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Towards a Right to Learn: Concepts and Measurement of Global Education Poverty

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Abstract

The idea that children have a "right to education" has been widely accepted since the Universal Declaration of Human Rights in 1948 (United Nations, 1948) and periodically reinforced since. The "right to education" has always, explicitly or implicitly, encompassed a "right to learn." Measures of schooling alone, such as enrollment or grade attainment, without reference to skills, capabilities, and competencies acquired, are inadequate for defining education or education poverty. Because of education's cumulative and dynamic nature, education poverty needs an "early" standard (e.g., Grade 3 or 4 or age 8 or 10) and a "late" standard (e.g., Grade 10 or 12 or ages 15 and older). Further, as with all international poverty definitions, there needs to be a low, extreme standard, which is found almost exclusively in low- and middle-income countries and can inform prioritization and action, and a higher "global" standard, against which even some children in high income countries would be considered education poor but which is considered a reasonable aspiration for all children. As assessed against any proposed standard, we show there is a massive learning crisis: students spend many years in school and yet do not reach an early standard of mastery of foundational skills nor do they reach any reasonable global minimum standard by the time they emerge from school. The overwhelming obstacle to addressing education poverty today is not enrollment/grade attainment nor inequality in learning achievement, but the fact that the typical learning profile is just too shallow for children to reach minimum standards.

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Measures and standards for "poverty" are social constructs that aim to establish levels of deprivation that societies find, or should find, unacceptable. The idea that children have a "right to education" that prepares them with the skills, capabilities, and competencies they need to fulfill their adult roles as parents, citizens, and members of their respective communities and equips them to generate an adequate income has been widely accepted since at least the Universal Declaration of Human Rights (Article 26) in 1948 (United Nations, 1948). This idea has also been periodically reinforced, including the Jomtien Declaration on Education for All in 1990, Goal 4 of the Sustainable Development Goals in 2015, and the World Bank's 2019 goal to eliminate learning poverty (UNESCO, 1994, United Nations, 2015, World Bank, 2019).

After a brief section introducing the concept of learning profiles, we make three arguments about education poverty.

First, measures of schooling alone, such as completion of a given level or grade of schooling— "time served" —without reference to learning of skills, capabilities, and competencies acquired have always been regarded as inadequate for defining education and hence education poverty. A definition and measure of education poverty must include a measure of learning.

Second, as education is intrinsically dynamic, education poverty should have (at least) a cohort "early" standard (e.g., grade 3 or 4 or age 8 or 10) and "late" standard, near completion of mandatory schooling (e.g., grade 10 or 12 or ages 15 and older). Moreover, as with all definitions of poverty for international use, there is a need for both a low, extreme, education poverty standard and a higher "global" education poverty standard that at least some fraction of students even in moderately well performing high-income countries would not reach. These can be combined to create two standards: First is an "early extreme" education poverty standard representing skills, capabilities, and competencies children should achieve early in their schooling (such as foundational literacy and numeracy). Children – and adults – who do not achieve these skills remain in extreme education poverty. Second is a "late global" standard that children should reach later in their schooling, which some children in all countries are likely not to achieve, but which is considered a reasonable aspiration for all children.

Third, against these standards (early/late, extreme/global) empirical data show that there is a massive learning crisis. In many low- and middle-income countries (LMICs) most (and in some cases, nearly all) children are not reaching an early or late minimum standard of education—even if they have attended school and completed the requisite grades (World Bank, 2018, Global Education Report Monitoring Team, 2020). In most countries of the world the overwhelming obstacle to addressing education poverty is not enrollment/grade attainment or inequality in learning achievement but the fact that the typical learning profile is just too shallow and the typical student learns too little each year they spend in school to reach anywhere near the global standards for learning.

I) Learning profiles and education poverty

A learning profile is a representation of the empirical relationship between the level of any measure of learning (acquired skill, capability, competency) and a child's grade or age

(Kaffenberger 2019). A learning profile for a given individual is the level of capability that individual achieves or would achieve from their completion of each level of instruction/grade. The incremental gain in a causal learning profile is the same as the LATE (local average treatment effect) on learning from an increment of instruction. This causal gain is a function of at least (i) the specific individual, (ii) the quality of the instruction and (iii) the match between the level and type of instruction and the individual.

