

A DALY for Education? The Economic Returns to Interventions that Increase Learning

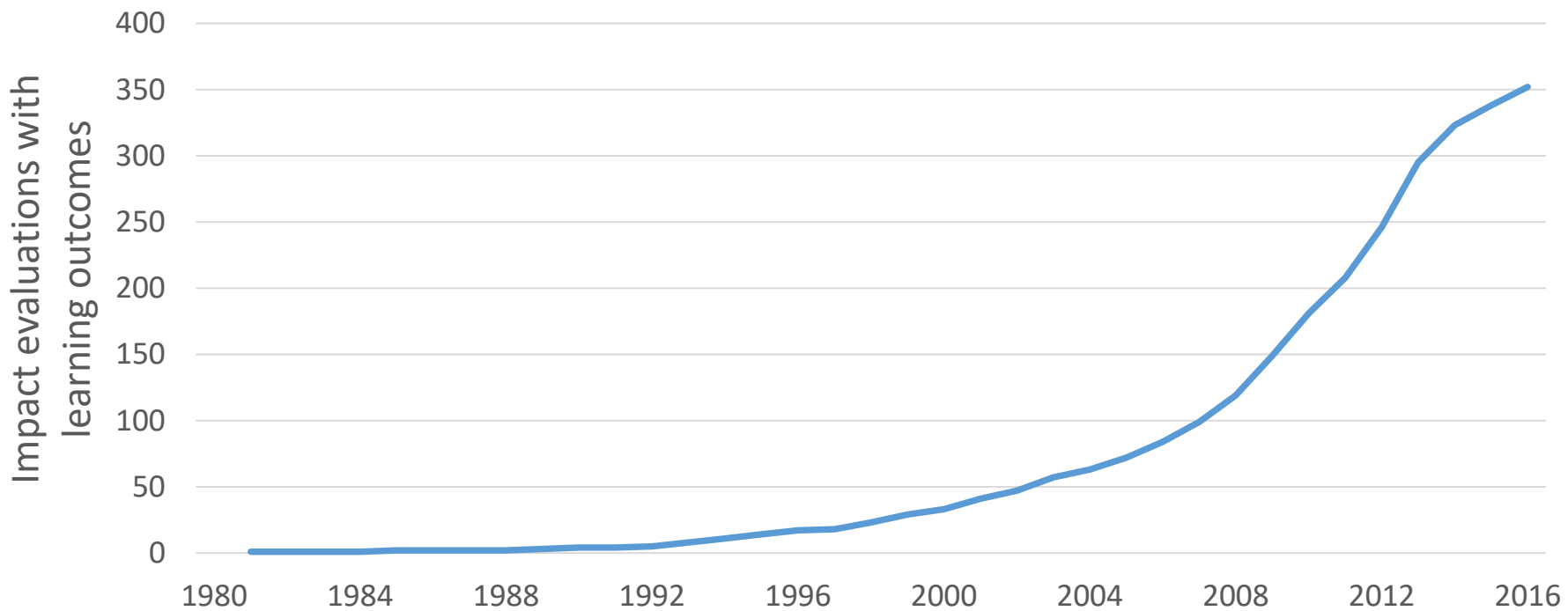
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There has been a large increase in recent years in what we know about improving learning in low- and middle-income countries.



Source: Updated from Evans and Popova 2016

How much of a difference do these interventions make?

Mindspark

0.36 SD in math
0.22 SD in Hindi

(Muralidharan et al.
2017)

Northern Uganda Literacy Program

0.22 SD in test scores

(Buhl-Wiggers et al. 2017)

Information in India
0.31 SD in test scores

(Afridi et al. 2017)

But what do those fractions of a standard deviation mean?

- Obscure for communication to policy makers
- Obscure for communication within research – why do we care about a 2nd grader being 0.15 standard deviations better at identifying letters?

How does health do it?

