Founders Pledge

Cause Area Report: Education

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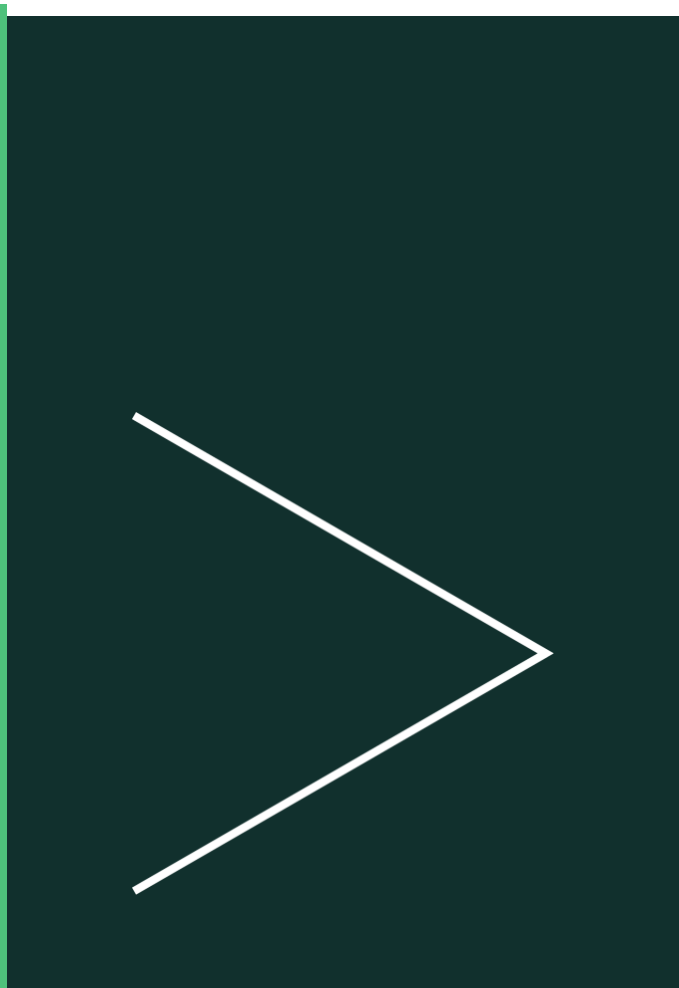

Executive Summary

In the US, only religion receives more philanthropic funding as a sector than education. This is due not just to the area's popularity with donors, but also because the cause area of education is incredibly broad. There are many forms of education, but all of them share the same fundamental goal: provide people with skills and knowledge, which will then provide a host of benefits both to students and to others. In this report we aim to find the best donation opportunities within education and compare them with the best opportunities in other areas.

1. Cause overview

The first section provides an overview of the main forms of education, levels of education around the world, the main skills education can bring about, and the main sources of funding.

Levels of funding and education around the world

Unsurprisingly, education levels and spending are both lowest in low-income countries. Whereas virtually everyone in high-income countries can read and write, literacy levels in low-income countries are around 60%. Around 10–100x more money is spent on each student in high-income countries than in low-income countries. Given this, we think it usually makes sense for donors to focus on low-income countries.

2. The benefits of education

The second section examines the main benefits of education. The most commonly proposed benefits of education are increased productivity, improved health, reduced crime, improved citizenship and female empowerment. Each of these is beneficial to both the recipient of education and to others in society. We judge income from increased productivity and reduced child marriage to be the most important of these,

although the benefits of education are hard to assess because they occur so long after schooling takes place, and because education is correlated with lots of other important traits, such as socioeconomic status, that might be the true cause of the benefit.

3. The best interventions

The third section looks at which interventions are most cost-effective. We include interventions that increase intelligence even if they are not conventionally educational, because the benefits of intelligence overlap so heavily with the benefits of education. Overall, the interventions that we think stand out are salt iodisation programmes, which increase IQ by reducing iodine deficiency, and 'Teaching at the Right Level' interventions, which aim to teach to the current level of the student rather than their age or class.

Other particularly promising interventions are:

- Building low-cost schools in areas where access to education is very low
- Merit-based scholarships
- Providing households with information on the returns to education
- Low-cost ways of encouraging additional stimulation for young children
- Iron supplementation
- Research to find and evaluate new approaches to improving education

Salt iodisation programmes

Iodine deficiency, which affects around 250 million children, reduces IQ by around four points. Salt iodisation programmes, which consist of salt manufacturers fortifying their salt with iodine, are a cheap and effective

solution to this problem. Our analysis of salt iodisation programmes is based heavily on the work of our research partner GiveWell in the area.

Teaching at the Right Level (TaRL)

Many pupils in low-income countries learn very little even when they are in school. One reason for this is because teaching is often mis-calibrated to the student's level of education: a student who has not yet mastered addition might sit through a class on multiplication and learn nothing. Teaching at the Right Level is a pedagogical approach that solves this problem by teaching to the current education level of the student, rather than the level laid out by the curriculum. This can take the form of tracking pupils by ability for small parts of their education, remedial classes for underperforming pupils or personalised software that targets content to the user's level.

4. Charity recommendations

The charities we recommend within education are:

- Global Alliance for Improved Nutrition (GAIN)'s Universal Salt Iodization (USI) programme
- Iodine Global Network

Global Alliance for Improved Nutrition (GAIN) - Universal Salt Iodization (USI) programme

What do they do? GAIN carries out a wide range of activities to try to achieve universal salt iodisation. These include advocacy, technical assistance, supplying equipment, training government officials and salt producers, and monitoring. GAIN is particularly focused on technical assistance.