Figure 1 is a graph showing causal learning profiles of four hypothetical individuals, A, B, C and D, at varied qualities of instruction and time in school. This figure frames the points in this paper. Child D stays in school on a learning profile which surpasses both early extreme and late global education poverty standards. Child C exceeds the early extreme standard but drops out of school after grade 6 and when assessed at age 15 is below the late global standard. Had child C stayed in school however, she would have surpassed both education standards. Child B stays in school on a learning profile in which he meets the early standard but misses the late standard even though he has completed the expected grades. Child A is on a very shallow learning profile, misses the early extreme standard for education poverty, and drops out in grade 5. However, even had she remained enrolled she would not have reached either education standard.

The natural measure of education poverty is the learning achievement of a cohort – all children (or adults) within a given age range, regardless of their years of schooling. Such a learning measure is not restricted to just simple measures like reading or arithmetic but can include any skill, competency, capability that a country's education system seeks to convey to students.

Measuring education poverty as a cohort learning standard may seem obvious, but very few countries currently do so. School-based examinations/assessments, either census or sample-based, only measure the learning achievement of those in school. A school-based assessment of the four children in Figure 1 at age 15 would show one who has successfully surpassed both education poverty standards and one who has surpassed the early (extreme) standard but is still education poor according to the late standard. The other two children would be completely absent from these measures since they have dropped out, and hence education poverty based on only learning assessments of the enrolled students would be highly distorted.

A value of learning profiles is that education poverty of an age cohort at a learning level is just the weighted average of the education poverty of the cohort which has reached/completed each level of grade attainment:

$$1)\ Education\ Poverty(A, L) = \sum_{g=0}^{g=g_{max}} w_g^A * EP(A, L, g)$$

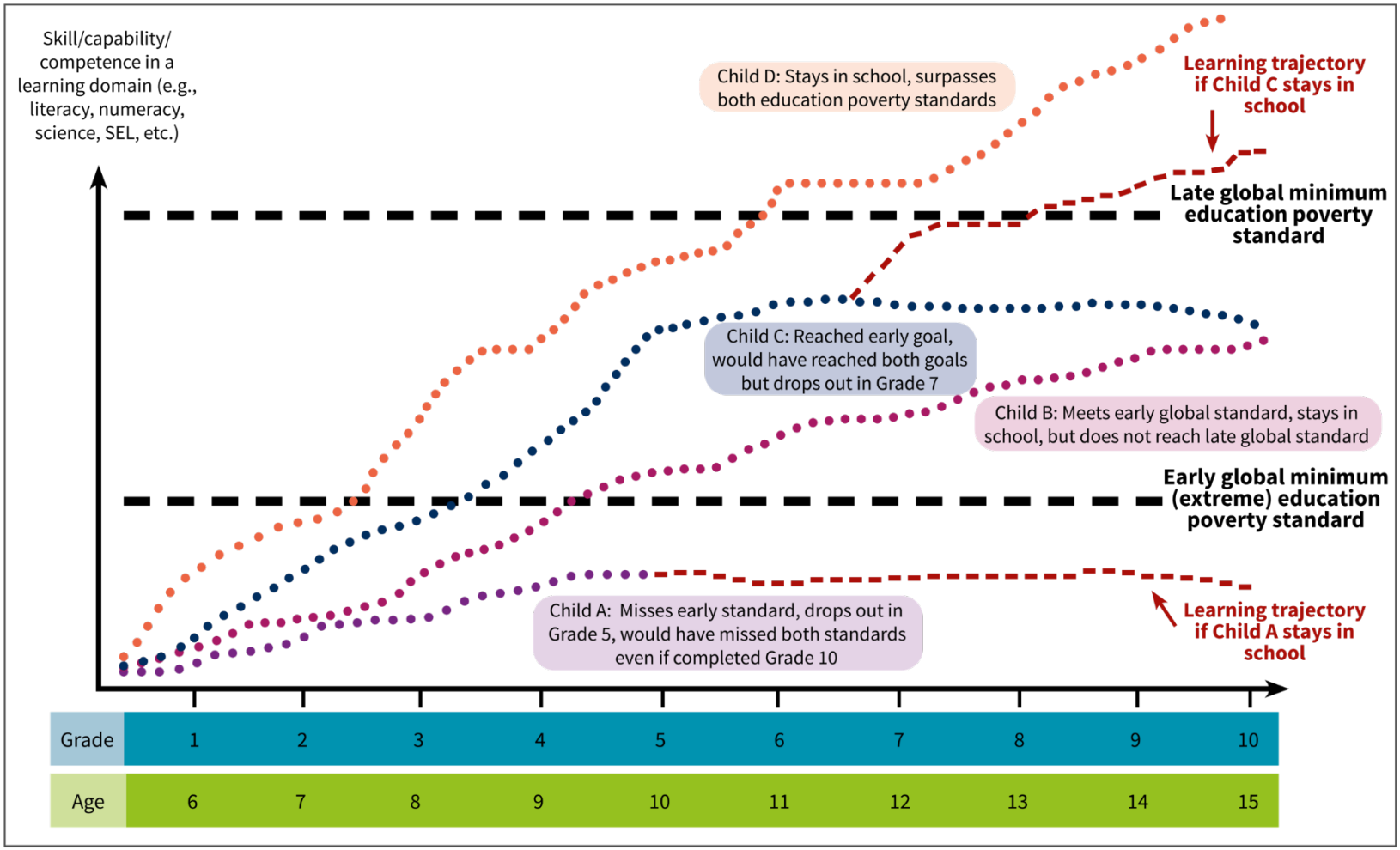
where, as with any headcount poverty measure, education poverty of age cohort A at learning level L at grade g is just the fraction of those N individuals in the cohort A with grade g complete whose learning level, l^i is below learning level L (where I[] is an indicator function that is =1 if the condition is true)[i].

