Its implications extend across sustainability governance and SDG monitoring, participatory policy design, enterprise ESG materiality assessment, and the theoretical reconceptualization of children's participation - from symbolic inclusion to epistemic access - making CIGSA a contribution not to any single field but to the interdisciplinary infrastructure that each of these domains requires. A preliminary application of the architecture confirms that the VGCF is operationalizable at scale and that the conditions for an Independent Convergence Finding can be met in practice: children's aggregate visual priorities corresponded with India's formally documented development deficits, arising entirely independently. This establishes a preliminary demonstration of operationalizability. CIGSA is a conceptual framework whose empirical validation has begun and whose claims the field is now invited to test.

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Appendices

CIGSA terminology glossary

This glossary provides definitive definitions for the original terms introduced or formalized in this paper. It is intended as a citable reference for researchers applying or extending the CIGSA architecture.

Structured Imaginative Prompt

An invitation extended to children to envision and express a desired future state - civic, social, or environmental - without specifying governance categories, policy vocabulary, developmental benchmarks, or expected outcomes. The prompt is structured in that it provides a directional frame (envision a future) without constraining the content of the response; it is imaginative in that it activates future-oriented, generative thinking rather than asking children to assess, report, or evaluate present conditions. The structured imaginative prompt is the foundational input condition of the CIGSA architecture.

Child-Inclusive Governance Signal Architecture

A modality-flexible conceptual framework comprising three sequentially interdependent components - VGCF, ICF, and DPS - designed to translate children's naturalistic expression into structured, governance-relevant data. CIGSA is designed to be replicable across national, sub-national, and cross-cultural governance contexts. Its primary application domain is sustainability governance and SDG alignment; its analytical architecture is extensible to health, education, climate, justice, and other domains where children's expression carries evidence value for adult decision-making. Distinguishing feature: addresses the uninvited signal pathway - governance evidence latent in child expression not framed as governance input of any kind - as distinct from invited participation frameworks.

Visual Governance Coding Framework

A three-layer instrument for translating children's visual expression into structured governance-relevant data. Layer 1 maps drawings to SDG categories (or equivalent national policy taxonomy) based on observable visual indicators. Layer 2 clusters coded issues into People-Planet-Prosperity thematic domains. Layer 3 codes representational features including problem depiction, future vision, causal triggers, positive resolution, catalyst presence, and self-positioned agency. The SDG taxonomy is the default international mapping layer but may be substituted with any recognized policy taxonomy.

Independent Convergence Finding

A two-step methodological instrument that first establishes structural conditions - absence of participant priming and researcher framing - for independence, then conducts direct comparison of VGCF-coded SDG priority distributions against formal governance performance scores. Convergence observed under these conditions - where children's most frequently depicted concerns correspond to formally documented deficit domains - constitutes a genuine governance signal. The ICF is not a claim that convergence has occurred; it is a methodological instrument that defines the conditions under which, if convergence is observed, it cannot be explained away as artifact. Distinguishing feature: when all ICF conditions are met, the resulting convergence cannot have been produced by design, securing it as a genuine governance signal.

Deficit Positioning System

A theoretical proposition grounded in Merleau-Ponty's account of embodied perception, holding that children's aggregate visual output - when produced in response to a structured imaginative prompt and systematically coded through the VGCF - functions as a real-time, community-embedded instrument for locating development deficits, including in domains that formal measurement infrastructure cannot reach. The DPS is distinguished from propositional knowledge (institutional indices) by three structural characteristics: no data lag; no ministry submission or coverage threshold; and reach into unmeasured domains. Distinguishing feature: analogous to GPS in physical space - the DPS locates development deficits in social space through distributed embodied knowledge.

Uninvited Signal Pathway

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The governance-evidence pathway addressed by CIGSA, in which children's naturalistic, unsolicited expression is systematically decoded for governance-relevant signal without the expression having been framed as SDG input, informed by national development indices, or intended as governance data - distinct from the invited participation pathway in which the governance purpose is explicit at the point of expression. Contrasts with the invited participation pathway addressed by existing Article 12 operationalizations (e.g. Lundy's Space-Voice-Audience-Influence model), in which adults create structured processes for children to be heard. Distinguishing feature: CIGSA extends the Article 12 evidence base to expression that predates and operates independently of any participation framing.

People-Planet-Prosperity (3P) Clustering

The Layer 2 thematic classification system of the VGCF, grouping SDG-coded issues into three higher-order domains derived from the UN 2030 Agenda's triple-bottom-line framework: People (social equity, human dignity, institutional justice), Planet (environmental protection, ecological systems, climate resilience), and Prosperity (infrastructure, economic development, technological innovation). Functions as a synthesis layer enabling cross-SDG thematic analysis. Distinguishing feature: while 3P is the validated default clustering taxonomy, researchers may substitute alternative tripartite or multi-domain frameworks where contextually appropriate, provided the substitution is documented and justified.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Avinash G. Jhangiani

Acquisition, analysis, or interpretation of data: Avinash G. Jhangiani

Drafting of the manuscript: Avinash G. Jhangiani

Critical review of the manuscript for important intellectual content: Avinash G. Jhangiani

Supervision: Avinash G. Jhangiani

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Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following:

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Data Availability Statements

The datasets (and/or code) supporting this study are available from the corresponding author upon reasonable request.

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Independent Convergence Finding, and the Deficit Positioning System - as presented in this paper were developed through the author's subsequent verification, expansion, and theoretical synthesis of that work. Her contribution to the rigor and integrity of the underlying research is gratefully acknowledged.

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