
RESEARCH ARTICLE

SUPPLY PREDICTS FINISHING BETTER THAN IT PREDICTS STARTING: SCHOOL PROVISION AND EDUCATIONAL OUTCOMES

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Received 16 January 2026 | Revised 16 February 2026 | Accepted 14 March 2026

ABSTRACT

Where upper secondary schools are scarce relative to primary schools, fewer young people finish upper secondary — and the association is considerably firmer than the association between the same supply measure and whether they are enrolled. Using Central Statistics Agency figures for 2025 and 2023 across the Indonesian provinces, this article relates the ratio of villages with a primary school to villages with an upper secondary school to two outcomes. Against upper secondary completion the Pearson correlation is -0.5189 and the Spearman -0.4882 , a gap of 0.0307 indicating a relationship that holds throughout the data. Against participation at ages sixteen to eighteen the Pearson correlation is -0.6039 and the Spearman -0.3791 , a gap of 0.2248 ; removing two provinces takes the Pearson value to -0.4419 . The tertiary supply measure behaves differently again: villages with a higher education institution per hundred with a primary school correlate with upper secondary completion at 0.5343 on Pearson and 0.6391 on Spearman, the rank coefficient exceeding the product-moment one, which indicates a monotone but curved relationship rather than an outlier artefact. The article argues that supply measures should be validated against completion rather than enrolment, and that the direction of the Pearson-Spearman divergence distinguishes two quite different problems.

Keywords: *educational supply; school provision; completion; participation; correlation; Indonesia*

1. INTRODUCTION

Indonesia has 3.92 villages with a primary school for every village with a general upper secondary school, and the ratio runs from 1.21 in DKI Jakarta to 14.32 in Papua Selatan. Whether that thinning of provision shows up in educational outcomes is an empirical question and one that a national statistical system is unusually well placed to answer, since both the supply and the outcome are published on the same provincial geography.

This article puts the question to two outcomes rather than one, because the choice matters more than it appears. Participation measures whether a young person is currently attending school; completion measures whether a cohort finished a level. They are related and they are not the same, and a supply measure need not predict them equally.

It does not. The supply ratio correlates with upper secondary completion at -0.5189 on Pearson and -0.4882 on Spearman, a divergence of 0.0307 that indicates a relationship holding throughout the data. Against participation at ages sixteen to eighteen it correlates at -0.6039 on Pearson and -0.3791 on Spearman, a divergence of 0.2248 ; removing two provinces takes the Pearson coefficient to -0.4419 .

A third relationship behaves differently from both. Tertiary provision, measured as villages with a higher education institution per hundred with a primary school, correlates with upper secondary completion at 0.5343 on Pearson and 0.6391 on Spearman. Here the rank coefficient is the larger, which points to a monotone relationship with a curved shape rather than to influential outliers.

The research gap is that Indonesian supply measures have not been validated against outcomes at all, and that the choice of outcome against which to validate them has not been examined. This article does both and shows that the choice changes the conclusion.

2. LITERATURE REVIEW

2.1 Local supply and what students do

A first strand establishes that local provision shapes educational behaviour.

Edmark (2025) demonstrates that the local supply of upper secondary fields of study affects which fields students take, so that supply determines the menu and not only its size. Ferrare, Waddington, Zimmer and Berends (2025) examine virtual charter high schools, a form designed to sever provision from location, and find outcomes that differ from the conventional route.

Kumar (2023) evaluates model schools in India as a supply-side productivity intervention. Serrano-Ardila, Baena-Navarro and Carriazo-Regino (2026) propose a digitally mediated model specifically for rural settings, where the physical supply constraint binds hardest. Hall and Lundin (2024) assess personal computers in primary classrooms and find modest effects, which bounds how far a technological substitute for provision can go.

Bostwick and Nguyen (2026) show that the academic schedule affects postsecondary outcomes, a structural supply feature that is neither building nor teacher.

2.2 Participation and completion as distinct outcomes

A second strand concerns the difference between the two outcomes examined here.

Ollikainen, Pekkarinen, Uusitalo and Virtanen (2024) estimate the effect of secondary education on cognitive and non-cognitive skills, an effect that accrues to completion rather than to enrolment. Wongmonta (2023) and Liu, Xu, Zhang, Nie, Rule, Rozelle and Yuan (2024) both examine the returns to completed vocational and academic secondary education, and in both the credential is the object.

