

OPEN ACCESS

EDITED BY

Rocio De Andrés Calle,
University of Salamanca, Spain

REVIEWED BY

Marno Wance,
University of Pattimura, Indonesia
Imranullah Akhtar,
Alfaluh University, Afghanistan

*CORRESPONDENCE

Ahmad Nur Hidayat
✉ ahmadnhidayat@gmail.com

RECEIVED 10 November 2025

REVISED 21 January 2026

ACCEPTED 30 January 2026

PUBLISHED 19 March 2026

CITATION

Hidayat AN, Karlina N and
Pancasilawan R (2026) Innovating
electoral metrics: a multidimensional
statistical model of the Indonesian
Electoral Participation Index (IPP).
Front. Polit. Sci. 8:1743002.
doi: 10.3389/fpos.2026.1743002

COPYRIGHT

© 2026 Hidayat, Karlina and
Pancasilawan. This is an open-access
article distributed under the terms of the
[Creative Commons Attribution License
\(CC BY\)](#). The use, distribution or
reproduction in other forums is
permitted, provided the original
author(s) and the copyright owner(s) are
credited and that the original publication
in this journal is cited, in accordance
with accepted academic practice. No
use, distribution or reproduction is
permitted which does not comply with
these terms.

Innovating electoral metrics: a multidimensional statistical model of the Indonesian Electoral Participation Index (IPP)

Ahmad Nur Hidayat*, Nina Karlina and Ramadhan Pancasilawan

Department of Public Administration, Faculty of Social and Political Science, Padjajaran University, Bandung, Indonesia

Introduction: Electoral participation is often measured solely by voter turnout, which obscures how citizens interact with electoral institutions before, during, and after election day. This study introduces the Indonesian Electoral Participation Index (IPP) to capture multidimensional, sub-national patterns of engagement across the electoral cycle.

Methods: Using verified administrative records from the General Elections Commission's Siparmas system for the 2024 general election, we construct a formative composite index from 15 indicators of citizen engagement and institutional performance across the preparation, administration, and post-election phases in 38 provinces. The IPP is validated through factor analysis, internal diagnostics, correlations with voter turnout, internet access and other contextual variables, and robustness checks including alternative weighting schemes and transformations.

Results: IPP scores reveal pronounced territorial disparities. Western provinces systematically outperform eastern ones, and participation is strongest in post-election engagement. Average provincial scores are preparation 61.40; administration 60.14; and post-election 68.48. Yielding a national IPP mean of national IPP = 63.43. The index correlates strongly with turnout and moderately with internet access and provincial income, but only weakly with territorial size.

Discussion: Conceptually, the IPP reframes electoral participation as a process of co-production between citizens and electoral institutions across the electoral cycle. Practically, it provides policymakers with a transparent, replicable diagnostic tool for evaluating institutional performance, identifying sub-national inequalities, and targeting reforms in Indonesia and other decentralised democracies.

KEYWORDS

decentralisation, electoral participation, engagement, governance, index construction

1 Introduction

Electoral participation is a core expression of democratic legitimacy, yet comparative research frequently operationalises it as a single outcome—voter turnout. While indispensable, turnout alone cannot capture the multidimensional character of citizens' engagement with electoral processes. Participation unfolds before, during, and after elections through registration, voter education, mobilisation, interactions with electoral management bodies, and post-election monitoring. Treating participation as a one-day event obscures the continuing relationships between citizens and institutions that sustain democracy beyond election day (Geys, 2006; Birch,

2010; Norris, 2011; Phillips, 2024; Franklin, 2004; Blais, 2006). This article therefore advances an explicitly cycle-wide view of electoral participation by analysing engagement across three phases of the electoral process as a continuous sequence of institutionalised interactions.

This conceptual gap has important measurement consequences. Classic civic voluntarism models emphasise individual resources, motivation, and recruitment (Verba et al., 1995), whereas governance-oriented perspectives conceptualise participation as a co-produced outcome of citizen agency and institutional capacity (Ostrom, 1996; Ansell and Gash, 2008; Voorberg et al., 2015). Yet most empirical indicators still privilege individual-level turnout and campaign activity. Existing global indices—such as V-Dem (Coppedge, 2019; Coppedge et al., 2019; V-Dem Institute, 2025) and the International IDEA Global State of Democracy framework (International Institute for Democracy and Electoral Assistance, 2024; International IDEA, 2025)—provide valuable benchmarks for cross-national comparison, but they remain predominantly national in scale and are often anchored in one or a few moments of the electoral cycle. As a result, within-country disparities in participation, particularly in large decentralised democracies, remain under-measured and poorly understood (Gallego, 2015; Lijphart, 1997). The absence of sub-national, cycle-wide measures limits both theory testing and the practical diagnosis of how citizen–institution interactions vary across territories.

Indonesia illustrates this problem with particular clarity. As the world's fourth-largest democracy, it combines high overall turnout with pronounced territorial, socio-economic, and administrative diversity across its 38 provinces. Decentralisation has expanded the formal opportunities for citizens to participate, yet engagement beyond voting remains uneven across regions. Differences in local capacity, civic infrastructure, and digital connectivity shape whether citizens receive information, can interact with electoral management bodies, and have access to channels for monitoring and contesting results. Without multidimensional, sub-national measures, these patterns remain anecdotal, limiting both scholarly understanding and the diagnostic tools available to electoral authorities.

The present study addresses this gap by developing and validating the Indonesian Electoral Participation Index (IPP), a province-level, multidimensional electoral participation index that spans the entire electoral cycle and is built from verified administrative data. Compiled from verified administrative records of the General Elections Commission (KPU), including the SIPARMAS system, the IPP combines 15 indicators into a composite framework covering three analytically distinct phases: Preparation, Administration, and Post-Election involvement. We explicitly specify the IPP as a formative index: it treats these indicators as distinct but complementary components that together form electoral participation, rather than manifestations of a single latent trait. The construction follows established guidelines on composite indicators, including careful normalisation, weighting, and robustness assessment (OECD and Joint Research Centre, 2008; Saltelli et al., 2008), and prioritises external validity, temporal stability, and robustness checks as primary criteria of index quality.

What is already known is that turnout in Indonesia is high by international standards and that administrative and socio-economic contexts vary widely across provinces (Geys, 2006; Norris, 2011; Phillips, 2024). What remains unknown is how citizen–institution interactions before, on, and after election day differ across the territory and how these patterns relate to broader resources such as

education and digital infrastructure. By treating participation as a process rather than a single act, the IPP allows us to ask new questions: which provinces excel in preparation but lag in administration; where post-election evaluation is strongest; and how these dimensions covary with existing political and socio-economic inequalities.

The article pursues three objectives. First, it introduces the IPP and evaluates its dimensional structure and reliability, combining internal diagnostics with external validation against official turnout, internet access, and other contextual indicators, with particular emphasis on external validity and robustness as appropriate quality criteria for a formative composite. Second, it maps the provincial distribution of electoral engagement across the three phases of the cycle, documenting spatial patterns such as the divergence between western and eastern Indonesia. Third, it examines correlates of provincial IPP scores, advancing the hypothesis that provinces with higher levels of education, digital connectivity, and administrative capacity will exhibit higher and more balanced engagement across all phases of the electoral cycle. A related expectation is that participation will be particularly strong in post-election evaluation, where institutional channels for complaints and oversight are more developed.

