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Coverage Is Not Capability: What UDISE+ 2025–26 Can and Cannot Establish About Digital Teaching Capacity in India's Four-Management School System

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Abstract*—India measures school digital infrastructure with binary presence flags and plans against them as though they described a child's chance of using a machine. This paper asks what can and cannot be established about instructional digital capacity from what the Ministry of Education actually publishes. Using UDISE+ 2025–26, covering 14,66,682 schools and 24.72 crore students, and disaggregating by the four school-management types, it reports five results. First, the government–private gap widens monotonically as the indicator is tightened: 13.1 percentage points on computer facility, 14.6 on computers usable for teaching, and 37.7 on functional desktop/PCs (25.5% against 63.2%), so the headline understates the device gap almost threefold. Second, government connectivity is growing at 8.45 points a year against 1.76 for government desktops; the binding input has changed, and between 33% and 43% of enrolment sits in device-limited rather than bandwidth-limited states. Third, the conjunction that programmes depend on is a joint UDISE+ does not publish. Fréchet–Hoeffding bounds place it in [30.50%, 63.06%], falling to 24.02% once functional electricity is required; indexing the joint on an explicit dependence parameter gives 42.53% under independence and 53.84% under moderate positive dependence, and the 21-point government–private gap survives every admissible assumption. Nearly half of India's school children are in states whose guaranteed floor is 20% or below. Fourth, a regression test shows the digital-library indicator is not measuring the same construct across states: one state's residual is 5.0 standard deviations, against a maximum of 3.2 for any hard indicator. Fifth, and against the paper's own convenience, no indicator in this family — headline or strict — is detectably associated with independently measured state learning outcomes. That null is not a measurement failure: the same capability measure explains 58% of the variance in an independently constructed infrastructure index (r = 0.76) while explaining 5% of learning outcomes (r = 0.23), a difference significant at p = 0.0001, and none of 96 analytic specifications reaches significance. A large association is formally excluded; a moderate one is not. The case for better measurement therefore rests on deployment targeting and accountability for spend, not on predicting learning. Set against all this, the record is strong: government schools produced 85.5% of the national connectivity gain since 2023–24. Three reporting changes are proposed, all using data the Data Capture Format already collects.

Keywords—*educational technology; education management information systems; UDISE+; partial identification; Fréchet–Hoeffding bounds; measurement validity; digital divide; school infrastructure indicators; India; NEP 2020*

I. INTRODUCTION

In July 2026 the Ministry of Education published the UDISE+ report for 2025–26. Two figures from it circulated widely. Sixty-nine point nine per cent of Indian schools have a computer; sixty-seven point four per cent have internet. Both were sharply up on the previous year, and both were read as progress towards the technology-enabled classroom that the National Education Policy 2020 describes [13].

The figures are correct. The reading is looser than the figures support. A UDISE+ facility flag records that a school answered yes to a question about a category of equipment. Between that and a child learning at a working machine sit several assumptions, and the published tables are not arranged to let anyone check them.

This paper checks them, and tries to keep separate three claims that are easy to conflate: what the data shows, what the data permits, and what is merely plausible. A planning decision that treats them alike will be wrong in a predictable direction. The framing is borrowed from the partial-identification literature [21]: where a parameter is not point-identified, the honest output is a set together with the assumptions that would shrink it.

The four-management structure of Indian schooling is central rather than incidental. UDISE+ classifies every school as Government, Government Aided, Private Unaided Recognised, or Others, the last comprising mainly unrecognised schools and recognised madrasas. These four differ in funding, size, accountability and intake. They also differ in digital infrastructure, and — as Section IV-A shows — they differ by different amounts depending on which indicator is used, which is itself the finding.

Contributions. (i) A three-level indicator cascade showing that the government–private gap almost triples as the definition of "computer" is tightened, with a bound on how much of the middle level rests on devices that are neither desktops nor laptops. (ii) A partial-identification treatment of joint capability, including a three-requirement extension and a dependence-parameterised interpolation that separates what the data guarantees from what an assumption buys. (iii) A binding-constraint classification with threshold sensitivity, showing the input that limits deployment has changed. (iv) A regression test of cross-state comparability that converts an eyeballed anomaly into a measured one. (v) A concurrent-validity test against independently measured learning

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outcomes, which returns a null and is reported as such, and which changes what this paper claims better measurement is for. (vi) A convergent–discriminant check establishing that the null is not a measurement failure, hardened with a 96-specification multiverse and an equivalence test.

The paper is deliberately two-sided. Section V-A sets out what the system is getting right, including a decomposition showing government schools produced 85.5% of the national connectivity gain since 2023–24, and treats the Fréchet lower bound as the conservative quantity it is rather than as a forecast. The argument is not that the statistics are bad. It is that they answer a narrower question than the one asked of them, and that the Ministry already collects what would close the gap.

II. BACKGROUND AND RELATED WORK

A. What the policy architecture assumes

NEP 2020 treats digital infrastructure as a precondition rather than an enhancement [13], and the curricular framework built on it assumes the same [14]. PM e-Vidya runs 48 SWAYAM Prabha DTH channels and a DIKSHA platform with two crore registered users as of March 2026 [15]. Under Samagra Shiksha, 1,76,728 smart classrooms had been approved by 10 November 2025, funded at Rs. 2.40 lakh non-recurring per school for two rooms and Rs. 38,000 recurring [16]. The Union Budget 2025 committed broadband to every rural government secondary school through BharatNet, with BSNL identifying 16,071 schools within 500 metres of existing fibre for the first phase [17].