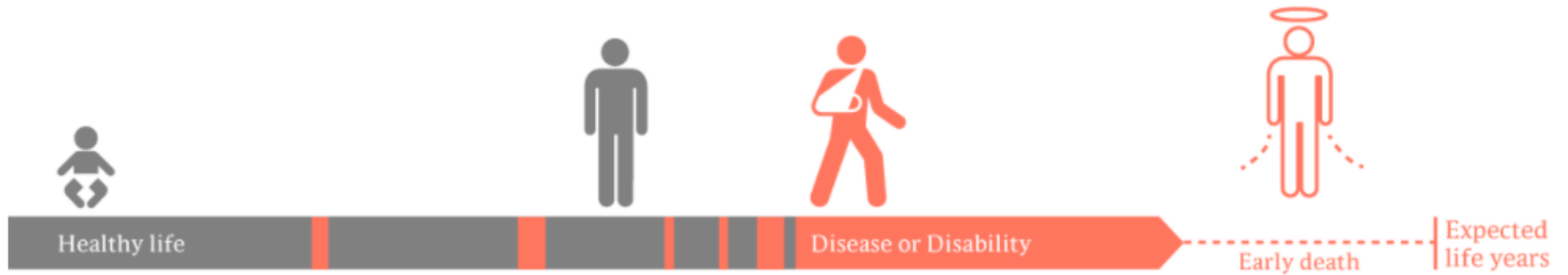
Since the 1940s, health researchers have used the concept of time lost due to death and time living with disability: QALY, then – in 1990 – the DALY

DALY

Disability Adjusted Life Year is a measure of overall disease burden, expressed as the cumulative number of years lost due to ill-health, disability or early death

$$= \text{YLD} + \text{YLL}$$

Years Lived with Disability Years of Life Lost



These measures get used

The Global Burden of Disease: 1990-2020

Table 4 Ten leading causes of disease burden (DALYs), developing world, 1990

	Total (millions)	Per cent of total
All Causes	1 218.2	
1 Lower respiratory infections	110.5	9.1
2 Diarrhoeal diseases	99.2	8.1
3 Conditions arising during the perinatal period	89.2	7.3
4 Unipolar major depression	41.0	3.4
5 Tuberculosis	37.9	3.1
6 Measles	36.5	3.0
7 Malaria	31.7	2.6
8 Ischaemic heart disease	30.7	2.5
9 Congenital anomalies	29.4	2.4
10 Cerebrovascular disease	29.1	2.4

Interventions ordered by DALYs saved

Citations = 12,449

And they get used in public discourse (not just citations)



Delhi residents lose 6.3 life years from exposure to PM 2.5: Study



Air pollution in India can cause about half a million premature mortalities every year, and exposure to fine particulate matter in India reduces life expectancy by about 3.4 years. Delhi, meanwhile, tops the list in the number of life years lost — as many as 6.3 years — due to exposure to particulate matter 2.5.

Source: Mascarenhas 2016



'Violence against children in South Africa - a national disaster'

Furthermore, violence against children has a severe impact on SA's economy. A report by Save the Children: Violence Unwrapped — The Social and Economic Burden of Violence Against Children in South Africa, says that the estimated economic value of disability-adjusted life years lost due to violence against children (including fatal and non-fatal) in 2015 totalled R202 billion. This accounted for 3,3% of SA's GDP in 2015.

Source: News24 2017

Current practice in education?

Use PISA results as a rule of thumb

Country	1 SD	1 yr gain	1 SD = X yrs
Australia	96	35	2.7
Chile	81	33	2.5
France	97	49	2.0
Germany	96	41	2.3
Indonesia	71	17	4.2
Mexico	74	26	2.8
UK	95	23	4.1
Uruguay	89	39	2.3
USA	90	41	2.2
OECD	92	41	2.2

Efforts by individual paper authors

- A “0.21 standard deviation difference in scores would be roughly equal to 7.39 months of learning – in a 9 month school year!” (Kane & Staiger 2010)
- “Effects of math were close to a full grade-level over just 4.5 months” (Muralidharan et al. 2017)

What this paper does

- Propose a systematic way to characterize the gains from learning interventions with two alternative metrics:
 - Equivalent years of schooling (EYOS)
 - Net present value of increased lifetime earnings
- Characterize the gains from evaluated learning interventions to this point