By integrating these elements, the study advances the literature in three ways. Conceptually, it reframes electoral participation as an ongoing, co-produced relationship between citizens and institutions rather than a discrete behavioural outcome, linking turnout research, civic voluntarism, and participatory governance. Empirically, it offers the first multidimensional, sub-national dataset of electoral participation for Indonesia, enabling comparative analyses across provinces and over time. Methodologically, it demonstrates how verified administrative data can be transformed into a transparent, formative and replicable index that is adaptable to other decentralised democracies. This formative specification underpins the subsequent focus on external validity, temporal stability, and robustness, rather than on high internal-consistency coefficients alone. Subsequent sections present the data and measurement strategy, discuss validation and robustness checks, and analyse the spatial distribution and correlates of the IPP.

2 Theoretical framework

Electoral participation is typically conceptualised as a latent disposition that manifests in observable acts such as voting, campaigning, or monitoring elections. Much of the measurement tradition in political behaviour, therefore, relies on reflective measurement models, where indicators are treated as effects of an underlying latent variable and are expected to be strongly intercorrelated. Structural-equation approaches formalise this logic by modelling observed variables as consequences of latent constructs, with reliability assessed through internal consistency and factor loadings (Bollen, 1989; Fornell and Bookstein, 1982). Within this reflective paradigm, high Cronbach's alpha and unidimensional factor structures are interpreted as hallmarks of valid measurement (Bollen and Lennox, 1991), which has encouraged a tendency to treat internal consistency as a near-universal quality criterion, even in settings where its assumptions are not met.

A parallel tradition in measurement theory argues that many constructs of interest—especially composite social indicators—are more accurately represented by formative rather than reflective

models. In formative models, the indicators are conceptualised as partial causes of the construct: changes in the indicators change the construct, while the indicators themselves need not be interchangeable or highly correlated (Diamantopoulos and Winklhofer, 2001; Jarvis et al., 2003). Work on composite indices and partial least squares structural modelling has shown that such constructs are often better represented as weighted composites of heterogeneous dimensions than as reflective latent factors (Fornell and Bookstein, 1982; Coltman et al., 2008). The broader literature on composite indicators and governance indices similarly stresses that multidimensional phenomena—such as institutional quality or sustainable development—are inherently aggregative, combining conceptually distinct dimensions into a single index for analytic and policy purposes (OECD and Joint Research Centre, 2008; Kaufmann et al., 2011; Saltelli et al., 2008). Electoral participation, when conceived as a process unfolding across several institutional arenas, fits naturally into this family of multidimensional, formative constructs.

The Indonesian Electoral Participation Index (IPP) is explicitly specified *ex ante* as a formative composite. The index aggregates three conceptually distinct dimensions—Preparation, Administration, and Post-Election engagement—each measured through multiple administrative indicators. These indicators capture different institutional interfaces and citizen actions across the electoral cycle; they are not expected to be mutually interchangeable manifestations of a single, stable disposition to participate. Instead, the indicators collectively constitute the construct of provincial electoral participation: omitting one dimension would change the meaning of the index itself, not merely reduce measurement precision (Bollen and Lennox, 1991; Diamantopoulos and Winklhofer, 2001). This has encouraged a tendency to treat internal consistency as a near-universal quality criterion, even in settings where its assumptions are not met (Edelsbrunner et al., 2025a).

This specification has important implications for reliability assessment. Conventional coefficients such as Cronbach's alpha rest on assumptions suited to reflective models: unidimensionality, tau-equivalence, and positively correlated items (Sijtsma, 2009; McNeish, 2018). Under these assumptions, very low or negative alpha values typically indicate misspecification or coding problems. For formative indices, however, internal consistency is not a definitional requirement. When indicators are formative, low or even negative inter-item correlations do not automatically signal poor measurement but may simply reflect the fact that the indicators tap complementary, non-redundant facets of a construct (Stadler et al., 2021). Recent methodological work cautions against using Cronbach's alpha as a universal quality criterion and recommends alternative approaches—such as composite reliability, model-based reliability, and external validation—especially for multidimensional scales and indices (Raykov and Marcoulides, 2019; Zakariya, 2022; Edelsbrunner et al., 2025b). In the context of the IPP, we therefore use Cronbach's alpha only as a descriptive diagnostic (including to check for potential coding errors), and we interpret it in light of the formative design rather than as a pass–fail test of quality. Where appropriate, we complement it with alternative reliability and quality checks and place greater weight on external validity, robustness checks, temporal stability, and sensitivity analysis, in line with best practice for composite indicators (OECD and Joint Research Centre, 2008; Saltelli et al., 2008; Kaufmann et al., 2011).

By grounding the IPP in the formative–reflective distinction, this theoretical framework justifies both the index's multidimensional structure and the methodological choices made in its construction.

Treating the IPP as a formative composite aligns the measurement model with the substantive conception of electoral participation as a process that accumulates across distinct phases and institutional arenas. It also clarifies why the subsequent Methods section prioritises evidence on external validity, temporal stability, and robustness over conventional internal-consistency thresholds, thereby linking conceptual arguments about participatory governance to rigorous, state-of-the-art measurement practice (Bollen, 1989; Bollen and Lennox, 1991; Diamantopoulos and Winklhofer, 2001) and providing a clear rationale for how we interpret internal-association statistics such as Cronbach's alpha in the empirical sections.

3 Materials and methods

3.1 Data source

The Indonesian Electoral Participation Index (IPP) was constructed using administrative data from the Sistem Informasi Partisipasi Masyarakat (Siparmas), managed by the General Elections Commission (Komisi Pemilihan Umum – KPU) of Indonesia. Siparmas is the KPU's official digital platform that consolidates standardised reports from provincial and district offices on participation-related activities. For the 2024 general election, the dataset covered all 38 provinces, with reporting periods spanning October 2023–July 2024. Each provincial KPU submitted verified reports covering the full electoral cycle, from pre-election preparation through election-day management to post-election evaluation. All entries were validated by the KPU's national data unit, ensuring accuracy and uniformity. Unlike survey data, administrative records in Siparmas provide exhaustive institutional coverage and avoid respondent biases, enhancing reliability (James et al., 2019; Norris and Grömping, 2019). Since its establishment in 2019, Siparmas has become a cornerstone of digital electoral governance in Indonesia (Komisi Pemilihan Umum (KPU), 2024), enabling consistent longitudinal data collection and supporting decentralised coordination under a unified reporting framework. Since its establishment in 2019, Siparmas has become a cornerstone of digital electoral governance in Indonesia, enabling consistent longitudinal data collection and supporting decentralised coordination under a unified reporting framework (Congge et al., 2023).

At the same time, reliance on administrative reports implies that informal, unregistered, or grassroots forms of participation that do not pass through official channels are not captured by the index, and that variation in local reporting capacity may introduce systematic differences in how completely activities are recorded across provinces; these scope conditions are taken into account in the interpretation of the IPP.

