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Learning Profiles and the 'Skills Gap': A Comparative Analysis of Schooling and Skills Development in Four Developing Countries

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The expansion of schooling in developing countries has improved educational access significantly in recent years, but less evidence is available on learning and learning progress in comparative perspective. This paper employs data from Young Lives to examine levels and trends in cognitive skill development and the links to enrolment in school across the four study countries for pupils aged five to fifteen. Enrolment is high in all countries except Ethiopia, where it is improving relatively equitably over time, but pupils who do not enroll in school or whose enrolment is interrupted are strongly disadvantaged in terms of learning. At younger ages, pupils in India master basic cognitive skills comparatively well, but by age 12 learning progress is closer to that in Ethiopia, while both learning and learning progress are notably higher in Peru and Vietnam. Inequalities in learning progress are strongly linked to differences in home backgrounds in all countries, but while improving enrolment remains an issue in Ethiopia, generally low levels of learning progress in both Ethiopia and India suggest that more general education quality improvements are a key priority. In Vietnam and Peru, high attainment by more advantaged pupils and those who perform well in the early years suggests that equity improvements intended to reduce 'gaps' are key to more general improvements in learning achievement.

Keywords: Cognitive skills; learning profiles; longitudinal studies; educational access; poverty.

1. Introduction

Comparative studies of learning achievement in higher income countries (for example TIMMS and PISA) show large differences in learning levels between high and low performing country education systems. Comparable data for lower income countries is only rarely available, however, and even in higher income countries there are few comparative longitudinal studies, without which it is difficult to compare learning progress over time. Young Lives provides comparable longitudinal data for 12,000 children in Ethiopia, India (Andhra Pradesh), Peru and Vietnam, presenting an opportunity to examine 'learning profiles' across four low and middle income countries at somewhat different stages of economic and educational development. Moreover, unlike school-based surveys, which usually sample only those children in school, Young Lives administers tests of cognitive skills at the households of all sample children, providing a fuller picture of learning levels across an age-cohort, especially where enrolment rates are far from universal.

All four study countries have experienced notable economic growth since the inception of the study in 2001 and all but Ethiopia had graduated to 'middle-income' status by 2011. The development of productive capacities in the form of cognitive skills is a key mechanism through which education acquires economic value, both to individuals and society; and the imperative to 'upskill' the labour force, linked to concerns around globalization and increasing competition is central to the economic rationale for educational expansion and improvement across the four countries. Further, all countries have made strong progress towards the global 'Education for All' goal of universal access to primary education (later included in the Millennium Development Goals) since its establishment in 1990. The extent to which provision is yet 'of good quality' (as required by the goal) is more questionable, but improvements in quality and equity of access between more and less advantaged groups are major current policy foci in each of the countries.

In this paper, levels and trends in enrolment and learning are examined for two cohorts of children, born in 1994/5 and 2001/2. While country systems of education differ markedly in many respects, an approach that allows for maximum comparability is adopted in order to shed light on patterns and trends across contexts. Descriptive analysis and regression modelling are employed to identify predictors of cognitive skill development, with a focus on the role of formal schooling. The relationships between skills development and a range of key predictors available in the surveys are explored within and across countries, including by means of simplified 'education production function' models (see Todd and Wolpin 2003) which take account of prior learning to understand the cumulative effects of schooling and home background on learning progress at particular stages in the child's life-course.

2. Contexts and Literature

The ability to improve access to good quality basic education is linked not only to the role of economic growth in increasing available resources, but also, *inter alia*, to trends in the size of youth populations. Table 1 reports basic economic, educational and demographic indicators for the four study countries, illustrating the comparatively favourable conditions in Peru and Vietnam, especially when compared with Ethiopia. Strong economic growth, low population growth and a large reduction in the size of the youth population during the period covered by the Young Lives surveys have enabled education quality improvements in Vietnam, where universal basic education was formally adopted in 1991, and where universal access had practically been achieved by 2010 when the net enrolment rate (NER) reached 98% (World Bank, 2013). Recent policies have set out to improve teacher training, curricula, instructional

hours and school facilities and materials at the primary level. In particular, programmes intended to ensure 'minimum standards' of quality, especially in disadvantaged areas, have been implemented; including SEQAP (School Education Quality Assurance Program) and PEDC (Primary Education in Disadvantaged Communes) (see World Bank 2004).

Table 1: Economic, Demographic and Educational Indicators by Country

	Ethiopia	Peru	India	Vietnam
Economic growth rate (GDP growth average 2001-09) %	8.3	5.4	7.2	7.3
Population growth rate (average 2001-2009) %	2.4	1.2	1.5	1.2
Usual age of enrolment	7	6	5	6
Youth population (age 0-14) 2001 (%)	46	34	34	31
Youth population (age 0-14) 2009 (%)	42	30	31	24
Per pupil expenditure (primary) 2001[1] (USD)	26.8	141.9	62.1	N/A
Per pupil expenditure (primary) 2009[2] (USD)	58.2	405.9	73.8	207.6

Source: World Bank (2013)

Youth populations have been shrinking in proportionate terms in the other three countries, although at a slower rate, while per-pupil expenditure has improved in all, most notably in Peru, whose 2003 'General Education Law' provided for compulsory basic education and where enrolment was also practically universal by 2010, reaching 95% (World Bank, 2013). Nonetheless, learning standards in comparative terms remain relatively low in Peru, being among the lowest in Latin America (World Bank 2007; OECD 2013) and show relatively high levels of inequality, especially linked to pupils' first language and to urban compared to rural locations (Cueto, 2007). Enrolment is also high in Andhra Pradesh (AP), with only 2.6% of children aged 6-14 estimated to be 'out of school' in 2012 (ASER 2013). Strong progress on enrolment in the longer term has been enabled by large-scale expansion of school-supply, linked to programmes such as the District Primary Education Project' (DPEP) and *Sarva Shiksha Abhiyan* (SSA); and more recently to the 2009 Right to Education Act (RTE) which provides for universal free and compulsory basic education (Little, 2010). Nonetheless, recent studies in AP and India more generally have demonstrated stagnation, or even decline, in learning levels over time (see ASER, 2013).

In Ethiopia, enrolment is lower, at 86% in 2011, while expansion has been rapid, arguably linked to declining school quality and learning levels (Dom 2010). The NER stood at just 44% in 2001 (World Bank, 2013). The 'General Education Quality Improvement Programme' (GEQIP) was introduced in Ethiopia in 2010, focused on improving quality, equity and learning outcomes through investment in key inputs such as infrastructure and textbooks. However, significant challenges persist, including those concerning access in rural and remote communities and the participation of girls and of those from disadvantaged (especially pastoralist) backgrounds (MOE, 2008).