Data

- **Return to skills and return to education**

- The World Bank STEP Skills Measurement Program

- measures reading proficiency of the adult urban population

- Bolivia, Colombia, Ghana, Kenya, Vietnam

- Exclude: Armenia, Georgia, and Ukraine, due to no variation in early years of schooling

- provides information on education, employment history and earnings

- Use data on all in work force: Net effect of learning on earnings, including through finding employment

- **Impact**

- Impact evaluations of structured pedagogical interventions (i.e., how to teach) from Snilstveit and others (2015), a comprehensive systematic review from 3ie

- **Earnings**

- GNI (WDI 2015) * Labor share of income (Neiman & Karabarbounis 2013)

- **Cost-effectiveness data for small set of interventions (J-PAL 2016)**

Assumptions

(an abridged edition)

Learning gains persist over time

- Little evidence on this: 90% of education IEs gather data within a month of treatment completion (McEwan 2015)
- Tiny fraction gathered data more than a year after that
- Some gains may decay
 - Remedial education in India (36%, 1 year later – Banerjee et al. 2007);
 - Short-term reading program in Philippines (46%, 3 months later);
- But some gains may compound rather than decay (e.g., early childhood)

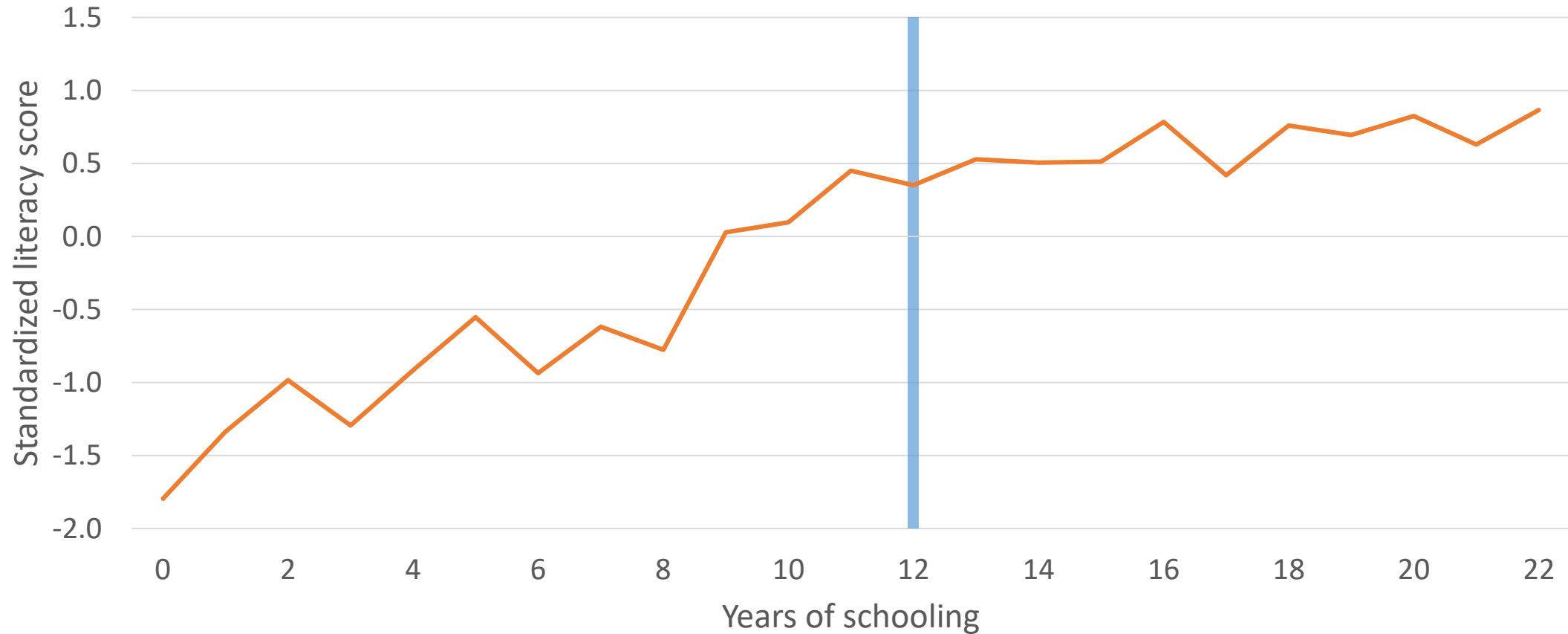
Standard deviations are comparable

- Problem 1: Easier to move SDs of some things (letter recognition) than of others (reading comprehension)
- Problem 2: Are the literacy measures in childhood comparable to the literacy measures in adulthood?