$$2)\ EP(A, L, g) = \frac{\sum_{i=1}^{N_g^A} I[l^i < L]}{Total\ in\ cohort\ A\ with\ grade\ G\ complete}$$

These two simple equations lead to simple arithmetic counter-factual calculations. As we see below, any comparison of education across time, countries/regions, or social groups (e.g. poor/rich), or any plans for progress in reducing education poverty can be decomposed into: (i) differences (or changes) in grade attainment along a given learning profile, (ii) differences (or changes) in the learning profile, and (iii) the interaction.

While education poverty based on grade attainment and learning profiles may seem "data hungry" and beyond the actual data that most countries possess, learning profiles provide a conceptually clear approach to constructing estimates of cohort education poverty, and makes clear the assumptions necessary to construct such estimates. For example, some estimates use the learning achievement of enrolled students to estimate the education poverty of the enrolled and then assume that *no child* who is not enrolled reached the learning standard and hence education poverty is the simple sum of children not reaching a given grade plus the fraction of children reaching that grade but not above a learning threshold. Alternatively, one could calculate estimates of education poverty using explicit assumptions about the learning profile, for instance, a linear extrapolation of learning by grade to calculate education poverty by grade attainment. Given the very widespread availability of grade attainment data this means that reasonable estimates of education poverty are feasible with data to hand.

Figure 1. Learning profiles for four hypothetical children. Even if all had stayed in school to age 15, some still would not have reached early or late education poverty standards because learning per year is too low.



Source: Authors' illustration.

II) "*Time Served" is not a sufficient standard for education poverty*

Given the conceptual definitions of Section I our first argument is that eliminating schooling poverty cannot be conflated with eliminating education poverty. The "right to education" has always, implicitly or explicitly, meant a "right to learn." The Jomtien Declaration, citing the Universal Declaration of Human Rights as its forebearer, states in Article 1.1 "Every person – child, youth and adult – shall be able to benefit from educational opportunities designed to meet their basic learning needs" (UNESCO 1994). It goes on to define learning needs as including literacy, oral expression, numeracy, and problem solving. The hidden premise of schooling goals, such as Millennium Development Goal 2, that called for universal completion of primary schooling, was that the learning profile was sufficiently steep and hence "schooling" goals would reach "learning goals" but this assumption is false for many/most LMICs (Filmer, Amer, and Pritchett 2006). Grade attainment to a specified level is a *necessary* condition for addressing education poverty and hence *instrumentally* of value but no one has ever proposed "time served" as either a *sufficient* condition for education or of *intrinsic* value.

There are four important, but under-appreciated, points about the connection between the expansion of grade attainment and progress in the distribution of cohort learning (and hence reducing education poverty).