Both home and school environments play significant roles in promoting or hampering cognitive skill development over time (Bird 2007: 25; Carneiro et al. 2003), not least because poverty of households and communities is both a cause and a consequence of low levels of education (Knight et al. 2008). From the outset, disadvantaged children's 'opportunities to learn' are limited by the relationships between their backgrounds and contexts and enrolment,

[1] Ethiopia data are for 1997

[2] Ethiopia data are for 2010, India data are for 2006, and Vietnam data are for 2008. This was calculated using GDP per capita and the expenditure per student at the primary level as a % of GDP per capita.

progression and completion of schooling (Filmer and Pritchett 1999; UIS and UNICEF 2005). Household income or material circumstances are clearly an important source of 'gaps' in cognitive achievement (see for example Alderman et al. 1997), while caregiver characteristics are also associated with children's educational outcomes; since, for example, educated caregivers are more likely to send their children to school and to invest more in their children's education (see for example Lloyd and Blanc 1996). At the level of the individual child, gender and age affect the true and perceived benefits of schooling, and also the opportunity costs of children's work in terms of foregone earnings, although many children combine both school and work.

While the benefits of education are not reducible to the development of measurable skills, many important productive abilities are rooted in cognitive skills, in whose development formal schooling plays a crucial role. Studies of the 'returns to education' show strong benefits of schooling for productivity and earnings across a wide range of countries (Psacharopoulos and Patrinos 2002), and also of cognitive skills gained through schooling specifically (Glewwe 1991; Hanushek and Woessman 2008). There are also well-established benefits of schooling and cognitive development across a number of social and psychological domains, including, for example, on fertility and health (Hannum and Buchmann 2005). Primary and lower secondary schooling play a particularly important role in the development of basic cognitive skills, especially literacy and numeracy, and these skills in turn form the foundation for the development of more complex cognitive skills, such as problem-solving, communication skills, and abilities to adopt new technologies. Skills developed through education may improve young people's prospects of entering the labour market and enable them to adapt better to the rapidly changing demands of the economy (King and Palmer 2006).

At the same time, cognitive development is only one, albeit crucial, dimension of a child's development and 'non-cognitive skills' along with economic, social and political environments play a vital role in the linkages between skills and productivity and opportunity. While educational expansion and skills development played a strong role in the East Asian 'miracle' (see Stiglitz 1996), this was arguably dependent on wider changes in economies and societies in East Asia, which have been less marked in the context of sub-Saharan Africa, where there is greater controversy over the economic benefits of schooling (see Bennell 1996; Pritchett 2001). Moreover, access to education by no means guarantees the development of appropriate skills for current and future livelihoods (Hanushek and Woessmann, 2008: 608). Studies in several countries have shown that completion of primary education does not ensure that students will have acquired even the basic skills of literacy and numeracy (see Hill and Chalaux 2011 for India). There is evidence in some countries that the expansion in school enrolment has impacted negatively on the quality of education and that economic returns to basic schooling have declined with increasing access, linked to a shift towards comparatively higher returns at later stages (Colclough et al. 2009). Low-quality education, pervasive in sub-Saharan Africa especially (see Glewwe et al. 2007), may reduce some of the potential benefits of education for the development of cognitive skills, especially for the poorest, to the extent that their schooling is of lower quality. Further, disadvantaged groups and regions are often characterized by low attendance and high drop-out rates (UIS and UNICEF 2005) as well as by low rates of progression to secondary and tertiary education. Nonetheless, especially in contexts where home disadvantage threatens undermine the development of young people's cognitive skills, school environments represent what is typically the largest influence on children outside of their homes; and are arguably more accessible and 'efficient' sites for intervention (Hanushek and Woessman 2008), emphasising the importance of effective schooling systems, especially for the most disadvantaged.

3. Data on Cognitive Skills

Table 2 summarises the comparable cognitive skills assessments administered in the Young Lives household surveys. Tests in basic reading, writing, numeracy, understanding of quantity and mathematics are translated versions of identical tests developed to be appropriate across country-contexts. Basic reading, writing and numeracy tests are identical at each survey round, allowing comparisons over time, while in mathematics different content is required to assess skills in line with age and grade-related curricula. Accordingly, while these tests are designed to assess common age and curriculum appropriate mathematical skills across countries, they do not permit simple direct comparisons over time.

Table 2: Young Lives Household Survey Tests in Numeracy and Literacy

Test	Domain	Description of Test	Data	Cohort	Survey Year	Age
Basic Reading	Reading	Asked to read single letters, words and a simple sentence	Categorical variable: No reading Can read letters Can read words Can read sentences	OC	2001/2	7-8
				OC	2006	11-12
				YC	2006	4-5
				YC	2009	7-8
Basic Writing	Writing	Asked to write a sentence	Categorical variable: No writing Writes with difficulty Writes without difficulty	OC	2001/2	7-8
				OC	2006	11-12
				YC	2006	4-5
				YC	2009	7-8
Basic Numeracy	Maths	Children asked to respond to a single item (2x4)	Categorical variable: Incorrect Correct	OC	2001/2	7-8
				OC	2006	11-12
				YC	2006	4-5
				YC	2009	7-8
CDA-Q (Cognitive Development Assessment - (Quantity)	Understanding of quantity	Test of basic understanding of concepts of quantity and number (10 items)	% correct responses	YC	2006	4-5
Maths	Maths	10 question maths test	% correct responses	OC	2006	11-12
Maths	Maths	30 question maths test	% correct responses	OC	2009	14-15
Maths	Maths	30 question maths test	% correct responses	YC	2009	7-8

OC: Older Cohort YC: Younger Cohort Source: Young Lives

4. Enrolment and Learning Levels

The age at which a child initially enrols in school is an important influence on the total exposure to schooling likely to be received. Later enrolling children are typically more disadvantaged and may also, as a result, experience pressure to leave school earlier than more advantaged pupils, especially where later stages of education are associated with rising costs. Table 3 reports the levels of school enrolment among the study children for each country and cohort, plus by gender for the highest and lowest quintiles of household wealth. Enrolment at age 5 is negligibly low in Ethiopia, Peru and Vietnam, while two-fifths of pupils had begun school in India (where the official age of entry is 5). By age 8, more than 90% of pupils were in school in both cohorts, except in Ethiopia, although enrolment at this age had improved in that country from 66% to 72% between cohorts, with a notable improvement in equity between wealth groups. While the vast majority of pupils in all countries were in school at age 12, rates of enrolment declined by age 15, especially in Vietnam, due to drop-out and to pupils completing

the basic education cycle (and not progressing further). Enrolment gaps between high and low wealth households are notable especially at age 8 and 15 in Ethiopia - at age 8 many disadvantaged pupils had not enrolled and at age 15 a number had left school. In India, more advantaged pupils were less likely to have left school at ages 12 and 15; a tendency mirrored in Vietnam at age 15.