- Solution: Restrict to evaluations that measure (a) word meaning, (b) sentence processing, and (c) basic passage comprehension

Empirical Strategy: Simple Profile

- Describe the learning profile comparing literacy skill and completed years of schooling (Grade 1-12)
- Which profile?
 - Ideal for policy dialogue: Own-country
 - But not available in many countries
 - For global discussion: Development EYOS (5 STEP countries)

Simple profile – STEP surveys



Data source: STEP surveys (2014)

Empirical Strategy: Adjusted Profile

- Estimate the vertical learning profile using a statistical model of an individual's skills as a function of completed years of schooling (Grade 1-12)

$$L_i = \beta_0 + \beta_1 S_i + \beta_2 Age_i + \beta_3 S_i Age_i + \beta_4 G_i + \varepsilon_i$$

L_i = standardized reading proficiency score of individual i ,

S = the number of years of schooling

G = an indicator of gender

- The learning gain for an individual from an additional year of schooling in terms of standard deviation

$$\Delta L = \beta_1 + \beta_2 + \beta_3 (S_i + Age_i + 1)$$

$$EYOS = 1 / \Delta L$$

$$S = 6 \text{ and } Age = 12$$

Comparing the methods

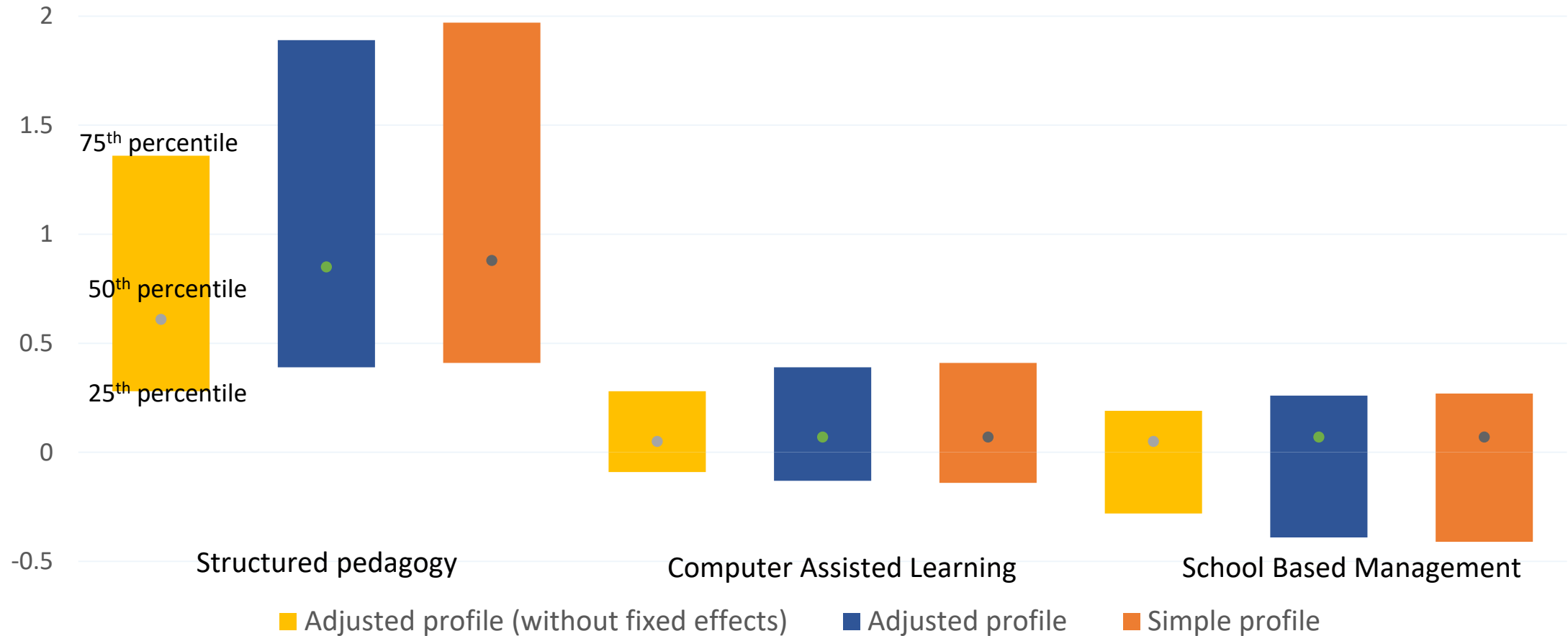
	Advantage	Disadvantage
Method 1: Simple profile	<ul style="list-style-type: none">• Simple, easy to understand	<ul style="list-style-type: none">• Selection (but better than PISA)
Method 2: Adjusted profile	<ul style="list-style-type: none">• Adjusted for observable characteristics	<ul style="list-style-type: none">• Still some selection