First, the slope of the descriptive learning profiles, the extent to which grade attainment produces learning, varies across countries from near zero to steep enough to produce near universal learning. Table 1 shows that only 1.7 percent of the children who have completed grade 6 in Central African Republic achieved the UNICEF standard of foundational literacy, versus 85.7 percent in Thailand (Silberstein 2021). Demographic and Health Surveys (DHS) data show that only 4.1 percent of adult women in the Gambia who completed grade 6 (and no higher) could read a single sentence, versus 100 percent in Honduras (Pritchett and Sandefur 2021). Only 2.3 percent of 15-year-olds enrolled in grade 7 or higher in Zambia reached PISA level 2 proficiency (an SDG Goal 4 standard) versus 91 percent in Hong Kong. Eliminating "schooling poverty" say, through universal primary completion could either (roughly) eliminate "education poverty" (in steep learning profile countries) or still leave nearly every child in "education poverty" (in shallow learning profile countries).

Table 1: The extent to which grade attainment leads to learning levels above an early extreme or late global education poverty standard varies from near zero to 100 percent across countries

	Possible "early/extreme" education poverty standards for literacy/numeracy				Possible "late/global" education poverty standards (e.g. SDG for PISA level 2)			
	Foundational numeracy (UNICEF) when highest grade attended in grade 7 (highest grade completed is grade 6)		DHS assessment, fraction of young adult women who completed grade 6 (but no higher) who can read a single sentence		PISA and PISA-D, Mathematics, assessment of enrolled 15 year olds			
					Percent above level 1c		Percent level 2 or above (SDG 4 standard)	
	Country	Percent	Country	Percent	Country		Country	
Three highest countries*	Thailand	85.7	Bolivia	100	Singapore	99.69	Singapore	92.44
	Kyrgyzstan	67.7	Honduras	100	Hong Kong	99.56	Hong Kong	91.01
	Palestine	55.5	Rwanda	97.1	Japan	99.49	Japan	89.31
Average	Average across 18 countries/ regions (un weighted)	39.8	Average across 51 countries (weighted population)	43.9	OECD Non-OECD	98.05 91.80	OECD Non-OECD	76.64 59.98
Three lowest countries**	Togo	14.54	Guinea	4.5	Cambodia	66.20	Paraguay	8.35
	CAR	1.65	Gambia	4.1	Senegal	52.79	Senegal	7.71
	DRC	1.2	Sierra Leone	3.5	Zambia	28.27	Zambia	2.30

Note: *,** The "highest" and "lowest" countries refer to the related sample of the underlying study (i.e., UNICEF MICS6, DHS, PISA and PISA-D).
Sources: Silberstein (2021) based on UNICEF MICS6 data for functional numeracy, Pritchett and Sandefur (2017) based on DHS data for literacy, PISA and PISA-D results.

Second, Le Nestour, Moscoviz, and Sandefur (2021) use repeated DHS surveys in the same country over time to estimate the fraction of women who can read a single sentence having completed grade 5 for cohorts born from the 1950s to 1990s for up to 87 countries. They estimate that in India the fraction of women born in 1958 who reached grade 5 (but no higher) who could read was 91.5 percent but for a woman born in 1995 this had fallen to only 56.2 percent—so the descriptive learning profile got much shallower over those 35 plus years. In Indonesia, in contrast, over 90 percent of those reaching grade 5 who were born in either 1954 or 1997 could read—so the learning profile was stable. The simple decomposition equations above imply the impact of expanding grade attainment are therefore very different in these two countries.

Third, a more subtle point is that the learning profile by grade need not be linear and could be concave (additional years of schooling produce less learning gain at higher grades) and hence increases in average grade attainment that push more children through higher grades could have little or no impact on cohort learning outcomes. Beatty et al. (2021) demonstrate exactly this phenomenon in Indonesia as they show that the gains in mastery of simple arithmetic are nearly completely flat past grade 6. Hence, the quite substantial expansion between 2000 and 2014 of grade attainment in Indonesia produced zero increase in cohort mastery of arithmetic.

Fourth, an even more subtle point is that the *causal* learning profile of those receiving additional years of schooling due to policies to expand access may be shallower than the *descriptive* learning profile on existing enrollment, particularly if existing school drop-out decisions are influenced by low learning. Kaffenberger, Sobol and Spindelman (2021) use long-

term panel data from the Young Lives surveys in four countries to demonstrate that students who are academically lagging behind are much more likely to drop out. Such differential dropout means average learning profiles among children who have dropped out will tend to be flatter than those who stay in school. Therefore, increasing enrollment will have even less impact on improving learning than the observed (low) learning levels of currently enrolled students suggests. Kaffenberger and Pritchett (2020) and Kaffenberger and Pritchett (2021) use a structured, parameterized model of learning to show that if drop-out is rank ordered by learning then even a massive expansion in grade attainment so that *every* child reached grade 10 would produce *zero* gain in the fraction of children in a cohort who reached PISA level 2 of learning (equivalent to the SDG4 learning goals). Barrera-Osorio, Barros, and Filmer (2018) show, in an experiment in Cambodia with long-term follow up, that children given a "needs" based scholarship had greater school grade attainment but that their additional schooling produced no additional learning or improvements in life outcomes.