Table 3: Proportions of Children Enrolled in School by Cohort, Age and Home Wealth

	Ethiopia			Peru			India			Vietnam		
	Total	**WQ1**	**WQ4**	**Total**	**WQ1**	**WQ4**	**Total**	**WQ1**	**WQ4**	**Total**	**WQ1**	**WQ4**
Age 5 YC	0.04	0.04	0.03	0.00	0.01	0.01	0.43	0.46	0.33	0.00	0.00	0.01
Age 8 YC	0.72	0.59	0.74	0.93	0.95	0.86	0.93	0.94	0.87	0.96	0.94	0.94
Age 8 OC	0.66	0.43	0.87	0.99	0.95	1.00	0.97	0.96	0.97	0.99	0.94	1.00
Age 12 OC	0.93	0.91	0.92	0.95	0.97	0.87	0.88	0.81	0.93	0.96	0.90	0.96
Age 15 OC	0.87	0.78	0.89	0.88	0.80	0.87	0.75	0.69	0.84	0.73	0.58	0.87

OC: Older Cohort YC: Younger Cohort WQ: Wealth Quintile Source: Young Lives

The proportions of children who had mastered basic cognitive skills in reading, writing and numeracy at age 8 are compared across cohorts in Table 4, where figures indicate the proportions of pupils reaching the highest level of basic skill in each case. Data are disaggregated by enrolment for Ethiopia (where levels are relatively low). Despite the increase in enrolment in Ethiopia, levels of mastery of basic skills did not increase notably between the cohorts among enrolled children, but differences in skills by whether pupils are enrolled or not are large for both cohorts. Notable differences in skill mastery are found between countries and there is no general pattern of improvement over time. The vast majority of children in Vietnam had mastered each of the three basic skills at age 8 in both cohorts, while only a minority of children in Ethiopia had done so, with Peru and India showing a slightly more mixed picture. The earlier enrolment in primary school of pupils in India draws attention to the lower levels of literacy at age 8 when compared to Vietnam, suggesting slower progress in India during the early years of schooling.

Table 4: Proportions of Pupils Mastering Basic Literacy and Numeracy at Age 8

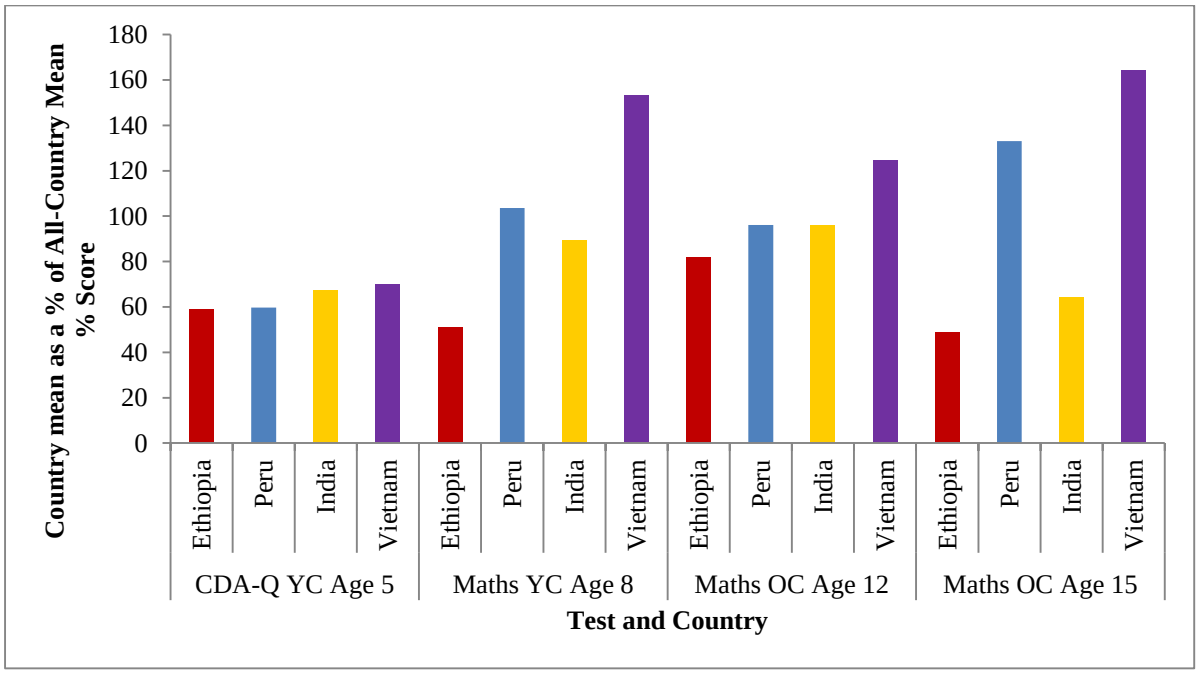
	Ethiopia			Peru	India	Vietnam
	Total	**Enrolled**	**Not Enrolled**	**Total**	**Total**	**Total**
			Older Cohort (2001/2)			
Reading	0.21	0.32	0.01	0.80	0.51	0.87
Writing	0.20	0.27	0.06	0.32	0.27	0.75
Numeracy	0.44	0.52	0.13	0.75	0.90	0.86
			Younger Cohort (2009)			
Reading	0.25	0.34	0.02	0.77	0.50	0.87
Writing	0.16	0.22	0.01	0.58	0.41	0.85
Numeracy	0.46	0.50	0.30	0.73	0.89	0.91

Source: Young Lives

Figure 1 presents the average test results of the maths assessments (including the CDA-Q) for the 'younger cohort' in each country as a percentage of the mean for the all-country sample. Differences on the CDA-Q, administered before most children began schooling, are small, suggesting that differences in children's backgrouds between countries related to overall levels of development were not strong influences on test results. At age 8, the same group of

Vietnamese children performed much better and Ethiopian children much less well than average in maths, with Vietnamese pupils' scores being around three times higher and with India and Peru lying closer to the all-country average. While later enrolment is a key explanation for lower achievement in Ethiopia, the results suggest more effective schooling in Vietnam in the early years, to the extent that mathematics skills are the result of schooling. At age 12 among the 'older cohort', when almost all children were in school in all countries, the pattern is consistent but less stark, particulaly because of relative 'catch-up' by Ethiopian children, whose enrolment had increased the most. By age 15, however, the gap between the same Vietnamese and Ethiopian pupils is substantially greater, while Peruvian pupils perform above average and those in India only slightly better than in Ethiopia, despite their earlier performance being much better at earlier stages. This finding suggests that learning in Ethipia and in India 'keeps pace' much less well as the demands of the age and curriculum-based tests increase. Overall, it is clear that there are very large difference in learning between countries and national education systems, least of all when most pupils have not begun school (at age 5) and when most children are in school (age 12) and most of all when there is variation in enrolment (age 8 and 15) and when the demands of the tests are greatest (age 15).