3.2 Conceptual framework, dimensions, and formative design

The IPP design draws on theories of participatory governance and co-production, which view participation as a collaborative process between citizens and state institutions (Ostrom, 1996; Ansell and Gash, 2008; Voorberg et al., 2015). This conceptual foundation integrates behavioural models of civic voluntarism (Verba et al., 1995) with institutional perspectives emphasising administrative capacity and inclusiveness (Bovaird et al., 2015; Roiseland, 2021). Accordingly, the IPP

operationalises participation across three interrelated dimensions corresponding to the stages of the electoral cycle: (1) Preparation—pre-election engagement, including voter education, registration, and mobilisation; (2) Administration—citizen interaction with electoral processes during election-day management and campaign oversight (Lundstedt and Edgell, 2022; Partheymüller et al., 2022); and (3) Post-election—participation in evaluation forums, complaint mechanisms, and civic education activities. These dimensions reflect the view that democratic participation is a process of ongoing co-production rather than a one-day act of voting (Birch, 2010; Dacombe and Wojciechowska, 2024), and they provide the substantive basis for the formative measurement model adopted in this study.

In measurement-theoretic terms, the IPP is explicitly specified as a formative index. The 15 indicators are treated as distinct but complementary components that collectively constitute provincial electoral participation; removing one indicator changes the substantive meaning of the construct rather than merely reducing measurement precision. This logic follows the literature on formative constructs and composite indicators, which distinguishes them from reflective scales whose indicators are interchangeable manifestations of a single latent variable and are therefore expected to display high internal correlations (Diamantopoulos and Winklhofer, 2001; Jarvis et al., 2003). His *ex ante* formative specification has direct implications for how we assess and report reliability and validity in the empirical sections, and underpins the interpretation of Cronbach's alpha in this study.

3.3 Indicator selection and index construction

Indicator selection followed three criteria: theoretical relevance to one of the IPP dimensions, empirical availability for all provinces, and non-redundancy. In consultation with the KPU and provincial offices, 15 indicators were chosen from Siparmas, covering activities such as voter education sessions, online voter-list verification, public complaint resolution, accreditation of election observers, and implementation of structured post-election evaluation forums. A full list of indicators, definitions, and units of measurement is provided in the supplementary material to enhance transparency and replicability.

Each indicator j in the province i was standardised using the z -score transformation:

$$Z_{ij} = \frac{X_{ij} - \mu_j}{\sigma_j}$$

Where X_{ij} is the observed value for province i on indicator j , and μ_j and σ_j represent the mean and standard deviation of indicator j across provinces. Standardised values were rescaled to a 0–100 range to ensure comparability across indicators and dimensions. Within each dimension, weighted arithmetic means were computed using factor-derived weights obtained from exploratory factor analysis (EFA), with weights for the indicator j in the dimension d defined as $\omega_{dj} = \lambda_{dj} / \sum_{k \in d} \lambda_{dk}$ where λ_{dj} denotes the loading of indicator j on the corresponding factor (OECD and Joint Research Centre, 2008; Saltelli, 2007). This procedure allows theory to guide the grouping of indicators into dimensions while letting the data inform their relative contribution within each dimension; robustness checks against equal weighting are reported below.

The overall provincial IPP was calculated as:

$$IPP_i = \nu_P P_i + \nu_A A_i + \nu_E E_i$$

where P_i , A_i , and E_i denote the weighted mean scores for the Preparation, Administration, and Post-Election dimensions, respectively, and ν_P , ν_A , and ν_E are non-negative dimension weights proportional to the variance explained by each factor in the EFA, rescaled so that $\nu_P + \nu_A + \nu_E = 1$. Scores above 70 indicate strong participation, 60–70 moderate engagement, and below 60 limited participation. This scaling aligns with common thresholds for index-based governance assessments (Nunnally and Bernstein, 1994; OECD and Joint Research Centre, 2008). An alternative specification using equal weights across the three dimensions is used in robustness checks to assess the sensitivity of results to this weighting choice.

3.4 Data validation and statistical analysis

To ensure data integrity, Siparmas applied a three-stage validation protocol. First, automated consistency checks identified missing or implausible entries. Second, reported values were cross-verified with official KPU statistics on voter turnout, campaign activity, and logistics. Third, outlier observations were manually reviewed by the KPU's national audit division. No province was excluded from the analysis. Missing values (less than 2% of the total) were imputed using within-island means, while extreme values were winsorised at the 5th and 95th percentiles. All analyses were conducted using R version 4.3, following composite-indicator guidelines issued by the OECD and Joint Research Centre (2008). As part of data cleaning, all indicators were inspected to ensure that higher scores consistently reflected higher levels of participation; where necessary, variables were recoded so that the direction of their contribution to the index was aligned before standardisation and aggregation.

To avoid repetition with the interpretive discussion later in the manuscript, we streamline the methodological diagnostics here as follows: Internal diagnostics comprised inter-item correlations, the Kaiser–Meyer–Olkin (KMO) measure, and Bartlett's test of sphericity, with Cronbach's alpha reported only as a descriptive check for coding consistency given the formative specification of the IPP (Sijtsma, 2009; Diamantopoulos and Winklhofer, 2001). Dimensional structure was evaluated using exploratory factor analysis (Varimax rotation); three factors (eigenvalues > 1.0) explained 72% of the variance (KMO = 0.81). Criterion validity was examined via correlations between the IPP and theoretically relevant correlates—turnout ($r = 0.76$, $p < 0.01$), internet access ($r = 0.55$, $p < 0.05$), and population size ($r = -0.12$, $p = 0.28$)—and these results are interpreted comparatively in Section 4 (Zhou et al., 2020; Angelucci et al., 2024).

Robustness checks compared weighted and unweighted indices ($r = 0.97$, $p < 0.01$) and applied alternative transformations (logarithmic and rank normalisation), all producing near-identical provincial rankings. Temporal reliability was examined using available 2019 SIPARMAS data, yielding a correlation of $r = 0.73$ ($p < 0.01$), confirming cross-cycle consistency. Taken together, these procedures mean that the quality of the IPP rests primarily on external validity, robustness to modelling choices, and the transparency that allows independent replication of all steps (Jarvis et al., 2003; Saltelli, 2007).

3.5 Ethical considerations

This study utilised aggregated, publicly mandated administrative data without any personally identifiable information. All procedures complied with the KPU's institutional data-use policies and Indonesian public-data regulations. Given the absence of human subjects or individual-level identifiers, separate ethics approval was not required. Nevertheless, transparency and accountability standards outlined in international research ethics were observed throughout data handling and reporting.

4 Results

4.1 Internal consistency and dimensional reliability

Cronbach's alpha for the Preparation dimension is 0.642, for Administration 0.615, and for Post-Election 0.668, with an overall alpha of 0.685 for the full IPP scale. These coefficients fall in the conventional moderate range and indicate that items within each dimension share variance but are not interchangeable in the manner expected for highly homogeneous reflective scales. On the 0–100 metric, the mean provincial scores are 61.4 for Preparation, 60.14 for Administration, 68.48 for Post-Election, and 63.43 for the composite IPP, showing that post-election activities attain the highest average level, while preparation and administration cluster just above 60 points. In keeping with the IPP's formative specification, these alpha values are reported to document the pattern of internal associations, not as a pass–fail criterion for the overall quality of the index.