III) Education poverty standards

Our second argument is that no one definition of education poverty is sufficient and that operational measures of education poverty will exist for both "early" and "late" stages of education/ages and that the levels of learning, L, in defining education poverty in equation 1 will have both a low, "extreme" and a higher, "global" level.

The Sustainable Development Goals (SDGs), adopted in 2015, made explicit what was left implicit in the MDGs and specified not just completion but "quality" leading to "learning outcomes" as part of Target 4.1.

> *Target 4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes*
>
> The indicator for that target specifies a cohort goal for "minimum" proficiency in at least literacy and numeracy at early, middle, and late states of basic education:
>
> *Indicator 4.1.1 Proportion of children and young people: (a) in grades 2/3; (b) at the end of primary; and (c) at the end of lower secondary achieving at least a minimum proficiency level in (i) reading and (ii) mathematics, by sex.*

These indicators raise two key issues for education poverty. One, that, unlike many other phenomena of poverty, education has a unique, cumulative and (somewhat) irreversible dynamic so both "early" and "late" standards are needed. Two, as with any "poverty" measure, any empirical estimate needs to specify what "minimum" means.

There are good reasons for countries to have an "early" education poverty standard (e.g. grades 2/3/4 or around age 10) for a minimal level of foundational learning, such as conceptual and procedural mastery of foundational skills (Belafi, Hwa and Kaffenberger, 2020). Many education systems are currently more "selection" systems than "education" systems (Muralidharan and Singh, 2021) and use late (grade 10 or 12), life-chance determining, high-stakes for students, examinations to select which students are eligible for scarce preferred education and career opportunities. In "selection" systems the objective of providing a

foundational floor of learning for all children can easily get lost and the early grades are often perceived (by parents and teachers) as a "filter" to sort children out of schooling rather than a time to achieve early mastery. Early targets and early assessment of literacy/numeracy, using tools such as ASER, EGRA/EGMA, and ICAN[ii], can help focus systems on learning for all.

An early minimum standard must indicate a sufficient level of proficiency to enable later learning. For instance, Abadzi (2011) suggests that automatic and effortless reading happens at 45-60 words per minute and that reading at a slower pace implies a child is devoting scarce mental resources to decoding and this impedes reading for meaning. Correct words read per minute is strongly correlated with (though not a substitute for) reading comprehension and children must reach adequate fluency to comprehend passages (Abadzi et al., 2005, Pretorius and Spaull 2016, National Reading Panel 2000). A review of assessments of early grade reading in low performing countries shows in many countries the modal or even median "words correct per minute" is zero and that many children cannot even recognize all of the letters of the alphabet (Crouch, Rolleston and Gustafsson 2021). But an early standard of "recognizing letters" is too low to ensure children reach a minimum level of proficiency.

The World Bank, in collaboration with UNESCO, has recently introduced a "learning poverty" indicator (World Bank, 2019). It focuses on reading and understanding, and combines schooling and learning. It is calculated as the sum of school deprivation (i.e., the share of primary-aged children who are out of school – by assumption these children do not reach minimum proficiency in reading) and learning deprivation (i.e., the share of children who at the end of primary school do not meet the minimum proficiency level in reading, which includes reading and understanding a simple text). According to these estimates, in 2019 53 percent of children in LMICs were in learning poverty, and in low-income countries this figure is 90 percent. The World Bank introduced the Learning Target, which aims to reduce by at least half the global rate of Learning Poverty by 2030.