Figure 1: Maths and CDA-Q Scores by Country and Age (as % of Overall Mean)

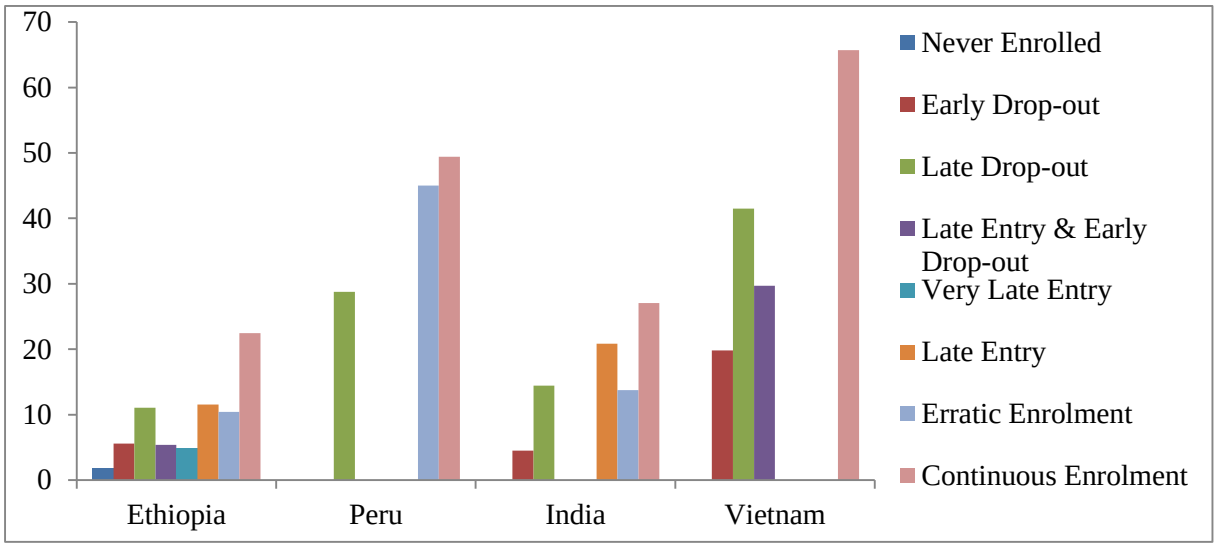


Source: Young Lives

To explore the relationship between learning and enrolment further, the study children may be grouped according to enrolment patterns based on successive rounds of survey data. Figure 2 presents the maths scores of pupils at age 15 by their enrolment histories. Pupils who were enrolled at all rounds of the survey achieved scores which are dramatically higher than those who had enrolled late or dropped out, and especially when compared to those who had never enrolled. The poor performance of pupils with various patterns of non-continuous enrolment in Ethiopia and India is especially notable. In Vietnam and Peru, pupils who had dropped-out performed much less well than their peers. Table 5 reports the percentages of children enrolled in school at age 12 who went on to drop-out of school by the age of 15, disaggregated by achievement in maths at age 12, in order to examine the extent to which poor learning is a pre-cursor to drop-out. In all countries, a considerably higher percentage of children in the lowest

achievement quartile at age 12 had dropped out by age 15 when compared to the highest achievement quartile.

Figure 2: Maths Scores at Age 15 by Enrolment History[3]



Source: Young Lives

Table 5: Drop-Out between Ages 12 and 15 by Achievement at Age 12

	Ethiopia (%)	Peru (%)	India (%)	Vietnam (%)
Total (all enrolled at Age 12)	9.54	8.76	9.61	23.40
Lowest Quartile Maths at Age 12	20.73	17.11	26.04	47.71
Highest Quartile Maths at Age 12	8.27	11.80	11.73	19.72

Source: Young Lives

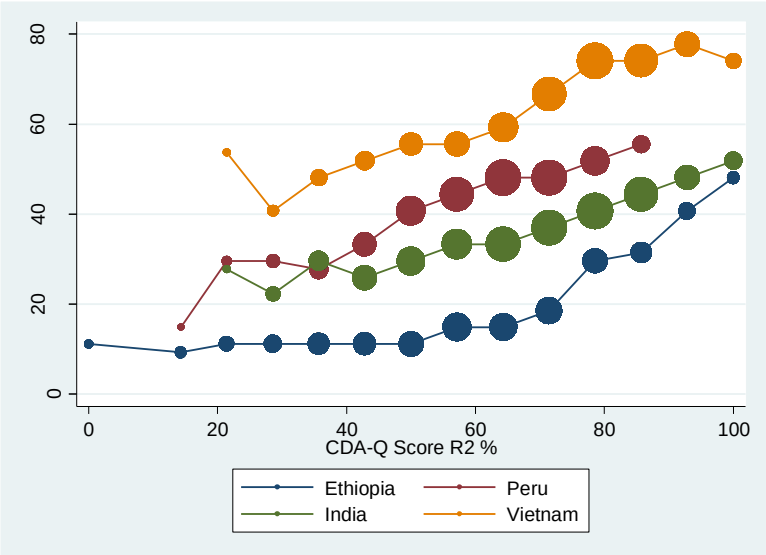
5. Learning progress

The differences in learning levels between countries illustrated so far reflect a variety of home background and school quality factors which are likely to have cumulative effects across the life-course of the child. In order to examine the progress made during a particular stage, it is important to take account of prior learning. Accordingly we examine the achievement of pupils in each cohort in maths in 2009 according to their performance in 2006, on the earlier maths or CDA-Q test. The median 2009 score is calculated for children grouped by their 2006 scores, so that no parametric assumption is made about the relationship between scores over time. The results for the age 5 to 8 stage are presented in Figure 3. Higher scoring children at age 5 also scored highly at age 8, but the age 8 scores are much higher across all levels of age 5 scores in Vietnam, followed by Peru, indicating that children across the range of initial performance learned substantially more in these countries, not linked to their prior learning. Compared to a pupil with the same prior score in Ethiopia at age 5, a pupil's score in Vietnam at age 8 was typically 2 to 3 times higher. The gradient of the relationship between scores is similar across countries with the exception that there is no relationship between scores for those pupils scoring