Pairwise inter-item correlations range from 0.08 to 0.23 ($p < 0.05$), implying positive yet modest associations that are compatible with a composite designed to capture non-redundant facets of participation. Exploratory factor analysis with principal-component extraction and Varimax rotation identifies three factors with eigenvalues greater than 1.0 that jointly account for about 72% of total variance. The Kaiser–Meyer–Olkin statistic ($KMO = 0.81$) confirms that the correlation matrix is suitable for factor analysis, and cross-loadings remain below 0.30. The combination of moderate alpha values, low-to-moderate inter-item correlations, and a clear three-factor solution is consistent with a multidimensional index in which indicators contribute distinct but related information about different phases of the electoral cycle, as expected for formative composite indicators that intentionally aggregate conceptually distinct dimensions rather than maximise internal homogeneity (Booyesen, 2002; Saisana and Saltelli, 2011).

4.2 External validity and robustness

External validity tests link provincial IPP scores to independent indicators of electoral engagement and contextual resources. The composite IPP correlates strongly with official voter-turnout rates reported by the General Elections Commission ($r = 0.76$, $p < 0.01$), indicating that provinces with higher multidimensional participation scores also register higher turnout. The index is moderately associated with provincial internet access ($r = 0.55$, $p < 0.05$), suggesting that digital connectivity accompanies opportunities for information, mobilisation, and interaction with electoral management bodies. The correlation

between IPP and provincial population size is weak and statistically non-significant ($r = -0.12$, $p = 0.28$), so the size of the electorate does not systematically influence the index. For a formative composite such as the IPP, these patterns of external association constitute central evidence of measurement quality.

Cross-validation using sub-national indicators from the V-Dem dataset (Coppedge, 2019; Coppedge et al., 2019; V-Dem Institute, 2025) and the International IDEA Global State of Democracy framework (International Institute for Democracy and Electoral Assistance, 2024; International IDEA, 2025) shows that provinces with higher IPP scores tend to be located in regions where democratic qualities such as citizen participation and impartial administration receive higher evaluations. This co-variation is consistent with the IPP's design as a composite that aggregates distinct moments of citizen–state interaction over the electoral cycle, and it illustrates how the IPP complements global indices by adding sub-national and phase-specific diagnostic detail.

Robustness checks indicate that the index is stable across alternative modelling choices. An unweighted specification, which averages the three dimensions without factor-derived weights, correlates very strongly with the preferred specification ($r = 0.97$, $p < 0.01$). Transforming indicators using logarithmic and rank-normalisation procedures yields provincial rankings that remain highly similar to the baseline (Morse, 2020) ($r > 0.95$ in all comparisons). Leave-one-out tests, in which each indicator is removed in turn and the index recomputed, change provincial rankings by fewer than two positions. Temporal validation using Siparmas data from the 2024 general election produces a correlation of $r = 0.73$ ($p < 0.01$) between provincial IPP scores in 2024, indicating stability in the relative ordering of provinces. Taken together, these results show that the IPP is robust to alternative modelling choices and temporally stable, which is particularly important for a composite indicator intended to track multidimensional participation over time.

The figure plots provincial IPP scores against official voter turnout, with shading proportional to provincial internet access, illustrating positive associations among variables.

4.3 Sub-national patterns of participation

Descriptive statistics for the composite IPP reveal substantial variation in electoral participation across Indonesia's 38 provinces. Provincial scores range from 52.7 to 77.7, with a national mean of 63.4 ($SD = 6.9$). Provinces in western Indonesia, such as East Java (77.6), the Special Region of Yogyakarta (77.5), and West Java (76.5), occupy the upper end of the distribution, while eastern provinces such as Southeast Sulawesi (52.7), Central Kalimantan (53.9), and Papua (54.6) fall below the national mean.

A west–east gradient is visible in the spatial distribution of scores. Western and parts of central Indonesia form a cluster of provinces with relatively high and upper-middle participation levels, whereas several eastern provinces group in the lower band of the index. The roughly 25-point span between the highest- and lowest-scoring provinces indicates pronounced heterogeneity in multidimensional electoral engagement within a single national electoral framework.

Disaggregation by dimension clarifies how participation varies across stages of the electoral cycle. Preparation scores display the greatest dispersion, with a range of about 36.3 points between the lowest and highest provinces, signalling marked differences in early mobilisation, voter registration, and participatory roles in the formation of electoral administration structures. Administration scores are more tightly distributed around

their mean of 60.1 (SD = 5.5), reflecting the presence of common procedural standards on election day and in vote counting. Post-Election scores record the highest average (68.5, SD = 7.4), indicating that, on average, provinces attain higher values on indicators associated with complaint mechanisms, evaluation forums, and continuing civic-education activities after the polls. At the national level, the three dimension means—61.4 for Preparation, 60.1 for Administration, and 68.5 for Post-Election—yield the composite IPP mean of 63.43.

4.4 Correlates and typologies of engagement

Associations between provincial IPP scores and contextual variables place the index within broader socio-economic and infrastructural patterns. Educational attainment, measured as the proportion of the adult population with at least upper-secondary education, is positively correlated with the IPP ($r = 0.62, p < 0.01$). Provinces with higher levels of education tend to occupy higher positions on the index. Internet access, operationalised as the share of households with reliable connectivity, is also positively associated with the IPP ($r = 0.55, p < 0.05$). Provincial income per capita shows a weaker but positive association ($r = 0.38, p < 0.10$), whereas indicators of provincial land area and total population are not significantly correlated with the index. These patterns identify human capital, digital infrastructure, and economic resources as salient correlates of multidimensional electoral participation, while territorial scale does not emerge as a systematic factor.

To summarise overall participation levels, provinces are grouped into three engagement categories based on their composite IPP scores. The high-engagement group comprises six provinces (15.78%) with IPP scores of at least 70. The moderate-engagement group includes 24 provinces (63.15%) with scores between 60 and 70. The low-engagement group consists of eight provinces (21.05%) with IPP scores below 60, many of which are located in eastern Indonesia. Taken together, these patterns identify human capital, digital infrastructure, and economic resources as salient correlates of multidimensional electoral participation, consistent with broader evidence linking participation to socio-economic resources, service delivery, and labour-market conditions (Nelson, 2023; Olawole, 2023; Parker and Hutti, 2023).

5 Discussion

5.1 Conceptual implications: rethinking electoral participation

The Indonesian Electoral Participation Index (IPP) clarifies how electoral engagement unfolds across sequential and partially distinct

stages of the electoral cycle. The three dimensions and 15 indicators documented in Table 2 and elaborated in the results section show that the same province can achieve relatively strong scores in one dimension while trailing in others. Post-election engagement records the highest mean and moderate internal consistency, whereas preparation exhibits greater dispersion across provinces. These patterns, together with the moderate correlations among indicators and the three-factor structure, indicate that participation is not well described as a single latent disposition to vote, but rather as a structured sequence of opportunities for interaction with electoral institutions. In this sense, the empirical results give concrete expression to the conceptual claim that electoral participation is a process extending beyond election day.