Each of these programmes is sized, targeted and evaluated against school counts. A state reporting 80% connectivity is treated as 80% ready. Where the flag and the capability diverge, each of those calculations inherits the divergence. The exposure grew in 2026: CBSE is extending artificial intelligence into the curriculum from Class 3 in the 2026–27 session, beyond the 15-hour skill module already offered from Class 6 in over 18,000 affiliated schools [18]. That is a syllabus commitment resting on an infrastructure assumption.

B. What the evidence on educational technology says

The experimental literature is settled on one point: hardware alone does not move learning. Banerjee et al. found computer-assisted learning in Vadodara raised mathematics scores while the programme ran, with gains fading afterwards [1]. Muralidharan et al. found large effects from a personalised after-school programme in Delhi, attributable to adaptive instruction rather than to the machines [2]. Escueta et al. conclude that technology helps when it changes instruction and does little when it merely arrives [3]. UNESCO's 2023 Global Education Monitoring Report reaches the same position from the policy side and adds that most countries measure the arrival and not the change [4]. Section IV-I of this paper is consistent with that literature at the level of Indian states.

This paper sits upstream of the effectiveness question. It asks whether the statistics used to decide where to send technology describe what they are taken to describe. That measurement question has received much less attention in the Indian context, and the two are not substitutes: an effectiveness estimate applied to a mismeasured population is misapplied twice over.

C. Measurement of school connectivity

Internationally, the ITU–UNICEF Giga initiative has argued that school-connectivity statistics built on administrative self-report overstate usable access, and has moved towards measured throughput [5]. India has no equivalent measured layer. UDISE+ is a self-reported census: school heads complete a Data Capture Format, and block, district and state officers validate it, with the Ministry stating explicitly where responsibility for accuracy sits [6]. That is the standard design for a national education management information system, and by the standards of such systems UDISE+ is unusually thorough; it remains a census of answers rather than of measurements.

III. DATA AND DEFINITIONS

A. Sources

Primary figures are from the Report on UDISE+ 2025–26, Department of School Education and Literacy, Ministry of Education, reference year 2025–26 with a cut-off of 31 March 2026 [6], [7]. Device-class counts are from the same report's Section 9 tables as compiled in [22]. Item definitions are from the UDISE+ Data Capture Format 2025–26 [23]. Learning-outcome scores are the Learning Outcomes and Quality domain of the Performance Grading Index 2.0 for States and UTs, reference year 2024–25, Annexure-2 [26]. PARAKH Rashtriya Sarvekshan 2024 figures, administered on 4 December 2024 to 21,15,022 students in 74,229 schools across 781 districts and released on 8 July 2025, are used for the management-type comparison and the school-questionnaire item [8], [25]. Household digital-access figures are from ASER 2024 [9].

One source choice needs stating explicitly. PGI 2.0 also carries an Infrastructure and Facilities domain, and that domain draws on UDISE+ ICT-lab and smart-class indicators. Using it as an outcome against this paper's infrastructure measures would be circular. Only the Learning Outcomes and Quality domain, which is built from learning assessment, is used as an outcome anywhere in this paper.

B. What UDISE+ collects and what it publishes

The distinction matters more than it might appear, and it is the basis of the recommendations. The Data Capture Format is considerably richer than the published tables. Item 2.24 collects, separately for desktops, laptops, tablets, PCs with integrated teaching-learning devices, digital boards, projectors, smart classrooms and mobile phones used for teaching, both the "total number of functional units available" and the "number of functional units for pedagogical purpose (out of total)". Item 2.25 collects ICT-lab presence together with lab and device counts. Item 2.26 collects internet presence, connection type and a pedagogical-use verification. Item 2.28 collects digital-library presence and a count of e-content [23].

What reaches the published tables is, in almost every case, the presence flag alone. Device counts become a yes or no; the pedagogical-use verification on internet is not published; the e-content count is not published. The quantity this paper spends most of its length bounding — the joint distribution of

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device and connectivity — exists in the collected microdata by construction, because both items are answered by the same school on the same form. It is lost at the publication step, not at the collection step. Table I lists every indicator used here with its source table, its underlying form item and its national value.

TABLE I. INDICATORS USED, WITH SOURCE AND DEFINITION

Indicator (short name)	UDISE+ table	DCF item	All-India 2025–26
Computer facility	7.9	2.24	69.94%
Usable for teaching	7.10	2.24	63.06%
Functional desktop/PC	9.1	2.24(a)	— (see IV-A)
Functional laptop	9.2	2.24(b)	— (see IV-A)
Internet facility	7.11	2.26	67.44%
Functional electricity	7.1	2.1	93.52%
Smart classroom	9.6	2.24(l)	33.90%
Digital library	9.8 / 8.11	2.28	7.14%

"Usable for teaching" is the UDISE+ indicator for a functional computer available for pedagogical purposes. Device-class rows are reported by management in Section IV-A. DCF item numbers are from [23].

C. Reconciliation and exclusions

Every indicator was reconciled against the report's national highlights table before use. Computer facility computes to 69.94% against a published 69.9%; internet to 67.44% against 67.4%; digital library to 7.14% against 7.1%; electricity to 94.99% against 95.0%. State counts sum exactly to the national row for all five indicators used at state level. Management totals close exactly: 10,05,245 + 79,261 + 3,41,689 + 40,487 = 14,66,682 schools.

Two indicators in the same table — boys' and girls' toilets — did not reconcile with the published national percentages and were excluded rather than reported. Device-class counts in [22] were checked against the management and state denominators in Tables 1, 3.3 and 3.5 and match exactly, which is why they are used. Figures before 2021–22 are shown where useful but used in no calculation, because the Ministry states that indicators up to 2021–22 are not strictly comparable with 2022–23 onwards following the introduction of the student registry [6].