[3] Groups of fewer than five pupils are excluded. Never enrolled = not enrolled in any survey. Early drop-out = enrolled only in 2001/2. Late drop-out = enrolled in 2001/2 and 2006 only. Late entry & early drop-out = enrolled in 2006 only. Very Late entry = enrolled in 2009 only. Late Entry = enrolled in 2006 and 2009 only. Erratic enrolment = enrolled in 2001/2 and 2009 only. Continuous enrolment = enrolled in all surveys.

less than 50% at age 5 in Ethiopia, all of whose results on the R3 test are close to zero; and with some suggestion of higher learning increments for previously higher achieving pupils in Vietnam. To some extent the pattern in Ethiopia reflects the prevalence of late-entry of pupils to school, most of whom would have attended school for only a year or so at age 8, while the pattern in Vietnam is suggestive of a relatively high-performing school system.

Figure 3: Progress in Maths by CDA-Q Score (Ages 5 to 8)[4]



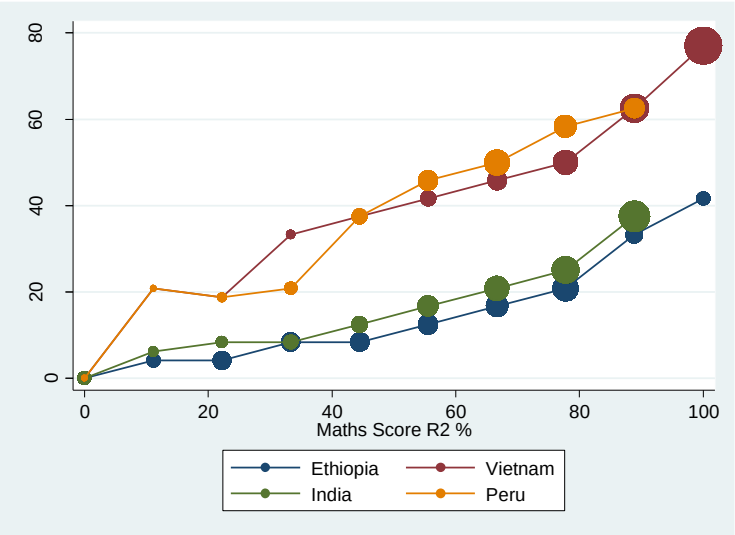
Source: Young Lives

The same broad pattern is observed for the age 12 to 15 stage, as shown in Figure 4. In this case, however, countries fall into two groups – higher performing Vietnam and Peru and lower performing Ethiopia and India. Pupils in the high performing countries with the same initial score as those in low performing countries at age 12 scored twice as high or better at age 15. Learning progress in India at the same level of prior score is similar to that in Ethiopia, despite considerably earlier enrolment in India and in many cases more favourable background characteristics and greater per-pupil resources spent on schooling, suggestive of relatively poor school quality in terms of the production of maths skills at age 15, consistent with the results in Figure 1, which do not take account of prior learning.

The picture by enrolment is illustrated in Figure 5, where data are disaggregated according to whether pupils have been enrolled at all rounds of the survey (continuous enrolment). The gaps are widest in Vietnam and Peru. This may be considered consistent with learning levels and school-quality being higher in these countries, since missed schooling may be expected to result in greater privation of 'opportunities to learn'. The difference in learning levels between pupils by enrolment status in Ethiopia and India is sizeable only for pupils with higher prior scores, indicating that low-performing pupils who were continuously enrolled in these countries learned little more than those who were out of school or whose enrolment was interrupted, suggesting that while learning levels and learning progress is relatiely low in general in these countries, progress may be particularly weak for lower performers.

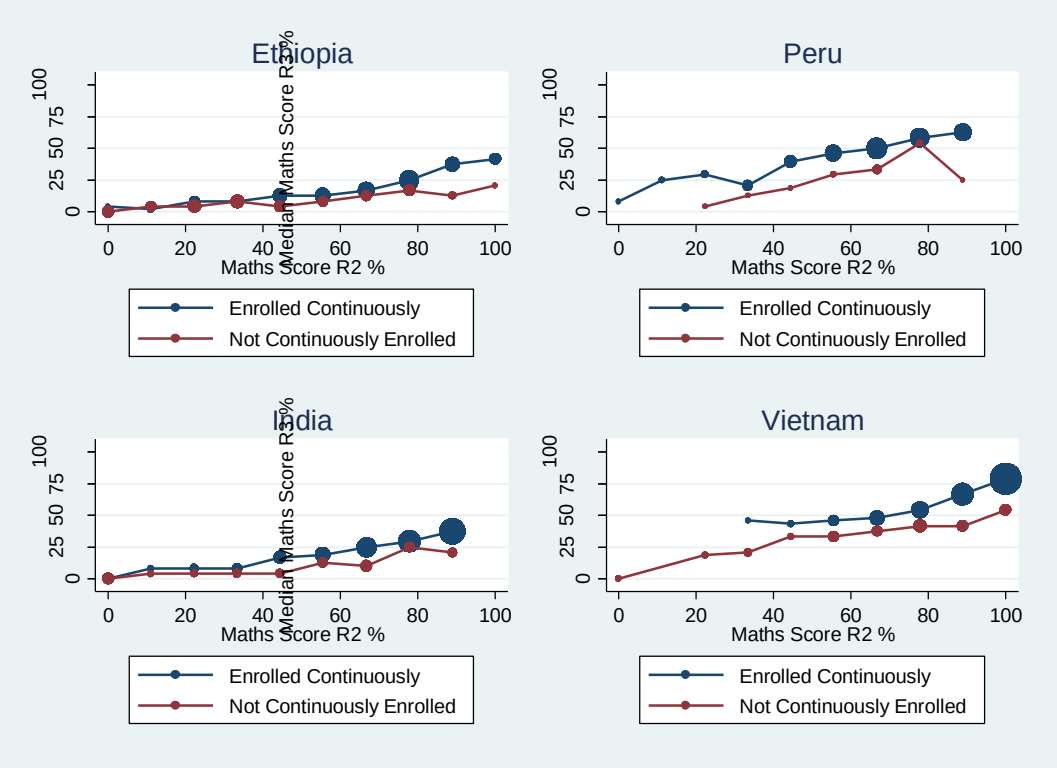
[4] Points are shown for groups containing 50 or more pupils. The size of the points reflects the number of pupils in each group.