Results: EYOS

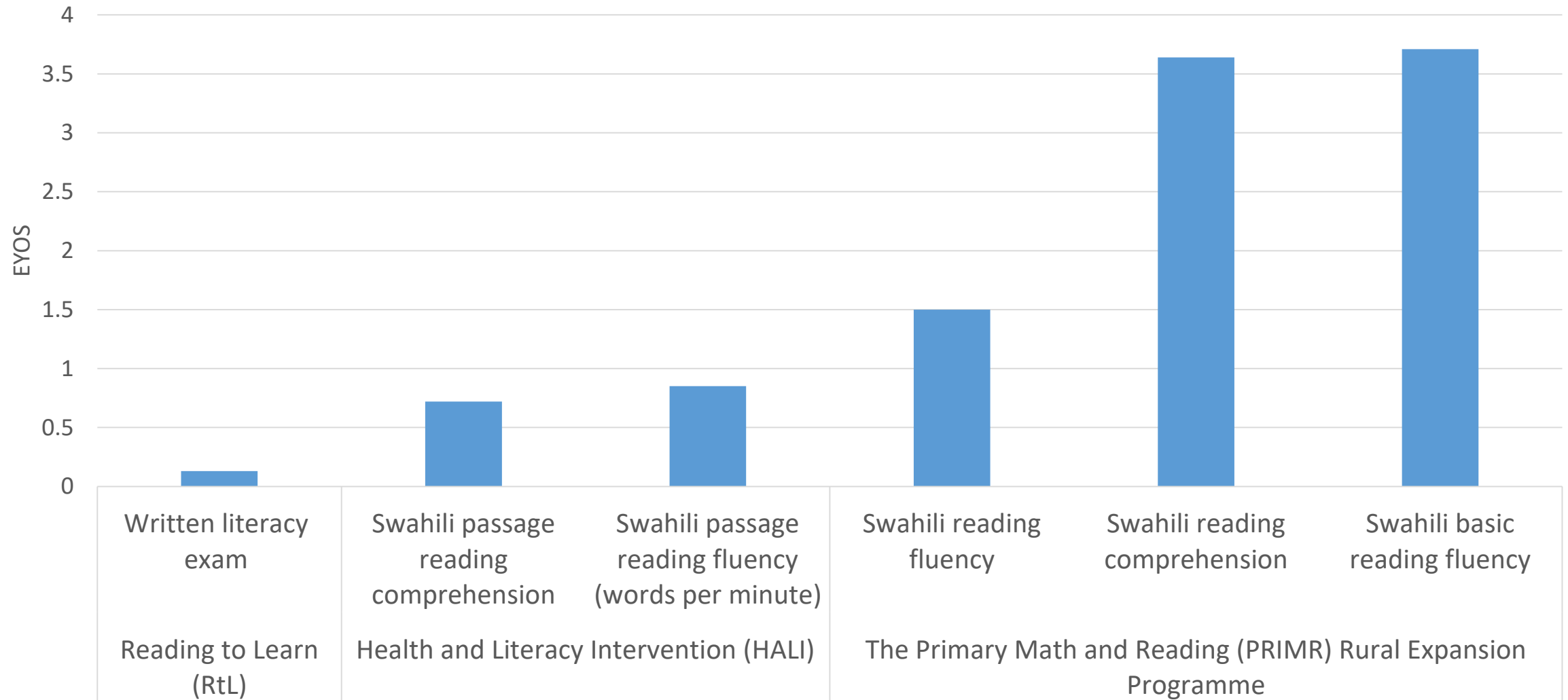
	Pooled	Bolivia	Colombia	Ghana	Kenya	Vietnam
Method 1: Descriptive learning trajectory	6.8	13.0	4.8	10.1	7.3	5.8
Method 2a: OLS model of skills and years of schooling with country fixed effects	6.5	6.8	9.3	4.4	10.3	7.3
Method 2b: OLS model of skills and years of schooling without country fixed effects	4.7					