D. Estimators

Indicator cascade. The ordered sequence of coverage values as the indicator is tightened from any computer facility, to one usable for teaching, to a functional desktop/PC. The quantity of interest is not each level but the *gap between strata at each level*, and whether that gap is stable across levels.

Capability bounds. A school is digitally capable if it has both a teaching-usable device and internet. UDISE+ gives the marginals p and i but not the joint j. The Fréchet–Hoeffding inequalities [10], [11] bound any joint by its marginals:

$$\max(0, p + i - 100) \leq j \leq \min(p, i) \tag{1}$$

Both bounds are attainable, so the interval cannot be narrowed without additional information; its width is a property of the reporting instrument, not of the estimator. For a conjunction of
k requirements with marginals $x1, \ldots, xk$, the same argument gives a floor of $\max(0, \Sigma\, xj - 100(k - 1))$, which Section IV-C uses to add functional electricity as a third requirement.

Dependence-parameterised joint. Reporting only the extremes is conservative to the point of being uninformative. For two binary variables the joint is a one-parameter family indexed by the phi coefficient [12], [24]:

$$j(\varphi) = p\cdot i + \varphi \cdot \sqrt{(p(1-p)\cdot i(1-i))} \tag{2}$$

with $\varphi = 0$ corresponding to independence and the admissible range of φ fixed by (1). Reporting j at φ = 0, 0.3, 0.5 and 0.7 alongside the bounds makes the assumption explicit and separable from the result.

Weighting-selection difference. School-weighted national coverage is the sum over the four management types of each type's share of schools times its coverage; enrolment-weighted coverage substitutes each type's share of enrolment. Coverage for Others is not published separately and is recovered as the residual that makes the school-weighted blend reproduce the published national figure; Section VI-B bounds the influence of that step.

Binding-constraint index. For each state, BCI = $p - i$. Negative means teaching devices are scarcer than connections, so the state is device-bound; positive means the reverse; a threshold band is treated as balanced, and Section IV-F reports the classification across thresholds from 0 to 10 points.

Comparability test. Each indicator's state-level rate is regressed on the other hard indicators across the 36 states and union territories, and standardised residuals are examined. An indicator measuring one construct consistently should produce residuals of similar magnitude to its peers; a much larger outlier is evidence of definitional rather than physical variation.

Convergent and discriminant validity. Each infrastructure indicator is correlated with two PGI 2.0 domains across the same 36 units: the Infrastructure and Facilities domain, which it should track if it measures what it claims to, and the Learning Outcomes domain, which is a separate question. Reporting both is what distinguishes a measure that fails from a relationship that is absent. The two correlations share a variable, so the difference between them is tested with Williams' modification of the Hotelling test [30]. These are validity tests, not causal estimates.

Multiverse and equivalence. Because a null invites the suspicion that some other analytic choice would have produced a result, the outcome association is recomputed across every combination of six indicators, four samples, three weightings and two statistics. A null is also not the same as evidence of absence, so two one-sided tests on the Fisher transform are used to ask which effect sizes can actually be excluded [31]. Bootstrap intervals follow [27]; family-wise error across the six indicators is checked with Bonferroni and Holm adjustments.

Rank agreement is measured with Spearman's ρ [12] and Kendall's τ, with 10,000-replicate bootstrap intervals. All computations are on published counts and are reproducible from the cited tables.

IV. RESULTS

A. The gap widens as the indicator is tightened

UDISE+ supports three progressively stricter readings of "this school has a computer". Nationally, 10,25,842 schools (69.94%) report a computer facility and 9,24,831 (63.06%) report one usable for teaching — a gap of 6.89 points,

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meaning 9.85% of computer-equipped schools have nothing a teacher can use.

The third reading changes the picture. Functional desktop/PCs are present in 2,56,165 of 10,05,245 government schools (25.48%) and 2,15,889 of 3,41,689 private unaided schools (63.18%). Laptops are in 11.7% of government schools. Across the three levels the government–private gap is 13.1 points, then 14.6, then 37.7: the headline understates the device gap by a factor of 2.9. This is the paper's central empirical result and it is not a modelling artefact — all three are published counts with published denominators.

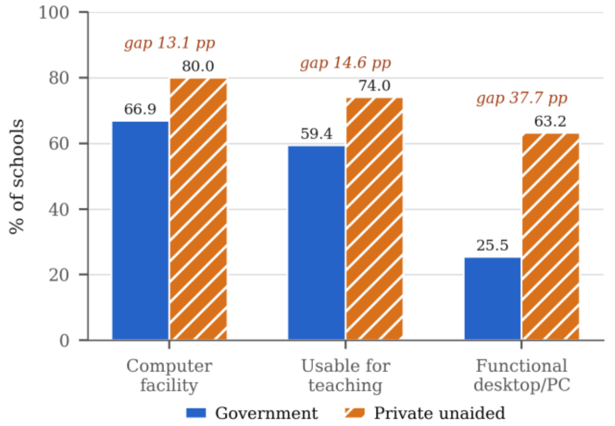

Fig. 1. The government–private gap at three levels of strictness. Each step tightens what counts as a computer; the gap almost triples between the first level and the third.

The composition question follows immediately. If 59.4% of government schools have a teaching-usable computer while at most 25.5% have a desktop and 11.7% a laptop, then by (1) the share with either device is at most 37.2%. At least 22.2 points of the 59.4% — between 37.4% and 57.1% of teaching-usable government schools — must rest on something that is neither a desktop nor a laptop. Item 2.24 offers the candidates: tablets, PCs with integrated teaching-learning devices, smart classrooms, or mobile phones used for teaching [23]. Those are legitimate instructional devices and the paper takes no position on their merits. The point is that the published indicator does not distinguish a thirty-seat computer laboratory from a single teacher-held handset, and a programme specified against it cannot know which it is provisioning for.