Figure 4: Learning Progress in Maths (Ages 12-15)[5]



Source: Young Lives

Figure 5: Learning Progress in Maths (Ages 12-15) by Enrolment Status[6]



Source: Young Lives

In order to examine the predictors of learning levels and progress, especially school enrolment, in more detail, regression modelling is employed to predict the outcomes of the basic literacy and numeracy and the mathematics tests for the older cohort of children (for whom three rounds of test data are available at ages 8, 12 and 15). Key background indicators which show strong

[5] Points are shown for groups containing 50 or more pupils. The size of the points reflects the number of pupils in each group.

[6] Median R3 score by R2 score and wealth quartile. Points are shown for groups containing 5 or more pupils.

relationships with learning achievement in the wider literature (see Glewwe and Kremer 2005: 29) are included, comprising gender, height-for-age (an indicator of nutritional status), household wealth, caregiver literacy (associated with educational preferences) and country-specific grouping factors associated with educational advantage – caste (in India), language (in Peru) and ethnicity (in Vietnam). Prior test scores (from the previous survey round) are included where available (at ages 12 and 15) to allow interpretation which is conditional upon prior learning and on the assumption that prior test scores partly reflect earlier 'inputs' – a simple 'value-added' approach. To the extent that these scores do absorb the effects of inputs in previous periods, it is possible to interpret the results in terms of the additional impacts of the indicators included in the period since the previous round of the survey. The predictors of literacy outcomes are modelled only where there is sufficient variation in school enrolment and in basic literacy – in Ethiopia at ages 8 and 12 and in India at age 12. For basic numeracy, models are shown for all countries at age 8, while sufficient variation in school enrolment to include this variable is only found in Ethiopia. The 'sentinel site' design of Young Lives means that data are strongly clustered. In order to estimate the strength of relationships between individual and household characteristics that are not due to site-level clustering, 'site fixed-effects' models are employed. The results of regression modelling are shown in Tables A1 (basic reading and writing) and A2 (basic numeracy and mathematics) in the Appendix.

At age 8, higher literacy levels (see Table A1) are attained in Ethiopia by boys, better nourished children (measured by height-for age), those with literate caregivers (for reading skills only) and by those who had already enrolled in school at age 8. At age 12, when controlling for literacy at age 8, boys continued to achieve significantly higher reading levels in Ethiopia, while there is no gender difference in India. The number of years of schooling received by age 12 is a strong predictor of literacy skills in India and especially in Ethiopia (where indicators of household background advantage do not show significant effects at this age). In India, caregiver literacy and household wealth are important predictors of writing skills. With regard to basic numeracy (at age 8 – see Table A2), boys are more likely to be numerate in Ethiopia and India and an advantage is found for better nourished children in all countries except India, for those from richer households, except in Ethiopia; and for those with literate caregivers in India and Vietnam. School attendance at age 8 (included for Ethiopia only) shows a strong effect on the numeracy outcome.

At ages 12 and 15 it is possible to model the predictors of mathematics test scores when including numeracy or maths test scores from the previous survey round plus a continuous measure of the number of years a child has attended school. At age 12 there is an advantage for boys in Ethiopia only. There are significant effects of home advantage (caregiver literacy and/or household wealth), of nutrition (in Vietnam) and for the majority group of those who speak Spanish as a first language in Peru. Comparing the effects of the number of years of schooling attained, an additional year at school is associated with an increase in numeracy test score at age 12 of around 9 percentage points in India, and 7 percentage points in Ethiopia, 5 in Vietnam and 2 in Peru. At age 15, the pattern is somewhat different. Boys show an advantage in Ethiopia and India and girls in Vietnam while better nourished children continue to show an advantage in Vietnam. Children from wealthier households achieve higher scores in all countries and those with literate caregivers in India. An additional year of schooling in is associated with an increase in numeracy score of around 1 percentage point in Ethiopia, 2 in India and Peru and 4 percentage points in Vietnam, indicating that conditional on attainment at age 12 and on home backgrounds, learning progress linked specifically to differences in exposure to schooling during later childhood are highest in Vietnam, where learning gains per year of schooling are similar to those found at ages 8-12, while in Ethiopia and India, learning

gains linked to schooling are notably lower in later childhood when compared to the 8-12 age range.

6. Discussion and Conclusion

Achievement on all comparable Young Lives tests is almost always highest in Vietnam, typically followed by Peru, India and Ethiopia in that order, although test scores at the younger ages of 5 and 8 in India are often similar to those in Peru. This ordering of countries also applies when considering learning progress in mathematics, taking account of prior scores. Enrolment is improving, and relatively equitably in Ethiopia, likely linked to policies to improve access in under-served areas (MOE 2008). Levels of learning, however, are typically low and learning progress is relatively weak, although in the earlier years, the benefits of school enrolment for cognitive skills development are strong. Later enrolment and consequent shorter exposure to schooling is clearly part of the explanation for lower learning levels in Ethiopia, but at later ages particularly, learning gains for pupils who are in school are relatively low, drawing attention to issues of quality.

Enrolment is high and relatively equitable in India and learning levels in the early years of schooling often compare favourably with the other study countries, including with much higher income Peru. Learning levels, however, at the later stages of schooling are relatively low. While formal curricular expectations in maths in the grades attended by the study children do not differ markedly from those in Vietnam, pupils in India often make weak progress in higher school grades, consistent with findings from the ASER surveys (ASER 2013) which indicate that improvements in both reading and arithmetic levels decline somewhat as children progress through the schooling system. The similarity in patterns of learning progress for enrolled pupils in India and Ethiopia may be taken to suggest that were universal and timely enrolment to be achieved in Ethiopia, learning levels might be expected to be comparable with those in India. While this may be considered an appropriate target given the relatively early stage of development towards universal access in Ethiopia, it also underlines the 'crisis of quality' in the much more established system in India, where access has been near universal for at least a decade. This further draws attention to the need, in the Ethiopian context, to maintain and improve quality, balanced with the continuing need for expansion in access.

While enrolment, learning levels and learning progress are high in Peru by comparison with India and Ethiopia, Peru is both the richest and, in education terms, the highest spending country in the Young Lives sample. Learning levels nonetheless compare with India in the early years; and are lower than in Vietnam at later stages; drawing attention to issues of school quality, consistent with concerns that learning in Peru is low by regional standards. In Vietnam, pupils perform relatively well on all tests, making strong progress over time and 'keeping pace' with curricular demands in mathematics, while there are nonetheless important differences in learning and learning progress between more and less advantaged pupils, especially in terms of household wealth. Somewhat similar differences linked to wealth are also found in the other countries at age 15, indicating that the effects of household background disadvantage are not captured in earlier test-scores and continue to exert an influence across the life-course of the child, being perhaps even higher at later stages, when education is arguably of the greatest economic value. Significant differences in learning progress between more and less advantaged social, linguistic or ethnic groups (based on simple indicators only) are not found, however, except in Peru.