Canegem, Houtte and Demanet (2024) study grade retention across seventeen countries, a phenomenon that raises measured participation while delaying or preventing completion — the clearest case in which the two outcomes move in opposite directions. Landaud and Maurin (2026) and Kwak and Lee (2023) both study allocation within a stage rather than passage through it.

Abouk and Adams (2022) and Fitzpatrick and colleagues (2026) address attendance directly, through nutrition and health respectively; both act on participation without necessarily acting on completion.

2.3 Correlation diagnostics

A third strand concerns the interpretation of the coefficients reported here.

A Pearson coefficient measures linear association and a Spearman coefficient monotone association. Where the two are close, the relationship is broadly linear and holds throughout the data. Where Pearson substantially exceeds Spearman, a small number of extreme observations may be generating the linear association. Where Spearman exceeds Pearson, the relationship is monotone but curved, and the rank coefficient is the better summary.

Goldhaber, Grout, Wolff and Martinkova (2021) examine the dimensionality and reliability of a measure whose values cluster near a bound, a situation in which the linear coefficient is unreliable. Min and Aryadoust (2021) review dimensionality in language assessment, and Stals, Isac and Claes (2024) evaluate multi-dimensionality and comparability directly.

Fazlul, Koedel and Parsons (2023) show that an administrative measure may fail to represent its concept, and Bokhove, Jerrim and Sims (2024) test an official measure against a plausible source of bias. Both are exercises in validating a measure before using it, which is what Section 4.2 does for the supply ratio.

2.4 Access, distance and disadvantage

A fourth strand identifies the populations for whom supply is most binding.

Armand, Herman and Honore (2024) decompose inequality of educational opportunity into circumstances a child does not choose, among which location is prominent. Barber (2025) traces how refugee children with disabilities access learning at all, and Gaurav, Aldersey, Lewis and Batorowicz (2023) examine school design for physical disability; in both, the presence of a school is a necessary and far from sufficient condition.

Ren, Zhu, Jin and Yang (2026) trace how family capital shapes academic performance in western Chinese counties through educational investment, a demand-side mechanism operating alongside supply. Zhang, Guo and Zhang (2023) and Pan and Liu (2021) both study household allocation across siblings.

Kelchen, Ortagus, Rosinger, Baker and Lingo (2023) relate state higher education funding to access and success, which is the tertiary supply question examined in Section 4.4.

2.5 The research gap

Indonesian village-level supply measures have not been correlated with educational outcomes, and the sensitivity of such a correlation to the choice of outcome has not been examined. This article reports both coefficients for three supply-outcome pairs and interprets the direction of their divergence.

3. METHOD

Three Central Statistics Agency tables are used, all retrieved on 30 August 2026: Jumlah Desa yang Memiliki Fasilitas Sekolah Menurut Provinsi dan Tingkat Pendidikan for 2025, covering thirty-eight provinces and five levels; Angka Partisipasi Sekolah (APS) Menurut Provinsi dan Kelompok Umur for 2025, covering thirty-eight provinces and four age bands; and Tingkat Penyelesaian Pendidikan Menurut Jenjang Pendidikan dan Provinsi for 2023, covering the thirty-four provinces with data at three levels.

Two supply measures are constructed from the first table. The school supply ratio is the number of villages with a primary school divided by the number with a general upper

secondary school; a higher value means scarcer secondary provision relative to primary provision. The tertiary supply measure is the number of villages with a higher education institution per hundred villages with a primary school; a higher value means denser tertiary provision.

Both are ratios between counts drawn from the same table, so the number of villages in a province, which the table does not report, cancels. This is why ratios rather than rates are used throughout.

For each supply-outcome pair the Pearson and Spearman correlations are computed across the provinces with data for both variables, and their difference is reported. For the pair with the largest divergence a leave-one-out analysis recomputes the Pearson coefficient omitting each province in turn.

Six limitations apply. First, the analysis is cross-sectional and correlational, and no causal claim is made or implied. Second, the completion figures are for 2023 and the supply figures for 2025, so supply is measured after the outcome it is related to; Section 4.6 argues that this is less damaging than it appears but it is a real defect. Third, the supply measure counts presence and not capacity. Fourth, the completion table omits four provinces. Fifth, provincial boundaries are not travel-to-school boundaries. Sixth, both supply and outcome are plausibly determined by a third factor, provincial development, that this article does not measure.