State dispersion within the government sector is extreme. Functional desktop/PCs reach 6.4% of government schools in Uttar Pradesh, 7.6% in Madhya Pradesh and in Meghalaya, and 9.5% in Bihar, against 95.2% in Punjab, 85.8% in Tamil Nadu and 71.9% in Sikkim. A near fifteen-fold range inside a single management type is not a rounding difference.

B. The binding input has changed; the reporting has not

Government connectivity rose from 46.2% in 2023–24 to 63.1% in 2025–26, a pace of 8.45 points a year. Government desktop availability rose from 20.2% in 2022–23 to 25.5% in 2025–26, a pace of 1.76 points a year. Connectivity is expanding 4.8 times faster than devices.

Extrapolating either rate is naive, and the paper does so only to fix magnitudes. At its observed pace government connectivity saturates in about 4.4 years; government desktop availability reaches 50% in about 13.9 years. Whatever the true trajectories, the ordering is unambiguous, and it means the constraint that was binding when these programmes were designed is no longer the constraint that binds.

C. What the published marginals leave undetermined

Applying (1) nationally with $p = 63.06$ and $i = 67.44$ gives a floor of 30.50% and a ceiling of 63.06%. The band is 32.56 points wide, which on 14,66,682 schools is exactly 4,77,491 schools — the number without internet — whose joint status the published tables do not settle. This is not sampling uncertainty that a larger census would shrink; it is a structural consequence of publishing marginals.

Most classroom software also needs power. Adding functional electricity (93.52%) as a third requirement lowers the guaranteed national floor from 30.50% to 24.02%. Under the three-way requirement, seven states and union territories have a floor of exactly zero — Madhya Pradesh, West Bengal, Jammu and Kashmir, Meghalaya, Tripura, Manipur and Arunachal Pradesh — holding 2,61,316 schools (17.8%) and 3,84,25,971 students (15.5%). Meghalaya is the limiting case, with functional electricity in 28.7% of its schools.

By management, the two-way floors are 22.5% for government schools, 53.4% for aided and 53.2% for private unaided. On the only figure the data guarantees, the government sector sits at less than half the private sector, against a headline connectivity gap of 16.1 points.

Weighting states by enrolment turns the floor into an equity statistic. The median Indian school student is in a state whose guaranteed floor is 29.4%. Nearly half — 49.4% — are in states with a floor of 20% or below, 20.3% in states at 10% or below, and 9.1% in the five states where the floor is exactly zero.

D. Narrowing the bounds with a stated assumption

A reviewer is entitled to object that a 32-point interval is too wide to act on, and the objection is fair. The bounds assume nothing about the correlation between device availability and connectivity, and that correlation is almost certainly positive, since the two are typically procured, powered and maintained together. Equation (2) lets the assumption be stated rather than smuggled in.

Nationally the admissible range of φ is $[-0.532, +0.908]$. Under independence the joint is 42.53%; under weak positive dependence ($\varphi = 0.3$) 49.31%, under moderate ($\varphi = 0.5$) 53.84%, under strong ($\varphi = 0.7$) 58.36%. A reader who believes procurement is strongly correlated should read the national figure as being in the middle fifties, not at the floor. The paper reports the floor as the guaranteed quantity and this curve as the plausible range, and keeps the two labelled.

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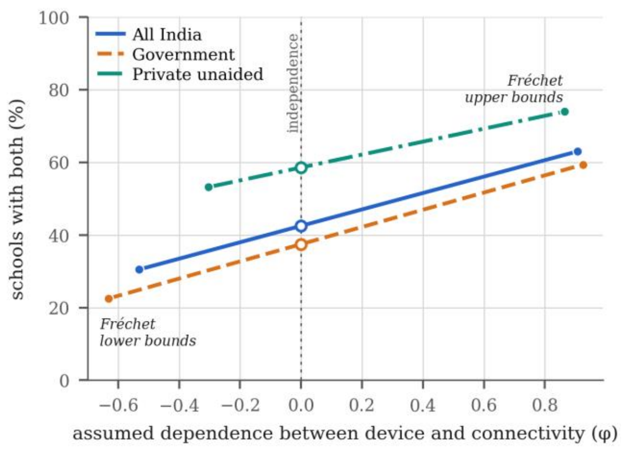

Fig. 2. The joint as a function of assumed dependence. Filled endpoints are the Fréchet bounds; hollow markers are independence. The government line lies below the private line across the entire admissible range, so the sector gap does not depend on the assumption.

The important property of Fig. 2 is what does not change. The private-minus-government difference in the joint is 30.7 points at the respective floors and 21.1 points at independence, and remains positive and large at every admissible φ. The conclusion about the sector gap is therefore robust to the dependence assumption in a way that the level of the national figure is not, and the two claims should be granted different confidence. Table II gives the four strata under each assumption.

TABLE II. CAPABILITY UNDER ALTERNATIVE ASSUMPTIONS (% OF SCHOOLS)

Stratum	Fréchet floor	Independence	φ = 0.5	Fréchet ceiling
All India	30.50	42.53	53.84	63.06
Government	22.50	37.48	49.33	59.40
Government Aided	53.40	58.74	67.59	73.70
Private Unaided Recog.	53.20	58.61	67.51	74.00

Joint availability of a teaching-usable device and internet, from (1) and (2). Only the first and last columns are guaranteed by the data; the middle two are conditional on the stated dependence assumption.

E. School weight against student weight

Government schools are 68.54% of schools and 48.10% of enrolment; private unaided schools are 23.30% of schools and 39.99% of enrolment. The cause is size: 118 students and 5.1 teachers per government school against 289 students and 12.0 teachers per private unaided school, and 311 students per aided school. Aided schools carry the only pupil-teacher ratio above the NEP benchmark, at 32.4.