Early disadvantage in terms of home background is an important predictor of cognitive skills (at age 8), particularly wealth and most especially in Peru. Moreover, differences established on the basis of earlier test-scores are found to persist to the extent that prior test scores are

typically strong predictors of later learning levels. In Ethiopia and India, there is evidence for lower learning progress among girls, a particular issue of policy concern regarding equity. Improving equity in learning progress requires particular attention to learning among the most disadvantaged groups, as has been the primary purpose of the SEQAP and PEDC programmes in Vietnam. Improvements in equity of access and of access to quality schools may be expected to improve average learning levels in all countries, including by mitigating the negative effects of home disadvantage, but the evidence suggests that in Ethiopia and India, beyond the level of basic skills acquisition, more general issues of educational quality, affect a majority of pupils in school, so that a comprehensive approach to improvements in learning and school quality are an important priority. In Peru and Vietnam, where learning levels are high for advantaged pupils and for those who make good progress in the early years, improvements in equity linked to a 'narrowing of gaps' based on home advantage may be considered an efficient way to raise learning standards overall. In particular, the gap between Spanish speakers and speakers of other languages in Peru and the relatively high prevalence of leaving school by age 15 among disadvantaged children in Vietnam stand out as areas of policy concern.

References

Alderman, H., J.R. Behrman, S. Khan, D.R. Ross and R. Sabot (1997) 'The Income Gap in Cognitive Skills in Rural Pakistan', *Economic Development and Cultural Change* 46.1: 97–122

ASER (2013) *Annual Status of Education Report (Rural) 2012,* New Delhi: Pratham

Bennell, P. (1996) 'Rates of Return to Education: Does the Conventional Pattern Prevail in Sub-Saharan Africa', *World Development* 24.1: 183–99

Bird, K. (2007) *The Intergenerational Transmission of Poverty: An Overview,* Chronic Poverty Research Centre Working Paper 99, London: Overseas Development Institute

Carneiro, P., F. Cunha and J. Heckman (2003) 'The Technology of Skill Formation', *American Economic Review* 97.2: 31–47

Colclough, C., G. Kingdon and A. Patrinos (2009) *The Pattern of Returns to Education and its Implications*, RECOUP Policy Brief 4, Cambridge: Research Consortium on Educational Outcomes and Poverty

Cueto, S., Guerrero, G., Leon, J., Seguin, E & Munoz, I. (2007) 'Explaining and overcoming marginalisation in education: a focus on ethnic/ language minorities in Peru,' *Background paper prepared for the Education for All Global Monitoring Report 2010*

Dom, C (2010), *Mid-term evaluation of the EFA Fast-Track Initiative – Country Desk: Ethiopia* Cambridge: Cambridge Education.

Filmer, D. and L. Pritchett (1999) 'The Effect of Household Wealth on Educational Attainment: Evidence from 35 Countries', *Population and Development Review* 25.1: 85–120

Glewwe, P. (1991) *Schooling, Skills and the Return to Government Investment in Education*, Living Standards Measurement Survey Working Paper 76*,* Washington DC: World Bank

Glewwe, P. and Kremer (2005) *Schools, Teachers and Education Outcomes in Developing Countries*, CID Working Paper 122, Cambridge, MA: Center for International Development at Harvard University

Glewwe, P., E. Maiga and H. Zheng (2007) 'The Contribution of Education to Economic Growth in Sub-Saharan Africa: A Review of the Evidence', unpublished report, Minneapolis, MN: Department of Applied Economics, University of Minnesota

Glewwe, P., Hanushek, E.A., Humpage, S.D. & Ravina, R. (2011) 'School Resources and Educational Outcomes in Developing Countries: A Review of the Literature from 1990 to 2010,' *NBER Working Paper No. 17554,* Cambridge MA: NBER

Hannum, E. and C. Buchmann (2005) 'Global Educational Expansion and Socio-Economic Development: An Assessment of Findings from the Social Sciences', *World Development* 33.3: 333–54

Hanushek, E. and L. Woessman (2008) 'The Role of Cognitive Skills in Economic Development', *Journal of Economic Literature* 46.3: 607–68

Hill, S. and T. Chalaux (2011) *Improving Access and Quality in the Indian Education System, Organisation for Economic Co-operation and Development*, Working Paper 885, Paris: OECD Publishing

King, K. and R. Palmer (2006) *Skills Development and Poverty Reduction: The State of the Art*, Post-Basic Education and Training Working Paper 9, Edinburgh: Centre of African Studies, University of Edinburgh

Knight, J., L. Shi and D. Quheng (2008) *Education and the Poverty Trap in Rural China*, Working Paper 281, Oxford: Centre for the Study of African Economies

Little, A.W. (2010) 'Access to Elementary Education in India: Politics, Policies and Progress,' *CREATE Pathways to Access Research Monograph No. 44,* CREATE, http://www.create-rpc.org

Lloyd, C.B. and A.K. Blanc (1996) 'Children's Schooling in Sub-Saharan Africa: The Role of Fathers, Mothers, and Others', *Population and Development Review* 22.2: 265–98

Ministry of Education (MOE) (2008) *General Education Quality Improvement Package (GEQIP),* Addis Ababa: Ministry of Education.

Pritchett, L. (2001) 'Where Has All the Education Gone?', *The World Bank Economic Review* 15.3: 367–91

Psacharopoulos, G and H.A. Patrinos (2002) *Returns to Investment in Education: A Further Update*, Policy Research Working Paper 2881, Washington DC: World Bank

Stiglitz, J.E. (1996) 'Some Lessons From the East Asian Miracle', *World Bank Research Observer* 11.2: 151–77

Todd, P.E. and K.I. Wolpin (2003) On the Specification and Estimation of the Production Function for Cognitive Achievement. *The Economic Journal* 113(485): F3-F33

UIS and UNICEF (2005) *Children Out of School: Measuring Exclusion from Primary Education*, Montreal: UNESCO Institute for Statistics

World Bank (2004) *Vietnam Reading and Mathematics Assessment Study Volume 1*, Washington D.C.: The World Bank

World Bank (2007) Toward High-Quality Education in Peru: Standards, Accountability, and Capacity Building. World Bank: Washington D.C.

World Bank (2011) *Viet Nam High Quality Education For All By 2020*, Washington D.C.: The World Bank.