An early global minimum standard of conceptual and procedural mastery of foundational skills will also help to "teach at the right level" (Belafi, Hwa, and Kaffenberger 2020, Banerjee et al. 2016, Hwa, Kaffenberger, and Silberstein, 2020) and avoid the "negative consequences of overambitious curriculum" (Pritchett and Beatty 2012) and hence is instrumentally essential to achieving late learning standards. A minimum learning standard needs to encompass both conceptual and procedural mastery, not merely rote memorization of number facts or, as above, decoding skills. In many education systems the curriculum races far ahead of actual student progress in mastery prioritizing breadth over depth of cognitive understanding (Atuhurra and Kaffenberger 2020), resulting in students in higher grades that are not prepared to learn the material. This can lead to learning profiles, particularly for the lagging students, that turn concave or even flat as they fall behind and stop learning (Kaffenberger & Pritchett, 2021). While we next argue for a relatively high global standard as the minimum for "late" measures of global education poverty, one cannot build a skyscraper by starting at the 10th floor: early foundations are essential.

The current SDG Indicator 4.1.1 "late" standard for "minimum" proficiency in literacy/numeracy uses, as one definition, reaching PISA level 2 proficiency. Level 2 proficiency

(which varies across the three PISA subjects but is near 400) is roughly a full student standard deviation below the OECD (normed) average of 500. The originators of the PISA assessment believed that Level 2 proficiency represents the minimal competence a person needs to manage in today's world. Table 1 shows that at a late global minimum standard like PISA Level 2 proficiency nearly every child in low performing countries is in education poverty. One might argue a lower late standard would help "focus" or "prioritize." However, for a global standard suggesting that children in poor countries do not "really" need PISA Level 2 learning while accepting that children in rich/middle income countries do seems unacceptable acquiescence to global inequities that would entrench inequalities into the far future.

IV) The primary means to reducing education poverty is addressing the learning crisis (not enrollment and not inequality within countries)

Our third argument is that empirically most LMICs are in a "learning crisis" such that for reasonable definitions of education poverty (either early or late, or at learning levels which are extreme or global) the scope for reducing education poverty via either (a) expansions of enrollment or grade attainment or (b) reductions in inequality of learning across groups is quite limited. Significant progress towards eliminating education poverty depends on across the board increases in learning per year of schooling—steepening the learning profile.

IV.A) Decomposition of reductions in education poverty from increased enrollment versus steeper learning profiles

Two intuitive and common sense but important and policy relevant findings have emerged from studies that decompose cohort education poverty gaps into "grade attainment" gaps and "learning profile" gaps.

First, for achieving reductions in early education poverty (say, literacy or numeracy by age 10) the sustained rapid expansion in enrollments in recent decades means that most countries are very near universal enrollment in primary school and near universal primary completion. Globally, according to World Bank data, only 8% of primary school aged children are out of school[iii]. Much of the potential gains, therefore, to eliminating early (extreme) education poverty through school enrollments have already been achieved, with, of course, large country and regional variation. In Sub-Saharan Africa 19% of primary school aged children are out of school so substantial gains from enrollment expansion can still be made. In India, only 2% of primary school aged children are out of school; in Bangladesh only 5% are. This implies that in many countries there is very little gain to be had in reducing early education poverty from expanding grade attainment and hence nearly all of early education poverty is due to shallow learning profiles.

Kaffenberger and Pritchett (2020) use comparable literacy data for adults across 10 LMICs to compare increases in school grade attainment to improvements (steepening) of learning profiles. Across the 10 countries, simulating achieving universal primary school completion increases literacy by 7.8 percentage points, from 65% to 73%. In contrast, steepening learning profiles to the best performing of the 10 countries (Indonesia, which is still a low-performer by global standards) increases literacy by nearly 14 percentage points.

Second, the extent to which measures of late (around age 15) global education poverty can be reduced by expansion in grade attainment is limited in very low performance countries, as their current learning profiles imply nearly all currently enrolled students are below the poverty threshold. Taking PISA level 2 as the late global minimum standard and making the simplifying (and not wildly inaccurate) assumption the PISA scores have a Normal distribution, the fraction of enrolled 15 year olds meeting the education poverty threshold is just a function of the mean and standard deviation. In the seven PISA-D countries, which Pritchett and Viarengo (2021) show are typical of LMICs' learning performance, the average mathematics score among enrolled students was 325 with a standard deviation of 75 so the fraction above the PISA level 2 threshold of 420 is 9.7 percent. This implies that even if all children reached grade 7 or higher, at observed learning trajectories, education poverty among 15 year olds would still be about 90 percent.

If, somehow, these countries steepened their learning profiles to achieve a PISA average of 385 (similar to Indonesia or Peru) then at 100 percent enrollment education poverty would be 68 percent. At an average score of 420 (similar to Turkey or Thailand) and universal enrollment late global education poverty would be 50 percent (obviously, as the distribution is assumed symmetric), and at OECD levels of 500 (reached by Vietnam) late, global education poverty would be only 14 percent.