Data source: STEP surveys (2014)

Summary Results: EYOS from interventions



Don't want to compare across countries? No problem! Kenya evidence only



Empirical Strategy: NPV

- Return to learning

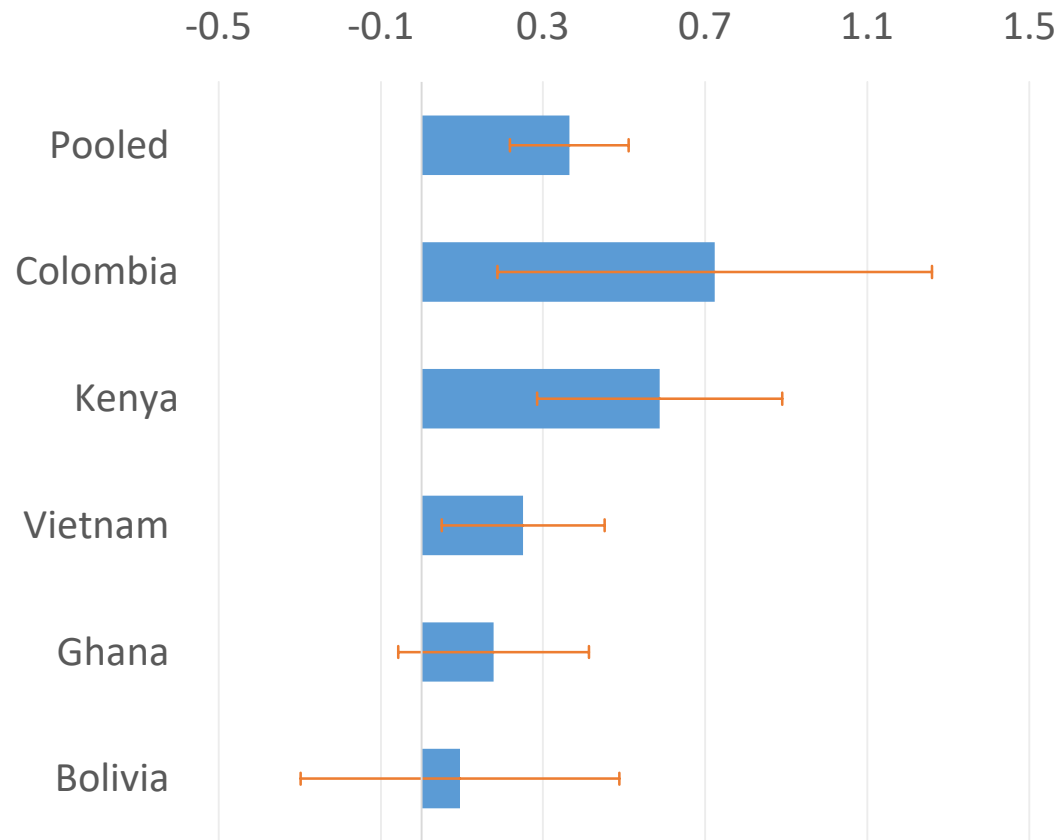
$$\ln y_i = \gamma_0 + \gamma_1 C_i + \gamma_2 Age_i + \gamma_3 Age_i^2 + \gamma_4 G_i + \varepsilon_i$$