World Bank (2013) *World Development Indicators*, available at: http://data.worldbank.org/indicator (accessed 11th April 2013)

Appendix: Table A1: Basic Literacy Outcomes: Ethiopia and India

	Ethiopia					India
	Age 8 (2002)		Age 12 (2006)			Age 12 (2006)
	Can read Words or sentences	Can write at all	Can read sentences	Can write without difficulty	Can read sentences	Can write without difficulty
Gender (male)	-0.009	0.097	-0.036	0.080	0.010	0.016
	(-0.34)	(2.50)**	(-0.99)	(2.06)**	(0.44)	(0.50)
Age (months, 2002)	0.004	0.003	-0.001	-0.002	-0.011	-0.014
	(0.95)	(0.47)	(-0.17)	(-0.30)	(-3.49)***	(-2.96)***
Majority group					-0.045	-0.052
					(-1.31)	(-1.14)
Height-for-age	0.037	0.075	0.009	0.011	0.006	0.008
	(2.99)***	(4.19)***	(0.55)	(0.61)	(0.56)	(0.53)
Years of schooling	0.282	0.461	0.113	0.114	0.085	0.100
	(6.18)***	(9.41)***	(7.79)***	(7.62)***	(5.92)***	(4.51)***
Can read words/sentences (2002)			0.072		0.113	
			(1.19)		(4.16)***	
Can write at all (2002)				0.088		0.161
				(1.77)*		(3.54)***
Wealth index	0.143	0.283	0.033	-0.041	0.091	0.324
	(1.09)	(1.33)	(0.16)	(-0.18)	(1.04)	(2.77)***
Caregiver literacy	0.076	0.078	-0.009	0.007	0.081	0.098
	(2.37)**	(1.61)	(-0.19)	(0.14)	(2.79)***	(2.44)**
Observations	816	911	893	877	925	895
R-squared	0.446	0.386	0.235	0.273	0.158	0.184

Probit models with site dummies (2002) Site fixed-effects models (2006 and 2009) t/z-statistics in parentheses*** p<0.01, ** p<0.05, * p<0.1

Notes for Tables A1 and A2: 'Majority group' refers to 'other castes' (as opposed to schedules castes and scheduled tribes) in India, Spanish speakers in Peru, and ethnic Kinh in Vietnam. For 'Height-for-age' and 'Wealth index', the value for the previous survey round is used, except for 2002, when the 2002 value is used. 'Years of schooling' for 2002 models is a binary variable for ever-attendance (for Ethiopia only as almost all children had attended by this age in the other countries); for 2006 and 2009 models schooling is the number of years of schooling received. 'Numeracy' refers to the previous survey round outcome; in 2006 a binary variable for a correct answer to a simple calculation in 2002 was used, and in 2009 the score on the ten-item numeracy test in 2006 is used.

Table A2: Basic Numeracy and Mathematics Test Outcomes

	Ethiopia			India			Peru			Vietnam		
	Age 8	**Age 12**	**Age 15**	**Age 8**	**Age 12**	**Age 15**	**Age 8**	**Age 12**	**Age 15**	**Age 8**	**Age 12**	**Age 15**
	2002	**2006**	**2009**	**2002**	**2006**	**2009**	**2002**	**2006**	**2009**	**2002**	**2006**	**2009**
	Simple Calcul-ation Correct	10 questions % Correct	30 questions % Correct	Simple Calcul-ation Correct	10 questions % Correct	30 questions % Correct	Simple Calcul-ation Correct	10 questions % Correct	30 questions % Correct	Simple Calcul-ation Correct	10 questions % Correct	30 questions % Correct
Gender (male)	0.128	4.568	4.629	0.041	2.230	8.182	0.043	2.173	-0.752	-0.012	-1.160	-3.537
	(3.08)***	(2.03)*	(5.96)***	(2.43)**	(1.33)	(4.73)***	(1.06)	(1.64)	(-0.53)	(-0.49)	(-1.17)	(-2.70)**
Age (months in 2002)	0.014	0.185	0.096	0.005	-0.960	-0.041	0.016	-0.344	0.077	0.014	0.068	-0.426
	(2.16)**	(0.91)	(0.73)	(2.18)**	(-4.63)***	(-0.25)	(3.32)***	(-2.00)*	(0.57)	(3.97)***	(0.26)	(-2.42)**
Majority group	-	-	-	0.000	1.116	3.027	0.110	9.423	0.289	0.070	5.706	3.391
				(0.01)	(0.49)	(1.56)	(0.75)	(2.38)**	(0.11)	(0.92)	(1.16)	(1.49)
Height-for-age	0.062	-0.062	0.473	0.012	0.999	0.759	0.083	-0.056	0.484	0.034	1.889	2.024
	(3.38)***	(-0.07)	(0.96)	(1.58)	(0.97)	(2.79)**	(3.80)***	(-0.08)	(0.94)	(2.36)**	(3.15)***	(3.18)***
Years of schooling	0.319	6.610	1.086	-	8.975	1.904	-	1.898	1.611	-	4.791	3.885
	(5.27)***	(7.78)***	(2.91)***		(6.33)***	(3.29)***	-	(2.53)**	(3.09)***	-	(2.12)**	(5.89)***
Numeracy	-	4.006	0.241	-	11.474	0.414	-	7.396	0.455	-	4.611	0.486
		(2.19)**	(7.69)***		(4.21)***	(11.05)***	-	(3.13)***	(10.55)***	-	(2.16)**	(7.73)***
Wealth index	0.326	3.652	10.939	0.148	10.486	17.222	0.608	11.819	9.742	0.288	9.503	15.745
	(1.53)	(0.57)	(2.40)**	(2.27)**	(1.72)	(4.63)***	(3.97)***	(2.51)**	(2.11)**	(3.01)***	(1.97)*	(3.86)***
Caregiver literacy	0.079	5.844	1.012	0.058	3.912	6.280	-0.044	-0.458	3.119	0.128	9.099	0.664
	(1.59)	(2.52)**	(0.93)	(2.62)***	(2.68)**	(5.47)***	(-0.65)	(-0.23)	(1.71)	(2.15)**	(2.77)**	(0.28)
Constant	-	5.508	-15.440	-	83.201	-22.616	-	65.730	-15.258	-	32.714	21.073
		(0.27)	(-1.30)		(5.68)***	(-1.64)	-	(4.60)***	(-1.60)	-	(1.96)*	(1.37)
Observations	696	676	892	874	900	867	497	496	650	724	720	889
R-squared	0.222	0.218	0.278	0.182	0.192	0.411	0.156	0.109	0.293	0.138	0.110	0.326

Probit models with site dummies z-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1