Re-weighting national coverage by enrolment raises every digital indicator, because the better-equipped sectors run larger schools. Internet moves from 67.44% to 70.98%, a difference of 3.53 points; teaching-usable computers move 3.24 points, computer facility 2.78, smart classrooms 1.85 and digital libraries 1.16, as Table III sets out. The published figure understates the share of children in a connected school, and does so precisely because access is concentrated in the private sector. The same arithmetic that lifts the national average also means 48.10% of India's school children sit in the sector with the lowest capability floor. One percentage cannot carry both facts, and the one published carries the less useful of the two.

An external check points the same way: PARAKH's own school questionnaire, which samples schools with Grade 3, 6 or 9 sections and so skews large, reported 72% internet access against the UDISE+ census figure of 63.5% for the same year [8].

TABLE III. SCHOOL-WEIGHTED AND ENROLMENT-WEIGHTED NATIONAL COVERAGE

Indicator	School-weighted (%)	Enrolment-weighted (%)	Difference (pp)
Computer facility	69.94	72.73	+2.78
Usable for teaching	63.06	66.30	+3.24
Internet	67.44	70.98	+3.53
Smart classroom	33.90	35.75	+1.85
Digital library	7.14	8.30	+1.16

Weights from UDISE+ Table 1. Coverage for the Others stratum is recovered as a residual; Section VI-B bounds its influence at 1.17 pp.

F. Which input binds, and how robust the split is

The binding-constraint index splits the country into groups that call for different spending. At a one-point band, twelve states and union territories are device-bound, holding 5,80,305 schools (39.6%) and 9.03 crore students (36.5%); sixteen are connectivity-bound, holding 6,43,154 schools (43.9%) and 10.69 crore students (43.2%); eight are balanced.

The one-point band is a choice, so the classification is reported across thresholds. At a zero band, sixteen units are device-bound and they hold 43.2% of enrolment; at two points, twelve and 36.5%; at five points, ten and 33.2%; at ten points, eight and 25.1%. For any threshold up to five points, between a third and 43% of Indian school enrolment is in device-limited states, as Table IV shows. The substantive claim does not depend on where the line is drawn.

Bihar is the extreme device-bound case, with 91.0% internet and 38.4% teaching-usable computers, a spread of 52.6 points; among its government schools only 9.5% have a functional desktop. Goa follows at 42.0 points and Chhattisgarh at 39.7. At the other end Sikkim has 90.7% teaching-usable computers and 53.3% internet, a spread of 37.3 points the other way.

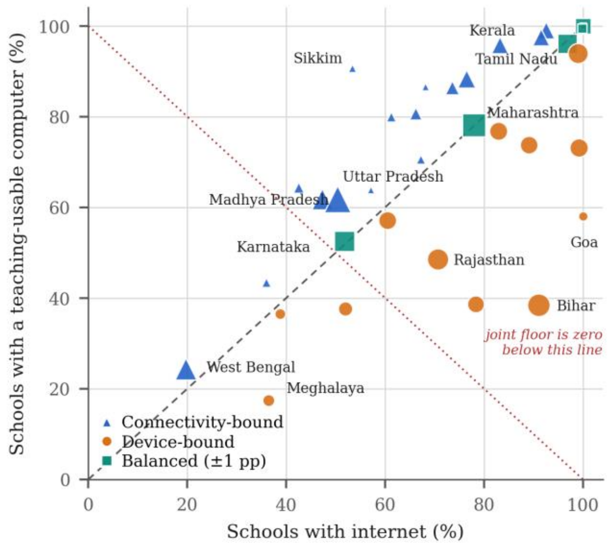

Fig. 3. Which input binds, by state and union territory. Marker area is proportional to enrolment. Points below the dashed diagonal are device-bound,

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above it connectivity-bound. Below the dotted line the two marginals sum to less than 100, so the guaranteed joint floor is zero.

This bears directly on the BharatNet school commitment. Extending fibre to a device-bound school adds nothing until a machine arrives, and roughly four in ten Indian schools are currently in that position. The commitment is sound; sequencing it uniformly is not, and the index that would sequence it is a one-line calculation on data already published.

TABLE IV. BINDING CONSTRAINT BY THRESHOLD, 2025–26

Threshold (pp)	Device-bound	Connectivity-bound	Balanced	Device-bound share of enrol. (%)
0	16	18	2	43.2
1	12	16	8	36.5
2	12	16	8	36.5
5	10	14	12	33.2
10	8	10	18	25.1

Counts are states and union territories out of 36. Device-bound states have fewer teaching-usable computers than internet connections.

G. Rank orderings disagree on cases

Spearman's ρ between the headline internet ranking and the capability-floor ranking is 0.910 ($p = 1.5 \times 10^{-14}$, bootstrap 95% CI [0.795, 0.967]); against the teaching-usable ranking it is 0.707 ($p = 1.4 \times 10^{-6}$, CI [0.441, 0.885]). A high rank correlation is compatible with disagreement on individual cases, and the concordance statistics make that concrete. Kendall's τ is 0.778 against the floor and 0.544 against the teaching-usable indicator, so 11.1% of all state pairs are ordered differently by the first comparison and 22.8% — nearly one pair in four — by the second.

Goa is the clearest single case: internet coverage of 100.0%, the only full State to reach it, ranking joint-first with the four union territories that also do; teaching-usable coverage of 58.0%, so a capability floor of 58.0% and a rank of sixteenth. Bihar drops eleven places and Chhattisgarh eleven; Sikkim rises seven and Telangana six. Bihar alone has 95,285 schools and 2.07 crore students, so this is not a reshuffling of small cases.