- Net present value of lifetime additional wage gains

$$NPV = \sum_{k=20-a_i}^n \frac{\Delta L \cdot \gamma_1 \cdot w_j}{(1+i)^k}$$

- ΔL = increased learning
 - w_j = average annual income of a worker in country j
 - n = number of years in the workforce
 - i = discount rate
 - a_i = age when received the intervention
- Program participants are assumed to enter the labor market at age 20, the expected work life is assumed to be 40 years and discount rate is taken at 3% (Hanushek & Woessman 2010; Hagist and others 2005; Borsch-Supan 2000)

Results: Return to cognitive ability



	Pooled	Bolivia	Colombia
Literacy	0.365*** (0.089)	0.095 (0.239)	0.724** (0.326)
Age	0.300*** (0.068)	0.323* (0.179)	0.246 (0.170)
Age ²	-0.004*** (0.001)	-0.004* (0.002)	-0.003 (0.002)
Female	-1.247*** (0.144)	-1.912*** (0.341)	-1.633*** (0.407)
Constant	-2.073 (1.397)	-1.906 (3.524)	-1.439 (3.433)
Observations	8,144	1,227	1,450
R-squared	0.059	0.048	0.037

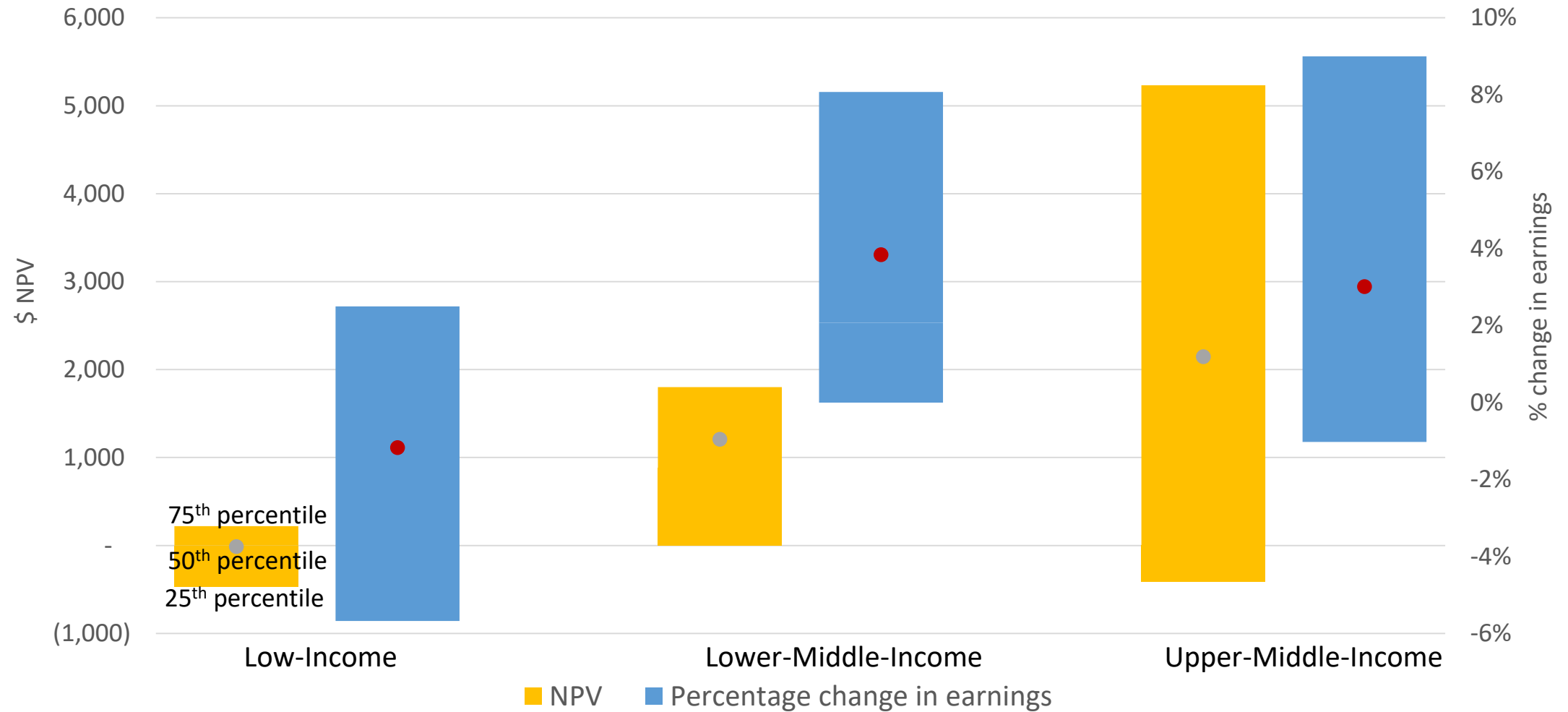
* Error bars show the 90% confidence interval of coefficients
Data source: STEP surveys (2014)