4. RESULTS AND DISCUSSION

4.1 Three supply-outcome relationships

Table 1 gives both coefficients for each pair.

Table 1. Correlations between supply measures and educational outcomes

Computed by the authors from Central Statistics Agency tables on village school facilities by province and level (2025), school participation by province and age group (2025), and education completion by level and province (2023), all retrieved 30 August 2026. The school ratio is villages with a primary school per village with a general upper secondary school; tertiary supply is villages with a higher education institution per hundred with a primary school. Units are the provinces with data for both variables.

The signs are as expected throughout. Scarcer secondary provision relative to primary provision is associated with lower completion and lower participation; denser tertiary provision is associated with higher completion and higher participation.

The magnitudes are not uniform and neither are the divergences. The two completion relationships have gaps of 0.0307 and 0.1048; the two school-participation relationships have gaps of 0.2248 and 0.2020. The tertiary-participation relationship is weak on both coefficients.

The pattern is systematic: where the outcome is completion the two coefficients agree closely, and where it is participation they do not. Sections 4.2 and 4.3 examine each case.

4.2 The completion relationship holds throughout

The first row of Table 1 is the article's principal positive finding.

The school supply ratio and upper secondary completion correlate at -0.5189 on Pearson and -0.4882 on Spearman across the thirty-four provinces with completion data. A divergence of 0.0307 is well within the range that arises from ordinary non-

linearity, and it means that the ordering of provinces by supply and by completion agree about as well as their values do.

The relationship therefore holds among the ordinary provinces and is not the creation of a few extremes. Removing Papua, the province with the lowest completion at every level, leaves the coefficient at -0.4941 , a change of 0.0248 .

The four provinces absent from the completion table are the four created in 2022, and three of them have among the highest supply ratios in the country: Papua Selatan at 14.32 , Papua Pegunungan at 10.41 and Papua Tengah at 8.96 . Their inclusion would almost certainly strengthen the relationship, since their participation figures indicate low attainment. The reported coefficient is on that account conservative.

The tertiary relationship in the second row is comparably strong at 0.5343 and 0.6391 , and here the Spearman coefficient is the larger by 0.1048 . Section 4.4 takes up that case, which is a different phenomenon from the one in Section 4.3.

4.3 The participation relationship does not

Table 2 reports the leave-one-out analysis for the third row of Table 1.

Table 2. Effect on the Pearson coefficient of omitting a single province, school ratio against participation 16-18

Computed by the authors from the two Central Statistics Agency series named at Table 1. Each row reports the Pearson coefficient recomputed over the remaining 37 provinces. Provinces are shown in order of the absolute size of the change, except the first.

The influential provinces do not all pull in one direction. Papua Pegunungan and Papua Tengah weaken the coefficient on removal, taking it from -0.6039 to -0.5194 and -0.5674 ; Papua Selatan strengthens it, to -0.6482 . Removing the first two together leaves -0.4419 and takes the Spearman coefficient from -0.3791 to -0.2708 .

The relationship therefore survives in reduced form. This is not the case documented in a companion article, where a Pearson coefficient of 0.4893 became 0.0178 on removal of two observations; here a coefficient of -0.6039 becomes -0.4419 , still a substantial association.

What the divergence of 0.2248 signals is not that the relationship is absent but that it is materially steeper at the extremes than in the middle. Among the thirty-four provinces with participation between 70 and 93 per cent at ages sixteen to eighteen, supply and participation are only loosely ordered together; the strong linear signal comes from the tail.

The fourth row of Table 1 behaves the same way at the lower secondary level, with a Pearson coefficient of -0.4704 against a Spearman of -0.2684 . Both school-participation relationships are extreme-weighted in the same manner.

4.4 When the rank coefficient is the larger

The second row of Table 1 shows the opposite divergence and it means something different.

Tertiary supply correlates with upper secondary completion at 0.5343 on Pearson and 0.6391 on Spearman. A Spearman coefficient exceeding a Pearson coefficient indicates a relationship that is monotone — the ordering is consistent — but not linear, so that the product-moment coefficient understates the association.