IV.B) Gains from eliminating differences by indicators (sex, rural, income/assets)

There are many dimensions of potential social disadvantage (e.g., sex, rural, income/assets) and the potential reductions to education poverty from eliminating within-country inequalities varies substantially by dimension and country.

Pritchett and Viarengo (2021) examine within-country inequalities for the seven countries that participated in the PISA-D assessments[iv] across five dimensions of inequality: sex, rural or urban geography, native or migrant status, socioeconomic status (using the PISA-D wealth index), and whether the child speaks the language of assessment at home or not. They find that, while gaps in education poverty by these dimensions vary by country, eliminating these gaps would contribute only modestly to reducing late, global education poverty (measured as Level 2 on the PISA scale). In these countries, even the high performing, advantaged, socio-economically elite children typically perform significantly below the PISA Level 2 standard.

Akmal and Pritchett (2021), using ASER and Uwezo learning data[v], similarly find that, while closing schooling and learning gaps between higher and lower SES children would improve outcomes for poorer students, large portions would remain in "early" education poverty lacking foundational literacy and numeracy by around age 10. Kaffenberger and Pritchett (2020) conduct similar analysis by gender, finding that women benefit only modestly from equalization with men. In some countries, equalizing learning profiles would reduce women's literacy as once in school, girls often learn more than boys.

Pritchett and Viarengo (2021) further find that the share of total variance in scores explained by student socio-economic status alone is not very large in PISA-D countries (on average 10.3%). Therefore. the conflation of "education poverty" with

income/consumption/asset poverty is badly wrong. Moreover, the "fraction explained" by SES is *lower* in the PISA-D than in the OECD countries. The gains from a unit increase in socio-economic status, in either absolute points or relative to the country average, is *higher* in the OECD than PISA-D countries so, at least among those enrolled, "exclusion" from learning is worse in OECD countries (but drop-out is much higher in PISA-D countries). This lower share of variation in learning outcomes explained by socio-economic status in PISA-D countries does not mean that PISA-D countries are more 'inclusive' overall but rather just highlights that learning levels in PISA-D countries are very low for (nearly) everybody. The primary challenge for every child to reach and surpass early and late education poverty standards is to ensure every child benefits from effective instructional practices that lead to mastery.

Conclusion

The world has been irrevocably transformed by a global commitment to universal schooling. The logical next stage is a shift to a global commitment to eradicate education poverty and ensure that every child emerges into adulthood adequately prepared for the world they will face. This requires a shift from a 'right to school' to a 'right to learn' and addressing the "learning crisis." Currently in most of the world's countries, students do not reach early mastery of foundational skills and (therefore) emerge from school far from any reasonable global minimum education standard. Getting every child into school was a necessary step towards a 'right to learn' but achieving further large and lasting reductions in education poverty is going to require most countries to radically improve the pace of learning of those in school. This is going to require a decisive break from "business as usual" education systems geared only to expansion of access and a move towards education systems coherent for learning (Pritchett 2015), or, more succinctly: learning for all requires all for learning (World Bank 2018).

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[i] In the standard continuous distribution representation this would be the partial integral of the distribution of learning of those who completed grade g up to L. This formulation makes the connection to the widely used FGT (Foster, Greer, Thorbecke 1984) income/consumption poverty measures, or their extension to

multidimensional poverty (Alkire and Foster 2011), obvious. This could extend to measures of "depth" and "severity" of education poverty by adding a 'weighting" function, but this has not yet been done.

[ii] ASER is the Annual Status of Education Report produced by the Indian NGO Pratham and uses a simple assessment tool for literacy and numeracy. EGRA/EGMA are the Early Grade Reading Assessment and Early Grade Mathematics Assessment, widely used by USAID. ICAN is the International Common Assessment of Numeracy, a tool created by the PAL (People's Action for Learning) for assessing numeracy in pre-literate children.

[iii] https://data.worldbank.org/indicator/SE.PRM.UNER.ZS?end=2020&start=1970&view=chart

[iv] The PISA for Development (PISA-D) data covers Cambodia, Ecuador, Guatemala, Honduras, Paraguay, Senegal and Zambia.

[v] The Annual Status of Education Report (ASER) data covers India and Pakistan and the Uwezo data covers Kenya, Tanzania, and Uganda.