Turnout remains a central indicator of democratic legitimacy and has been widely used as a shorthand for participation (Geys, 2006; Norris, 2011). The strong association between IPP scores and voter turnout displayed in Figure 1 confirms that citizens who vote in larger numbers also tend to live in provinces where other forms of participation are more developed. At the same time, the IPP demonstrates that engagement is broader than the act of casting a ballot. The index incorporates activities that precede, accompany, and follow voting, including voter education, registration, participation in campaign events, and contributions to complaint and evaluation forums. In line with work on participatory governance and electoral integrity (Birch, 2010; Dacombe and Wojciechowska, 2024), the findings suggest that democratic participation should be conceptualised as a multidimensional process in which citizens and institutions repeatedly interact over time, with turnout understood as one important manifestation within a wider sequence of participatory opportunities.

The three IPP dimensions mirror the main arenas in which these interactions occur. Preparation captures how institutions design and implement programmes that enable and mobilise citizens, such as registration drives and education efforts. Administration measures the quality and accessibility of procedures on election day and in the immediate counting process. Post-election engagement reflects the existence and use of channels for oversight, redress, and learning once results are known. This comparison of the distribution of scores across these dimensions indicates that post-election mechanisms are relatively well developed, while preparation is more uneven. This configuration suggests that once electoral institutions open spaces for feedback and evaluation, citizens are willing to make use of them, but that building and sustaining inclusive preparatory activities remains more challenging, especially where resources and capacity are constrained.

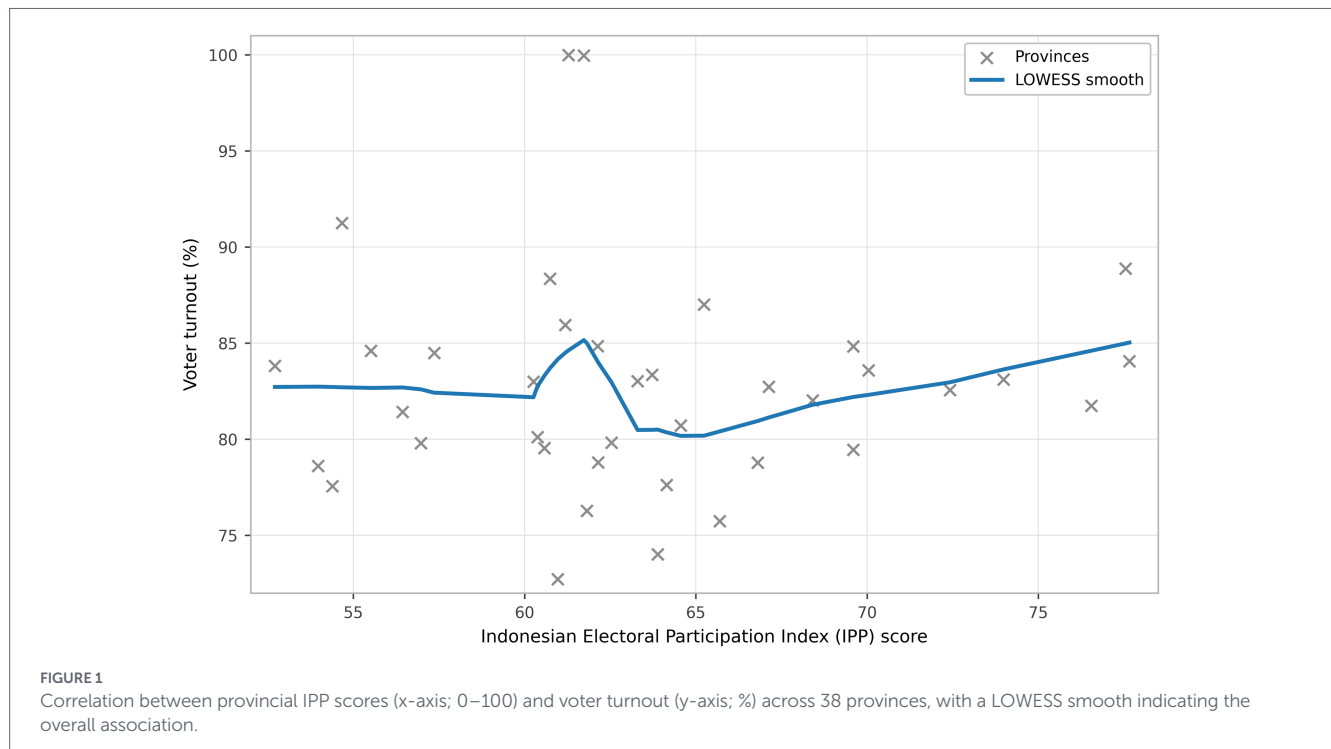
Taken together, these results support a view of participation as an institutionally embedded sequence of interactions rather than a one-off act. The IPP thus connects debates on turnout and political participation with broader discussions of co-production, in which public outcomes are understood as the result of joint efforts by citizens and state

TABLE 1 Provincial engagement categories based on the Indonesian Electoral Participation Index (IPP).

Engagement category	IPP score range	Number of provinces	Share of provinces (%)	Illustrative provinces
High engagement	≥ 70	6	15.78	East Java, Yogyakarta, West Java
Moderate engagement	60–70	24	63.15	South Sulawesi, South Sumatra, West Kalimantan
Low engagement	< 60	8	21.05	West Papua, Maluku, Southwest Papua

TABLE 2 Internal diagnostics (reported descriptively given the formative specification of the IPP) and mean scores of the Indonesian Electoral Participation Index (IPP). Cronbach's alpha is presented as a coding-coherence diagnostic rather than a decisive reliability test.

Dimension	Indicator	Mean IPP score	Cronbach's alpha (α)	Reliability interpretation
Preparation dimension	3	61.40	0.642	Moderate/adequate
Administration dimension	10	60.14	0.615	Moderate/adequate
Post-election dimension	2	68.48	0.668	Moderate/adequate
Total IPP	15	63.43	0.685	Moderate/adequate



actors (Ostrom, 1996; Ansell and Gash, 2008; Voorberg et al., 2015; Bovaird et al., 2015). High scores emerge where citizens are both willing and able to engage and where electoral authorities provide accessible, credible channels for doing so. Lower scores indicate interruptions in this chain, whether due to limited outreach, logistical barriers, or weak mechanisms for post-election scrutiny, resonating with arguments on participatory resilience and local democratic capacity (Roiseland, 2021; Kabanov, 2022). By documenting these dynamics across all phases of the cycle, the IPP helps to specify how co-production operates empirically in a large, decentralised democracy.

5.2 IPP and global indices

The IPP also contributes to ongoing debates on how democracy and participation are measured in cross-national research. Global indices such as V-Dem, the International IDEA Global State of Democracy, and related projects supply indispensable benchmarks for comparing institutional performance across countries. However, their design makes them less suited to capturing systematic variation within countries or to tracing engagement across all phases of the electoral cycle. The IPP is not intended as a substitute for these measures. Instead, it complements them by providing a sub-national, phase-specific diagnostic that is rooted in verified administrative data rather than surveys, expert codings, or elite assessments (Verba et al., 1995; Norris and Grömping, 2019).

The external validity tests reported in the results section and summarised in show that provinces with higher IPP scores tend to be located in regions where global democracy indices also rate participation and impartial administration more favourably. This co-variation points to convergent validity while underscoring the added resolution of the IPP. Whereas global indices condense broad institutional qualities into country-level scores, the IPP decomposes electoral engagement into its component activities and locates variation across 38 provinces and three dimensions. In methodological terms, the index follows recognised practice in composite-indicator construction, including standardisation, aggregation, and robustness checks, while exploiting the formative logic that underpins many governance indicators (Saltelli et al., 2017).