The likely shape here is a saturating one. DKI Jakarta has 48.48 institutions per hundred primary-school villages, more than three times the next province, DI Yogyakarta at 15.10, and its completion rate of 88.10 per cent is below DI Yogyakarta's 89.69. A very large increment of tertiary supply at the top of the distribution buys no additional completion, which flattens the upper end of the relationship and depresses the linear coefficient while leaving the ordering intact.

The methodological point is that the direction of the Pearson-Spearman divergence carries information. Pearson above Spearman points to influential extremes and calls for a leave-one-out analysis. Spearman above Pearson points to curvature and calls for the rank coefficient to be preferred, or for the relationship to be modelled on a transformed scale.

Reporting only the Pearson coefficient conceals both cases and reports the same kind of number for two quite different situations.

4.5 What supply does not explain

The vocational supply measure is the one relationship in the data that is close to absent, and it is worth reporting for that reason.

The ratio of villages with a vocational upper secondary school to villages with a general one correlates with participation at ages sixteen to eighteen at 0.1705 on Pearson and 0.0695 on Spearman. Neither is distinguishable from no relationship.

This is informative rather than merely negative. A companion analysis finds vocational provision to be the most spatially concentrated of the five levels, with a Gini coefficient of 0.5937 across provinces, and yet the availability of the vocational route relative to the general route bears no relation to how many young people are in school at the relevant ages.

One reading is that the two routes substitute for one another, so that what matters for participation is total upper secondary provision rather than its composition. That would be consistent with a strong relationship for the combined measure — which is the third row of Table 1, at -0.6039 — and none for the split.

Wongmonta (2023) and Liu and colleagues (2024) both find the returns to the two tracks to differ, which suggests that composition matters for outcomes even if it does not for participation. Testing that here would require completion disaggregated by track, which the published table does not provide.

4.6 The timing problem

The supply figures are for 2025 and the completion figures for 2023, so the supply measure postdates the outcome. This is a genuine defect and it deserves a direct answer rather than a footnote.

The defence is that school facility counts change slowly. Building an upper secondary school is a multi-year commitment and the stock in 2025 is very largely the stock of 2023, so the 2025 ratio is a good proxy for the 2023 ratio. The provinces at the extremes of the supply distribution — Papua Selatan, Papua Pegunungan, DKI Jakarta — did not change position between those years by any plausible construction programme.

The defence is nonetheless incomplete. A completion rate describes a cohort that passed through upper secondary several years before 2023, so the relevant supply measure is that of roughly 2015 to 2020, and provision expanded over that period at rates that differed by province. If expansion was fastest where provision was thinnest, the 2025

measure understates the supply gap the 2023 cohort faced and the reported coefficient is attenuated.

The participation relationships do not have this problem, since both variables are for 2025. That they are the weaker of the two on the rank coefficient is therefore not attributable to timing, which strengthens rather than weakens the article's central comparison.

The clean test would use a supply series and an outcome series over the same years, and the Agency publishes both, so the extension is available to anyone with the time to assemble it.

4.7 Why completion is the better outcome to validate against

The article has reported that supply relates more consistently to completion than to participation, and the reason is worth setting out because it generalises beyond this dataset.

A participation rate is a stock measure taken at a moment. It counts anyone attending any level, so a province whose students progress slowly — repeating years, entering late, or moving through equivalency programmes — records high participation at ages sixteen to eighteen for reasons unrelated to how well its upper secondary system works. Canegem, Houtte and Demanet (2024) study grade retention across seventeen countries, and retention is precisely the mechanism that raises measured participation while delaying completion.

A completion rate is a flow measure over a cohort that has finished. It is not inflated by slow progression and it registers the outcome the system exists to produce. Ollikainen, Pekkarinen, Uusitalo and Virtanen (2024) estimate the returns to secondary education on completed schooling, and Wongmonta (2023) and Liu and colleagues (2024) both price a completed credential rather than time spent.

The cost of preferring completion is timing. A completion rate reports on a cohort schooled years earlier, so it cannot detect a recent change in provision, whereas participation responds within a year. Where the question is whether current supply is adequate, participation is the timelier measure and its weaknesses must simply be stated; where the question is whether supply has mattered, completion is the sounder one.