H. A comparability test on the soft indicators

Facility flags without an operational threshold are vulnerable to differing interpretation across reporting units. Nationally 7.14% of schools report a digital library; Telangana reports 92.4%, supplying 36.8% of all reported digital libraries from 2.8% of India's schools. Kerala, the next-highest state with a substantial school base, reports 18.0%. Excluding Telangana the national figure falls from 7.14% to 4.64%.

Two tests turn that observation into a measurement. First, concentration: the Herfindahl index of the digital-library count across the 36 units is 0.1757 against 0.0734 for the school count itself, so the indicator is 2.4 times more concentrated than schools are. The same index is 0.0647 for internet, 0.0733 for computer facility and 0.0721 for teaching-usable computers — all within a factor of 1.0 of the school benchmark.

Second, and more directly, regressing each state's digital-library rate on its computer, teaching-usable, internet and electricity rates gives $R^2 = 0.12$ and a residual standard deviation of 16.0 points. Telangana's residual is +80.0 points, or 5.0 standard deviations. The next largest absolute standardised residual anywhere in that model is 1.4. Applying the same procedure to the hard indicators produces maximum absolute residuals of 2.1 for internet (West Bengal), 3.0 for computer facility (Jharkhand) and 3.2 for teaching-usable computers (Chhattisgarh). A five-sigma outlier on the indicator with no published definition, against a worst case of 3.2 on the indicators that do have one, is what would be expected if the difference were definitional rather than physical.

I. Do any of these indicators track learning outcomes?

The preceding sections argue that the strict indicators are better measures of instructional capacity than the headline. A natural further question is whether they also track learning. Across the 36 states and union territories, using the PGI 2.0 Learning Outcomes domain as the outcome, they do not, and neither does the headline.

The correlations are 0.204 for computer facility, 0.242 for teaching-usable computers, 0.186 for headline internet, 0.225 for the capability floor and 0.233 for capability at $\varphi = 0.5$. None reaches conventional significance (smallest $p = 0.155$) and none explains more than 6% of the variance. Nothing survives a Bonferroni or Holm adjustment across the six. Weighting by school count pushes every correlation towards zero.

A null of this kind has two possible causes, and separating them is the point of this section. Either the capability measure is poor, or the relationship is genuinely weak. The test is whether the same measure tracks something it ought to track. It does, strongly: the capability floor correlates with the PGI Infrastructure and Facilities domain at $r = 0.762$ ($p = 7 \times 10^{-8}$), explaining 58% of its variance, against $r = 0.225$ and 5% for Learning Outcomes. Williams' test that these two correlations differ gives $t = 4.38$, $p = 0.0001$ [30]. The pattern holds for every indicator in Table V, and extends across the other PGI domains: the capability floor correlates at 0.726 with Access, 0.687 with Teacher Education and Training and 0.578 with Equity, but at 0.248 with Governance and 0.225 with Learning Outcomes. These measures track the provisioning side of the school system closely and the learning side not at all.

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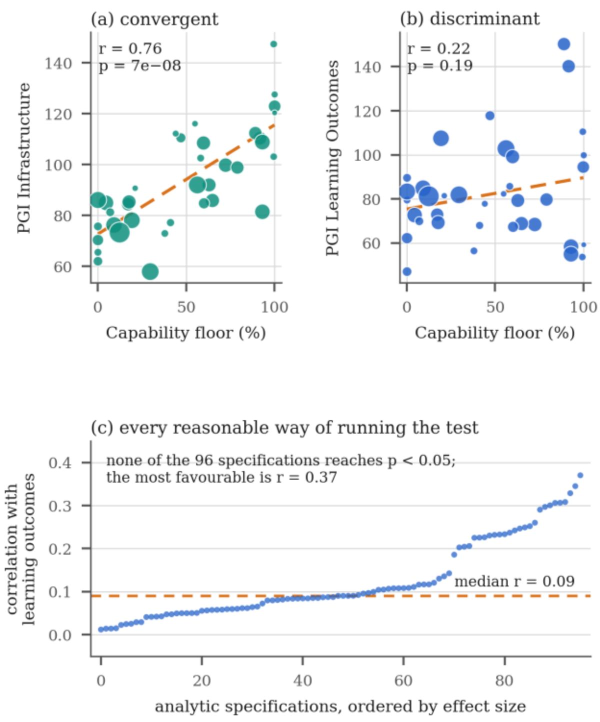

Fig. 4. (a) The capability floor against an independently constructed infrastructure index and (b) against learning outcomes, on identical axes; marker area is proportional to enrolment. (c) The outcome association recomputed across 96 analytic specifications.

The individual cases show why. Punjab pairs a capability floor of 88.9% with the highest learning-outcome score in the country and Kerala 91.7% with the second highest. But Tamil Nadu pairs a floor of 93.0% — among the best — with one of the three lowest outcome scores, while Rajasthan pairs a floor of 19.2% with an outcome score above Maharashtra's. Meghalaya is low on both.

Two further checks guard against the obvious objections. The first is that some other analytic choice would have produced a result. Recomputing the association across every combination of six indicators, four samples (all units; excluding those under 1,000 and under 5,000 schools; excluding West Bengal), three weightings and two statistics gives 96 specifications. The median correlation is 0.090, the range is 0.012 to 0.370, and none reaches $p < 0.05$. The most favourable specification obtainable — teaching-usable computers, large states only, unweighted, Pearson — is $r = 0.370$ at $p = 0.082$. There is no path through these data to a significant positive result.