In this way, the IPP extends the composite-index tradition into the domain of electoral participation. It offers a meso-level link between individual-level studies of political behaviour and national democracy scores. Individual surveys can describe who participates and why; national indices assess institutional guarantees and outcomes; the IPP occupies the intermediate space by documenting how participation is structured across territories and phases of the electoral cycle. This three-level architecture has the potential to sharpen both scholarly analyses and policy debates, aligning micro-level explanations and macro-level evaluations with the concrete institutional arrangements through which citizens and electoral authorities interact. Seen together, these three levels form an integrated architecture in which global indices supply

cross-national benchmarks, the IPP reveals sub-national and phase-specific patterns, and micro-level studies explain individual behaviour, thereby sharpening both scholarly analyses and policy debates.

5.3 Sub-national inequalities and participatory governance

The spatial patterns displayed in the results section, together with the typology reported in [Table 1](#), highlight persistent sub-national inequalities in electoral engagement. A clear west–east gradient emerges: western provinces such as East Java, West Java, and the Special Region of Yogyakarta fall into the high-engagement category, while several eastern provinces cluster in the low-engagement band. This distribution parallels broader socio-economic and infrastructural divides documented in Indonesia and in other decentralised democracies ([Marín, 2021](#); [Barras, 2024](#)). The IPP confirms that electoral participation is shaped not only by individual motivation but also by the availability of civic infrastructure, digital connectivity, and administrative capacity, echoing the correlational patterns linking IPP scores to education, internet access, and income.

From the perspective of participatory governance, these inequalities show the limits of decentralisation as a sufficient condition for democratic equality. Formal devolution of authority to sub-national units can coexist with large differences in the ability of provincial institutions to mobilise citizens, administer elections effectively, and provide meaningful post-election oversight. The co-production lens suggests that high engagement occurs where empowered citizens encounter responsive and capable institutions; low engagement arises when either side of this relationship is constrained ([Ostrom, 1996](#); [Bovaird et al., 2016](#); [Karlina et al., 2025](#)). By distinguishing preparation, administration, and post-election dimensions rather than collapsing them into a single score, the IPP makes these asymmetries visible.

This diagnostic capacity is especially important in a context characterised by high aggregate turnout. National figures could suggest uniformly strong electoral participation, but the IPP reveals pockets of weak mobilisation, thin administrative engagement, and restricted opportunities for post-election scrutiny. The classification of high, moderate, and low-engagement provinces presented in [Table 1](#) translates the index into a form readily usable by electoral authorities and policymakers. It identifies where multidimensional participation is most and least developed and clarifies whether the primary obstacles lie before, during, or after election day, providing a concrete basis for prioritising provincial support and reform efforts.

5.4 Policy implications, limitations, and future research

The IPP has direct implications for electoral management and public policy. For the General Elections Commission (KPU), the index can serve as an instrument for evaluating institutional performance across the electoral cycle rather than as a purely descriptive scoreboard. Comparisons of provincial scores on preparation, administration, and post-election engagement make it possible to identify specific bottlenecks—for example, weak voter education despite robust election-day procedures—and to design targeted interventions in collaboration with provincial offices and civil-society organisations. Repeating IPP calculations across electoral cycles would allow authorities to monitor the effects of reforms and programme innovations,

linking administrative changes to measurable shifts in multidimensional participation ([Norris and Grömping, 2019](#); [Saltelli et al., 2017](#)). In this evaluative role, the IPP functions as a performance dashboard for electoral governance, pointing not only to where participation is low but also to which phase of the cycle requires institutional strengthening. One direction is to integrate IPP scores into multilevel models examining how provincial participation interacts with trust, socio-economic disadvantage, and inequality, including standardised inequality measures such as SWIID ([Solt, 2020](#)).

Policy relevance extends beyond electoral bodies. Provincial governments can use IPP profiles to prioritise investments in civic education, digital infrastructure, and administrative training in low-engagement areas, particularly in eastern Indonesia. International organisations involved in democratic assistance can employ the IPP framework to complement global indices by focusing on sub-national disparities and concrete institutional practices rather than national averages alone. Because the index is constructed from standardised administrative reports, it offers a relatively low-cost, replicable template that could be adapted to other large, decentralised democracies, where comparable administrative systems exist at the sub-national level.

Several limitations qualify the interpretation of the findings. First, reliance on administrative data means that forms of informal or grassroots participation that does not pass through official channels remains outside the scope of the index ([Birch, 2010](#)). Second, the analysis is constrained by the temporal coverage of the Siparmas system. Although the results section documents stability in provincial rankings across the elections for which data are available, a fuller understanding of temporal dynamics will require additional electoral cycles recorded in a comparable format. Third, the IPP focuses on the breadth and intensity of participation rather than on its deliberative quality or normative content, which are better captured through qualitative research and dedicated survey modules ([Kabanov, 2022](#)).

These limitations point to concrete avenues for future research. One direction is to integrate IPP scores into multilevel models that examine how provincial participation interacts with individual attitudes, trust in institutions, and socio-economic inequality. Another is to combine the index with qualitative studies of electoral administration and citizen engagement in selected provinces, investigating the mechanisms that produce high or low scores in each dimension. A further step is to test the portability of the IPP framework in other decentralised systems such as India, Brazil, or Nigeria. In such cases, the core elements of the framework—a formative, multidimensional index covering preparation, administration, and post-election phases, built from standardised administrative reports—could be adapted to the institutional architecture and data infrastructure of each country. Applying comparable indices across cases would make it possible to place Indonesia's experience within a broader comparative agenda on participatory governance and electoral resilience ([Dacombe and Wojciechowska, 2024](#); [Røiseland, 2021](#)).

6 Conclusion

6.1 Core contributions and substantive insights

The Indonesian Electoral Participation Index (IPP) establishes a multidimensional, sub-national lens on electoral engagement that spans

the full electoral cycle. By integrating 15 administrative indicators into three phases—Preparation, Administration, and Post-Election—the index demonstrates that participation is distributed across several institutional arenas rather than reducible to a single moment in the polling booth. The empirical results show that Indonesia combines relatively high aggregate engagement with pronounced variation between provinces and between phases. Post-election involvement systematically registers the highest scores, while preparatory activities are more unevenly developed, revealing gaps in early mobilisation and voter outreach and highlighting where institutional investments are most urgently needed.

These patterns underscore the persistence of territorial inequalities in participatory infrastructure. The west–east gradient in IPP scores points to enduring differences in civic and administrative capacity across provinces and raises concerns about uneven democratic inclusion within a formally decentralised polity. At the same time, the three IPP dimensions render visible the ways in which participation operates as a continuous process sustained by repeated interactions between citizens and electoral authorities. Voter education and registration, election-day administration, and post-election evaluation and complaint mechanisms together form an interconnected chain through which institutions enable, channel, and respond to citizen engagement. Normatively, this means that electoral participation should be understood as an ongoing governance process rather than a one-day event, and the IPP helps to institutionalise participation as an explicit outcome of electoral governance rather than as an exogenous background condition of elections.