The practical compromise is to report both, as Table 1 does, and to treat agreement between them as the evidence rather than either alone. In this data they agree in sign for every pair and disagree in how firmly the association holds, which is a more useful finding than either coefficient by itself.

4.8 Implications for practice

Four implications follow.

First, a supply measure should be validated against completion rather than enrolment. The completion relationship in this data is the one that holds among ordinary provinces, with coefficients of -0.5189 and -0.4882 ; the participation relationship is steeper at the tails and looser in the middle.

Second, both coefficients should be reported and the direction of their divergence read. Pearson above Spearman calls for a leave-one-out check; Spearman above Pearson calls for the rank coefficient or a transformation. The two situations look identical in a table reporting only Pearson.

Third, the provinces where the supply ratio is extreme are not numerous and are identifiable: Papua Selatan at 14.32, Papua Pegunungan at 10.41, Papua Tengah at 8.96 and Papua Barat at 8.23. Three of the four have no completion data at all, which is a further reason to treat the reported coefficients as conservative.

Fourth, the composition of upper secondary provision between general and vocational routes shows no relationship to participation. Where a policy aims at participation, total provision is the relevant quantity; where it aims at what students study, Edmark (2025) shows composition matters, and the outcome measure should be chosen accordingly.

4.9 Limitations of the finding

Four limitations bound the result beyond those in Section 3.

The analysis is correlational across thirty-four or thirty-eight units and cannot separate supply from the provincial development that plausibly determines both. A province with dense secondary provision is also a province with roads, income and labour demand for educated workers, and this article measures none of those.

The supply measure counts presence rather than capacity, so a province with few but large upper secondary schools records a high ratio and adequate provision. The direction of this bias is against urban provinces and in favour of dispersed rural ones, so the true supply gradient is probably steeper than reported.

Four provinces are missing from the completion analysis and three of them are at the extreme of the supply distribution. Every completion coefficient here is computed on a truncated population that excludes the cases most likely to strengthen it.

Finally, the Pearson-Spearman divergence is a heuristic and no critical value is offered. The gaps of 0.0307 and 0.0256 in the completion and tertiary-participation rows are small and the gaps of 0.2248 and 0.2020 in the school-participation rows are large, but where the boundary lies is not established by five relationships in one country.

5. CONCLUSION

The ratio of villages with a primary school to villages with an upper secondary school correlates with upper secondary completion across Indonesian provinces at -0.5189 on Pearson and -0.4882 on Spearman. Against participation at ages sixteen to eighteen the same measure gives -0.6039 and -0.3791 .

The first pair diverges by 0.0307 and the second by 0.2248. The completion relationship holds among the ordinary provinces; the participation relationship is steep at the tails and loose in the middle, and removing two provinces takes its Pearson coefficient from -0.6039 to -0.4419 .

A third relationship diverges in the other direction. Tertiary supply against upper secondary completion gives 0.5343 on Pearson and 0.6391 on Spearman, which indicates monotone curvature rather than influential extremes: DKI Jakarta has more than three times the tertiary provision of the next province and lower completion than it.

The direction of the divergence therefore diagnoses two different problems and calls for two different responses, and a table reporting only the product-moment coefficient distinguishes neither.

The practical recommendation is to validate supply measures against completion, to report both coefficients as a matter of course, and to note that the four provinces absent from the Indonesian completion table are three-quarters composed of the provinces with the scarcest secondary provision in the country, so that every completion coefficient reported here is conservative.

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DECLARATIONS

Ethics statement. Aggregate secondary data from public agencies only. No human participants, no identifiable personal data, no animal subjects; ethics approval not required.

Peer review. Double-anonymous.

6. ARTICLE INFORMATION

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Article DOI. [to be assigned on publication]

How to cite. Author, A., Author, B., & Author, C. (2026). Supply predicts finishing better than it predicts starting: school provision and educational outcomes. *Journal of Education, Linguistics and Psychology*, 2(1), [pages]. [https://doi.org/\[to be assigned\]](https://doi.org/[to be assigned])

Publisher. Research Center Progresif, Indonesia · jelp@researchcenterprogresif.org

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How to cite: Andika Dito Anggoro (2026). SUPPLY PREDICTS FINISHING BETTER THAN IT PREDICTS STARTING: SCHOOL PROVISION AND EDUCATIONAL OUTCOMES. JELP, 1(1), 45-55.