The second is that absence of evidence is not evidence of absence. Two one-sided tests on the Fisher transform put this precisely. A large association, $r \geq 0.6$, is rejected ($p = 0.004$); $r \geq 0.5$ is rejected ($p = 0.033$); $r \geq 0.4$ is not ($p = 0.132$). The 95% interval on the correlation is [−0.112, 0.515]. The defensible statement is therefore that a large state-level association between digital infrastructure and learning outcomes can be ruled out and a moderate one cannot, and that this is a state-level result which does not license conclusions about individual schools [29].

What the null does is change what better measurement is for. It cannot be justified as a route to predicting learning outcomes, because at this level of aggregation no indicator in this family predicts them and a large association has been excluded. It is justified by the two things Sections IV-A to IV-F establish: knowing what has actually been bought, and knowing where the next rupee buys the most. Those are procurement and targeting arguments and they stand on their own. The caution runs the other way too — a programme document projecting learning gains from device coverage alone is not supported by this data, which is also the conclusion of [1]–[3].

TABLE V. CONVERGENT AND DISCRIMINANT VALIDITY (N = 36)

Indicator	r vs PGI Infrastructure	r vs PGI Learning Out.	Differ-ence
Computer facility	0.681	0.204	0.476
Usable for teaching	0.741	0.242	0.499
Internet (headline)	0.601	0.186	0.415
Capability floor	0.762	0.225	0.537
Capability at φ = 0.5	0.754	0.233	0.522
Three-way floor	0.764	0.230	0.533

Every correlation in the first column is significant at $p < 0.001$; none in the second reaches $p < 0.05$. The two PGI domains correlate with each other at $r = 0.428$.

V. DISCUSSION

A. What the system is getting right

A paper built on the limits of an indicator owes an account of its strengths. UDISE+ is a near-census of 14.67 lakh schools with block, district and state validation layers. Since 2022–23 it has carried individual student records rather than school aggregates, which is what makes dropout and transition rates computable at all. It publishes full state tables and an explicit disclaimer about self-report. Very few countries run anything comparable, and this analysis was possible only because the underlying tables are public and internally consistent.

The substantive record is also strong. Government schools raised internet coverage by 16.9 points in two years and smart classroom coverage from 21.2% to 32.2%. Decomposing the national internet gain of 13.54 points since 2023–24 by management, government schools contributed 11.58 points, or 85.5% of the total, against 8.4% from private unaided and 2.6% from aided schools. The gap between the best non-government sector and government schools narrowed from 28.1 points to 16.6. On the axis the system chose to push, it has delivered, and quickly.

The Fréchet floor should be read in that light. It is the worst case consistent with the data, not a description of the world, and Section IV-D gives the more plausible range. What the floor establishes is narrower and still useful: no programme can currently justify an assumption above it from published evidence alone.

B. For deployment planning

Plan against the floor, and state the assumption if you plan above it. For any programme needing a device and a connection in the same room — DIKSHA in class, the Class 3 artificial-intelligence syllabus, adaptive practice — 30.50% nationally and 22.5% for government schools are the figures the data supports. A planner working from 53.84% is

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assuming φ = 0.5, which may well be right and should be written down.

Sequence by binding constraint. Bandwidth into Bihar, where 91.0% of schools are connected and 9.5% of government schools have a desktop, buys less than devices would; devices into Sikkim buy less than bandwidth would. The relevant index is computable from published tables, and Section IV-F shows the split is robust to where the line is drawn.

Specify the device class. A procurement written against "computer availability" can be satisfied by a handset. Between 37.4% and 57.1% of teaching-usable government schools currently depend on something other than a desktop or laptop, and a syllabus assuming a laboratory will not run on that base. Offline-first delivery, shared-device rotation and low-bandwidth content are not fallbacks for the government sector; on these numbers they are the primary case.

Do not justify the spend by projected learning gains. Section IV-I finds no detectable state-level association between any of these indicators and measured outcomes, and rules out a large one. The defensible justifications are equity of access, curricular obligation, and knowing what was bought.

C. For the reporting instrument

Three changes would let UDISE+ answer the question already asked of it, and none requires new fieldwork, because items 2.24 and 2.26 already collect what is needed.

Publish the cross-tabulation. The same school answers the device item and the internet item on the same form. Releasing the two-by-two table instead of two marginals would collapse a 32.56-point indeterminacy to a point estimate at zero collection cost. This is the single highest-value change available and the paper's main recommendation.

Publish device counts and the pedagogical-use flag, not just presence. Item 2.24 already records functional units and functional units for pedagogical purpose by device class; item 2.26 already records a pedagogical-use verification for internet. Publishing device-to-student ratios by class would make the distinction between a laboratory and a handset visible, which no current published indicator does.

The same gap runs through the district instrument. The Performance Grading Index for Districts 2025–26 scores 784 districts on a Digital Learning category worth 50 points across five indicators, and publishes the category score but not the indicator values behind it [32]. District scores on it run from three or four points to forty-two and vary widely inside single states. Publishing the underlying values would let this analysis be repeated at the unit at which deployment actually happens.

Give the soft indicators operational definitions. Section IV-H shows a five-sigma cross-state outlier on an indicator published without a threshold, against a worst case of 3.2 sigma on indicators that have one. A minimum specification — device count, catalogue size, functional state — would make cross-state comparison defensible. Reporting enrolment-weighted coverage beside school-weighted coverage, both computable from existing tables, would cost a column.

D. Why the timing matters

Three deadlines converge. The artificial-intelligence curriculum reaches Class 3 in 2026–27 and will need a working device in an ordinary classroom, not in a locked laboratory [18]. The Digital Personal Data Protection Rules, notified on 14 November 2025 with an eighteen-month phased compliance window, will require verifiable parental consent for processing children's data, raising the operational bar for every classroom platform [19]. And ASER 2024 found that 82.2% of rural 14–16 year-olds can use a smartphone while only 57% use one for study, with a gender gap of 85.5% against 79.4% [9]; household access is no longer the binding constraint on exposure, but school-mediated educational use still is.