6.2 Policy relevance, future directions, and broader implications

The findings carry direct implications for electoral management and for the design of participatory governance reforms. For the General Elections Commission (KPU), the IPP offers a diagnostic instrument to identify specific weaknesses in each dimension at the provincial level—for example, strong Administration scores combined with weak Preparation or Post-Election performance—thereby informing the prioritisation of targeted interventions in civic education, outreach, or feedback mechanisms. Regular recalculation of the index across electoral cycles would allow the KPU and provincial governments to track whether such interventions produce measurable improvements and whether west–east gaps in multidimensional participation are narrowing, turning the IPP into a practical tool for monitoring institutional performance over time.

Beyond Indonesia, the IPP framework suggests a template for analysing electoral participation in other large, decentralised democracies. Future research can extend the index by incorporating qualitative assessments of deliberative quality, linking IPP scores to measures of trust and institutional performance, and applying the approach in comparative perspective. Such work would deepen understanding of how different institutional configurations support or hinder engagement across the electoral cycle. By anchoring analysis in verified administrative data while retaining a multidimensional perspective, the IPP provides a foundation for a broader research and policy agenda on the governance of electoral participation and for practical efforts to reduce territorial disparities in democratic inclusion.

Data availability statement

The aggregated province-level data generated for the Indonesian Electoral Participation Index (IPP) and any supporting materials provided by the authors are available in the [Supplementary material](#). Access to the underlying administrative records from KPU's SIPARMAS system is subject to KPU data-governance procedures; further inquiries can be directed to the corresponding author.

Ethics statement

This study utilised aggregated, publicly mandated administrative data without any personally identifiable information. All procedures complied with the KPU's institutional data use policies and Indonesian public data regulations. Given the absence of human subjects or individual level identifiers, separate ethics approval was not required. Nevertheless, transparency and accountability standards outlined in international research ethics (Birch, 2010; Norris, 2011) were observed throughout data handling and reporting.

Author contributions

AH: Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. NK: Investigation, Project administration, Resources, Validation, Writing – review & editing. RP: Methodology, Supervision, Writing – review & editing.

Funding

The author(s) declared that financial support was not received for this work and/or its publication.

Acknowledgments

The authors would like to express their sincere appreciation to the General Elections Commission (Komisi Pemilihan Umum–KPU) of Indonesia for providing access to administrative data through the SIPARMAS platform and for their institutional collaboration during this research. The authors also acknowledge the academic and research support provided by Universitas Padjadjaran, which contributed significantly to the completion of this study.

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that Generative AI was used in the creation of this manuscript. The author(s) verify and take full responsibility for the use of generative artificial intelligence (AI) in the preparation of this manuscript. Generative AI tools (specifically ChatGPT, developed by OpenAI) were used to assist in language refinement, structural editing, and improvement of academic readability. All conceptualization, analysis, data interpretation, and conclusions were conducted entirely by the authors. The authors have carefully reviewed and verified the accuracy, originality, and integrity of all AI-assisted content prior to submission.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

References

- Angelucci, D., Improtta, M., Lachat, R., and Vittori, D. (2024). Time will tear us apart: European electoral participation over the long run. *Electoral Stud.* 90:102819. doi: 10.1016/j.electstud.2024.102819
- Ansell, C., and Gash, A. (2008). Collaborative governance in theory and practice. *J. Public Adm. Res. Theory* 18, 543–571. doi: 10.1093/jopart/mum032
- Barras, C. (2024). Does decentralization boost electoral participation? *Electoral Stud.* 92:102873. doi: 10.1016/j.electstud.2024.102873
- Birch, S. (2010). Perceptions of electoral fairness and voter turnout. *Comp. Polit. Stud.* 43, 1601–1622. doi: 10.1177/0010414010374021
- Blais, A. (2006). What affects turnout? *Annu. Rev. Polit. Sci.* 9, 111–125. doi: 10.1146/annurev.polisci.9.070204.105121
- Bollen, K. A. (1989). *Structural equations with latent variables*. New York, NY: John Wiley & Sons. doi: 10.1002/9781118619179
- Bollen, K. A., and Lennox, R. (1991). Conventional wisdom on measurement: a structural equation perspective. *Psychol. Bull.* 110, 305–314. doi: 10.1037/0033-2909.110.2.305
- Booysen, F. (2002). An overview and evaluation of composite indices of development. *Soc. Indic. Res.* 59, 115–151. doi: 10.1023/A:1016275505152
- Bovaird, T., Stoker, G., Jones, T., Loeffler, E., and Pinilla Roncancio, M. (2015). Activating collective co-production of public services: influencing citizens to participate in complex governance mechanisms in the UK. *Int. Rev. Adm. Sci.* 82, 47–68. doi: 10.1177/0020852314566009
- Coltman, T., Deviney, T. M., Midgley, D. F., and Venaik, S. (2008). Formative versus reflective measurement models: two applications of formative measurement. *J. Bus. Res.* 61, 1250–1262. doi: 10.1016/j.jbusres.2008.01.013
- Congge, U., Guillamón, M.-D., Nurmandi, A., Salahudin, and Sihidi, I. T. (2023). Digital democracy: a systematic literature review. *Front. Polit. Sci.* 5:972802. doi: 10.3389/fpos.2023.972802
- Coppedge, M. (2019). “V-Dem codebook v9” in Varieties of Democracy (V-Dem) Project. Available online at: <https://www.v-dem.net>
- Coppedge, M., Gerring, J., Knutsen, C. H., Krusell, J., Medzihorsky, J., Pernes, J., et al. (2019). The methodology of “varieties of democracy” (V-Dem). *Bull. Sociol. Methodol.* 143, 107–133. doi: 10.1177/0759106319854989
- Dacombe, R., and Wojciechowska, M. (2024). Social choice and citizen participation: bringing democratic theory to public administration. *Polit. Stud. Rev.* 22, 722–739. doi: 10.1177/14789299231203657
- Diamantopoulos, A., and Winklhofer, H. M. (2001). Index construction with formative indicators: an alternative to scale development. *J. Mark. Res.* 38, 269–277. doi: 10.1509/jmkr.38.2.269.18845
- Edelsbrunner, P. A., Simonsmeier, B. A., and Schneider, M. (2025a). The cronbach's alpha of domain-specific knowledge tests before and after learning: a meta-analysis of published studies. *Educ. Psychol. Rev.* 37:4. doi: 10.1007/s10648-024-09982-y
- Edelsbrunner, P. A., Simonsmeier, B. A., and Schneider, M. (2025b). The reliability, but not the Cronbach's alpha, of knowledge tests matters. *Educ. Psychol. Rev.* 37, 37–48. doi: 10.1007/s10648-025-10023-5
- Fornell, C., and Bookstein, F. L. (1982). Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *J. Mark. Res.* 19, 440–452. doi: 10.1177/002224378201900406

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpos.2026.1743002/full#supplementary-material>