*** p<0.01, ** p<0.05, * p<0.1
Data source: STEP surveys (2014)

What about countries without return to learning estimates?

Region	Country (GDP per capita, 2015 PPP)	Nearest countries (GDP per capita)	Country estimate, % change in earnings (1 SD of learning)
Sub-Saharan Africa	Ghana (\$4,210)	South Africa	18
	Kenya (\$3,089)	The Gambia, Liberia, Madagascar, Malawi, Niger, Senegal, Uganda	59
Latin America and Caribbean	Bolivia (\$6,954)		10
	Colombia (\$13,829)	Brazil, Chile, Ecuador, Mexico, Peru	72
East Asia and Pacific	Vietnam (\$6,035)	China, Indonesia, Philippines	25
Pooled		India, Nepal, Sri Lanka and others	37

Summary Results: NPV from interventions



Benefits of Pedagogical Interventions

Program description	Effect Size	EYOS	↑ income	NPV\$
Chile: Collaborative Language and Literacy Instruction Project	-0.10	-0.65	-7%	-9,385
Kenya: Reading to Learn (RtL) *	0.02	0.13	1%	206
India: PicTalk ,year 2, activities only *	0.06	0.39	3%	959
India: PicTalk, year 1 machine + activities *	0.08	0.52	4%	1,279
Philippines: materials + teacher training *	0.09	0.59	2%	1,023
Kenya: Health and Literacy Intervention *	0.11	0.72	6%	1,132

Program description	Effect Size	EYOS	↑ income	NPV\$
Kenya: Primary Math and Reading (PRIMR) Rural Expansion Programme *	0.14	0.91	8%	1,440
Brazil: Decentralised schooling system	0.19	1.24	14%	15,966
Uganda:Northern Uganda Literacy Project *	0.30	1.95	18%	1,278
Cambodia: School Readiness Programme	0.50	3.25	13%	1,824
Kenya: Primary Math and Reading (PRIMR) Rural Expansion Programme *	0.56	3.64	33%	5,762
Liberia: EGRA Plus *	0.81	5.27	48%	1,395

Rule of thumb for policy discussions

STEP	
<i>Country</i>	<i>1 SD = ? EYOS</i>
Bolivia	6.8
Colombia	9.3
Ghana	4.4
Kenya	10.3
Vietnam	7.3
Pooled STEP (developing)	6.5

Three take aways

- A number of interventions boost learning as much as multiple years of business-as-usual education: There are interventions that work.
- This is true regardless of method. But the magnitudes depend on the assumptions.
- Learning gains can be presented simply and intuitively.
- EYOS and NPV permit the impact of education interventions to be discussed much more broadly

Ultimate objective

“We increased student learning on a letter identification test by 0.17 SDs.”



Source: Big Cheese Photo LLC / Alamy

“This intervention delivers the equivalent of 8 months of business-as-usual schooling.”



Source: Mosbacker 2013

Thank you