All three assume a school that can run a session reliably. On published evidence between 30.50% and 63.06% of Indian schools can, with the middle fifties the most plausible figure, and no published table says which schools they are.

VI. ROBUSTNESS AND LIMITATIONS

A. Self-report and provenance

UDISE+ is self-reported, and nothing here can separate a misreported flag from a real facility. Section IV-H indicates the reporting layer contributes real variance, at least for indicators without an operational definition.

One provenance issue affects the largest outlier in the dataset. The UDISE+ 2025–26 report notes that all states and union territories except West Bengal feed data directly into the national portal, and that West Bengal maintains its own management information system and supplies a bulk data link [6]. West Bengal is also lowest on internet (19.7%) and on teaching-usable computers (24.3%), and accounts for 4,133 of India's 5,663 zero-enrolment schools (73.0%) and 19,502 of the 20,667 teachers posted to them (94.4%). A pipeline difference of that kind can produce systematic under-reporting of facility flags. The West Bengal figures are reported as published and should not be read as a clean measurement of the state's physical stock. Excluding West Bengal, the two-way zero-floor group falls from five states to four and from 9.3% of schools to 3.0%; the three-way group falls from seven states to six and from 17.8% to 11.5%.

B. Sensitivity of the Others residual

Coverage for the Others stratum is derived, not published. Varying it by ±30 points around the fitted value of 52.1% moves enrolment-weighted national internet coverage by at most 1.17 points in total, because the stratum carries 2.76% of the school weight and 1.95% of the enrolment weight. No conclusion turns on it. The fitted values — 47.6% computer facility, 40.6% teaching-usable, 52.1% internet — are plausible for a stratum of mainly unrecognised schools and madrasas and inherit the rounding of the three published strata.

C. What the estimators do and do not assume

The Fréchet–Hoeffding bounds are sharp given the marginals, which is both their strength and their limit: they establish what is certain, not what is likely. Section IV-D indexes the joint on a stated dependence parameter, and Fig. 2 shows which conclusions survive every admissible value. The sector gap survives; the level of the national figure does not.

The enrolment-weighted estimator assumes that within a management stratum, facility presence is independent of school size. If larger schools within a stratum are better equipped, which is likely, the estimator understates enrolment-weighted coverage, so the reported differences are conservative. The contribution decomposition in Section V-A holds management school shares fixed at 2025–26 values; it is a contribution accounting, not a shift-share, and does not separate composition change from within-sector improvement.

D. Limits on the validity test

Section IV-I carries the most caveats. The outcome is measured for 2024–25 and the infrastructure for 2025–26; the test is concurrent validity under an assumption that state infrastructure is persistent year to year, and it is not a causal estimate in either direction. The equivalence tests establish that a large association is excluded and a moderate one is not, which is the strongest statement 36 units support; the smallest correlation this sample could detect at 80% power is about 0.33 [28]. The PGI Learning Outcomes domain is a composite with its own construction choices, and one large state scores implausibly low on it relative to its reputation, which the paper notes rather than adjusts. The convergent comparison uses a second domain of the same instrument, so the two share a respondent; that is a reason to read r = 0.762 as an upper estimate of convergent validity, not a reason to doubt the contrast, which is a within-instrument difference.

The analysis is at state level throughout, and states are not the unit at which deployment happens. Within-state dispersion is large: on the district digital-learning score, districts inside Kerala span 22 to 37 of 50 while districts inside Meghalaya span 2 to 11 [32]. A district-level replication would be the natural next step and is not possible from published sources, because neither UDISE+ nor PGI-D publishes district indicator values — which is itself one of this paper's recommendations.

E. Compiled figures and descriptive juxtapositions

Device-class figures are compiled counts checked against published denominators rather than figures extracted from the primary tables directly, and a reader with access to the source tables should verify them. The laptop figure for private unaided schools was unavailable, so the composition bound in Section IV-A is computed only for the government sector. The PARAKH school-questionnaire comparison noted in Section IV-E is descriptive and no main result depends on it.

VII. CONCLUSION

India's school digital statistics are accurate and are read for more than they say. Tightening the indicator from any computer, to one usable for teaching, to a functional desktop moves the government–private gap from 13.1 to 14.6 to 37.7 points, so the headline understates the device gap almost threefold. Government connectivity is growing 4.8 times faster than government devices, which has already flipped the binding constraint for a third to two-fifths of Indian school enrolment without changing what is reported.

The conjunction that programmes depend on is not published and is bounded only to [30.50%, 63.06%] nationally, or [24.02%, 63.06%] once electricity is required; under moderate positive dependence the likeliest value is near 53.84%. The government sector's floor is 22.5% against 53.2% for private unaided schools, and that gap holds under every admissible dependence assumption. Nearly half of India's school children are in states whose guaranteed floor is 20% or below.

What better measurement is for changed in the course of writing this. No indicator in this family is detectably associated with independently measured state learning outcomes, and a large association is formally excluded. That is not a failure of the measure: the same capability floor explains 58% of the variance in an independent infrastructure index and 5% of learning outcomes, and none of 96 analytic specifications closes the gap. So the case for fixing the statistics cannot rest on outcome prediction. It rests on knowing what has been bought and where the next rupee buys most, which is enough. And the investment is working on its own terms: government schools produced 85.5% of the national connectivity gain since 2023–24.

The instrument measuring that investment should be asked to publish two more things it already collects — the device-by-internet cross-tabulation, and device counts by class. The first would replace the largest single source of uncertainty in this paper with a number. That is an unusually cheap fix for an unusually consequential statistic.

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