- Franklin, M. N. (2004). *Voter turnout and the dynamics of electoral competition in established democracies since 1945*. Cambridge: Cambridge University Press.
- Gallego, A. (2015). *Unequal political participation worldwide*. New York, NY: Cambridge University Press.
- Geys, B. (2006). Explaining voter turnout: a review of aggregate-level research. *Electoral Stud.* 25, 637–663. doi: 10.1016/j.electstud.2005.09.002
- International IDEA (2025). *The global state of democracy 2025: democracy on the move*. Stockholm: International IDEA.
- International Institute for Democracy and Electoral Assistance. (2024). *The global state of democracy indices methodology v8*. Stockholm: International IDEA.
- James, T. S., Garnett, H. A., Loeber, L., and van Ham, C. (2019). Electoral management and the organisational determinants of electoral integrity: introduction. *Int. Polit. Sci. Rev.* 40, 295–312. doi: 10.1177/0192512119828206
- Jarvis, C. B., MacKenzie, S. B., and Podsakoff, P. M. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *J. Consum. Res.* 30, 199–218. doi: 10.1086/376806
- Kabanov, Y. (2022). Refining the UN e-participation index: introducing the deliberative assessment using the Varieties of Democracy data. *Gov. Inf. Q.* 39:101656. doi: 10.1016/j.giq.2021.101656
- Karlina, N., Miftah, A. Z., Widianingsih, I., and Gill, S. S. (2025). Organizational capacity and policy integration: government communications strategy in managing COVID-19 in Indonesia. *Cog. Soc. Sci.* 11:2563038. doi: 10.1080/23311886.2025.2563038
- Kaufmann, D., Kraay, A., and Mastruzzi, M. (2011). The worldwide governance indicators: methodology and analytical issues. *Hague J. Rule Law* 3, 220–246. doi: 10.1017/S1876404511200046
- Komisi Pemilihan Umum (KPU) (2024). *Indeks Partisipasi Pemilu 2024*. Jakarta: Komisi Pemilihan Umum Republik Indonesia.
- Lijphart, A. (1997). Unequal participation: democracy's unresolved dilemma. *Am. Polit. Sci. Rev.* 91, 1–14. doi: 10.2307/2952255
- Lundstedt, M., and Edgell, A. B. (2022). Electoral management and vote-buying. *Electoral Stud.* 79:102521. doi: 10.1016/j.electstud.2022.102521
- Marín, D. A. (2021). Political competition, electoral participation and local fiscal decentralisation. *Reg. Stud.* 55, 1863–1874. doi: 10.1080/00343404.2021.1872394
- McNeish, D. (2018). Thanks coefficient alpha, we'll take it from here. *Psychol. Methods* 23, 412–433. doi: 10.1037/met0000144
- Morse, S. (2020). To rank or not to rank with indices? That is the question. *Sustainability* 12:5572. doi: 10.3390/su12145572
- Nelson, M. H. (2023). Explaining socioeconomic disparities in electoral participation: the role of health in the SES-voting relationship. *Soc. Sci. Med.* 320:115718. doi: 10.1016/j.socscimed.2023.115718
- Norris, P. (2011). *Democratic deficit: Critical citizens revisited*. New York, NY: Cambridge University Press. doi: 10.1017/CBO9780511973383
- Norris, P., and Grömping, M. (2019). *Electoral integrity global report 2019–2021*. Cambridge, MA: Harvard University/Electoral Integrity Project.
- Nunnally, J. C., and Bernstein, I. H. (1994). *Psychometric theory*. 3rd Edn. New York, NY: McGraw-Hill.

- OECD and Joint Research Centre (2008). *Handbook on constructing composite indicators: Methodology and user guide*. Paris: OECD Publishing. doi: 10.1787/9789264043466-en
- Olawole, I. M. (2023). The consequences of service delivery for voter turnout in Nigeria. *Electoral Stud.* 86:102675. doi: 10.1016/j.electstud.2023.102675
- Ostrom, E. (1996). Crossing the great divide: coproduction, synergy, and development. *World Dev.* 24, 1073–1087. doi: 10.1016/0305-750X(96)00023-X
- Parker, G., and Hutti, E. (2023). Race, poverty and unemployment as quantitative predictors of voter turnout in St. Louis amidst COVID-19 and a racial justice movement. *Int. J. Sociol. Soc. Policy* 43, 405–417. doi: 10.1108/IJSSP-02-2022-0061
- Partheymüller, J., Müller, W. C., Rabitsch, A., Lidauer, M., and Grohma, P. (2022). Participation in the administration of elections and perceptions of electoral integrity. *Electoral Stud.* 77:102474. doi: 10.1016/j.electstud.2022.102474
- Phillips, J. B. (2024). Affective polarization and habits of political participation. *Electoral Stud.* 87:102733. doi: 10.1016/j.electstud.2023.102733
- Raykov, T., and Marcoulides, G. A. (2019). Thanks coefficient alpha, we still need you. *Educ. Psychol. Meas.* 79, 200–210. doi: 10.1177/0013164417725127
- Roiseland, A. (2021). Co-creating democratic legitimacy: potentials and pitfalls. *Adm. Soc.* 54, 1493–1515. doi: 10.1177/00953997211061740
- Saisana, M., and Saltelli, A. (2011). Rankings and ratings: instructions for use. *Hague J. Rule Law* 3, 247–268. doi: 10.1017/S1876404511200058
- Saltelli, A. (2007). Composite indicators between analysis and advocacy. *Soc. Indic. Res.* 81, 65–77. doi: 10.1007/s11205-006-0024-9
- Saltelli, A., Munda, G., and Nardo, M. (2017). The statistical evaluation of composite indicators. *J. R. Stat. Soc. A. Stat. Soc.* 180, 813–829. doi: 10.1111/rssa.12209
- Saltelli, A., Ratto, M., Andres, T., Campolongo, F., Cariboni, J., Gatelli, D., et al. (2008). *Global sensitivity analysis: the primer*. Chichester: Wiley.
- Sijtsma, K. (2009). On the use, the misuse, and the very limited usefulness of Cronbach's alpha. *Psychometrika* 74, 107–120. doi: 10.1007/s11336-008-9101-0
- Solt, F. (2020). Measuring income inequality across countries and over time: the standardized world income inequality database. *Soc. Sci. Q.* 101, 1183–1199. doi: 10.1111/ssqu.12795
- Stadler, M., Sailer, M., and Fischer, F. (2021). Knowledge as a formative construct: a good alpha is not always better. *New Ideas Psychol.* 60:100832. doi: 10.1016/j.newideapsych.2020.100832
- V-Dem Institute (2025). *Varieties of Democracy (V-Dem) Dataset v15*. Gothenburg: University of Gothenburg.
- Verba, S., Schlozman, K. L., and Brady, H. E. (1995). *Voice and equality: Civic voluntarism in American politics*. Cambridge, MA: Harvard University Press.
- Voorberg, W., Bekkers, V., and Tummers, L. (2015). A systematic review of co-creation and co-production. *Public Manag. Rev.* 17, 1333–1357. doi: 10.1080/14719037.2014.930505
- Zakariya, Y. F. (2022). Cronbach's alpha in mathematics education research: its limits and alternatives. *Front. Psychol.* 13:1074430. doi: 10.3389/fpsyg.2022.1074430
- Zhou, D., Deng, W., and Wu, X. (2020). Impacts of internet use on political trust: new evidence from China. *Emerg. Mark. Finance Trade.* 56, 3235–3251.