Does the intervention work? Salt iodisation programmes effectively increase iodine levels. A systematic review found that nearly all programmes featured increased iodine levels. GiveWell has investigated the

evidence and believe there is a reasonably strong case that countrywide salt iodisation efforts have successfully reduced iodine deficiency.

Do they effectively deliver the intervention? GiveWell reviewed GAIN's work in Ethiopia and concluded that GAIN's activities likely played a role in the increase in access to iodised salt in the country, but they do not yet have confidence about the extent of GAIN's impact.

Are they cost-effective? We estimate that GAIN is more cost-effective than the best conventional education charities we know of, though these calculations are uncertain.

Is there room for funding? GAIN believe they could use an additional $2 million per year. This would most likely be used to focus on high-burden countries including Nigeria, Egypt and India.

Iodine Global Network (IGN)

What do they do? Iodine Global Network (IGN) aims to reduce iodine deficiency globally by advocating for national salt iodisation programmes, tracking progress, and providing global and country-specific guidance on related issues.

Does the intervention work? Salt iodisation programmes effectively increase iodine levels. A systematic review found that nearly all programmes included increased iodine levels. GiveWell has investigated the evidence and believes there is a reasonably strong case that countrywide salt iodisation efforts have successfully reduced iodine deficiency.

Do they effectively deliver the intervention? Organisations that partner with and fund IGN claim that the organisation's work is often important to achieving the implementation of iodisation policies. GiveWell has not been able to fully document demonstrable impact but believes they may have had significant impact.

Are they cost-effective? We estimate that IGN is more cost-effective than the best conventional education charities we know of, though these calculations are uncertain.

Is there room for funding? IGN have told us they could use an additional $1.2 million in 2020. This would likely be used mainly to engage with food industry groups, convene large salt producers and recruit additional national coordinators.

Acknowledgements

We are grateful to the people who provided advice and feedback on this report, including:

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- Michael Kremer, Gates Professor of Developing Societies at Harvard University
- James Snowden, GiveWell

Table of Contents

1 Overview of Education

This section gives an overview of education, covering the following questions:

- What are the different forms of education?
- How do levels of education vary around the world?
- Who are the main funders of education?
- What are the main skills that education can bring about?
- Should philanthropists focus on high-income countries or low-income countries?

The subsequent sections will cover the long-term benefits to education, the most promising interventions that philanthropists could fund and the charities we recommend in the area of education.

1.1 What are the different forms of education?

This section gives a brief overview of the main forms of education that exist today. Education can consist of any activity that facilitates the acquisition of skills or knowledge, so it encompasses a wide range of activities that take place in many areas of life. Educational activities can be placed in three broad categories:[1]

- **Formal education** - organised education that takes place in recognised educational institutions, such as state schools and universities.

[1] See definitions and descriptions in the following two sources: UNESCO Institute for Statistics, *International Standard Classification of Education: ISCED 2011* (Montreal, Quebec: UNESCO Institute for Statistics, 2012); Christopher Lange and Jamie Costley, "Opportunities and Lessons from Informal and Non-Formal Learning: Applications to Online Environments," *American Journal of Educational Research* 3, no. 10 (October 28, 2015): 1330–36, https://doi.org/10.12691/education-3-10-20.

- **Non-formal education** - organised education that takes place outside of but is complementary to the formal education system.
- **Informal education** - education that is not organised by institutions and occurs outside of educational institutions, such as learning in the family, workplace or daily life.

Formal education

Formal education is typically characterised by high levels of structure and hierarchy, clear long-term objectives such as qualifications, and substantial time commitment for pupils. Five main sub-categories of formal education are:[2]

- **Early childhood education** - education for children under the age of five, a key stage of brain development. The main aims of education during this period are school readiness and cognitive and socioemotional development. Many governments do not provide early childhood education so fewer children receive it; the global enrolment rate at pre-primary school is around 50%.[3]
- **Primary education** - primary education starts between the ages of 5–7 years and lasts 4–8 years.[4] There is now near universal primary enrolment in most countries.[5] Primary curricula vary by country

[2] Some forms of adult, special-needs and gifted education are also included in the formal education system
[3] https://data.worldbank.org/indicator/SE.PRE.ENRR
[4] "Primary School Starting Age (Years) | Data," accessed January 3, 2019, https://data.worldbank.org/indicator/SE.PRM.AGES?year_high_desc=true; "Primary Education, Duration (Years) | Data," accessed January 3, 2019, https://data.worldbank.org/indicator/SE.PRM.DURS?year_high_desc=true.
[5] http://datatopics.worldbank.org/sdgatlas/SDG-04-quality-education.html

but almost always include language, mathematics, social science, science, arts and physical education, with language and mathematics consuming most of a pupil's time.[6]

- **Secondary education** - secondary education starts around the ages of 10–14 and lasts around 6–8 years.[7]

- **Higher education** - around 40% of people of university-age are enrolled in higher education globally, but there are large variations across regions. In North America the rate is 84%, while in Sub-Saharan Africa it is 9%.[8] Even though higher education tends to be received by wealthier people, governments spend more per student at tertiary level than primary and secondary level (even when R&D spending is excluded).[9]

- **Vocational education** - education focused on specific job skills, including apprenticeships, work experience or classroom teaching. One advantage of vocational education relative to higher education

[6] "It turns out, thus, that through this century one may speak of a relatively clear 'world primary curriculum' operating, at least as an official standard, in almost all countries. A bit more than a third of the student's time is to be spent on language – and mainly on national language(s), not on local or foreign or classical ones. About one-sixth of the time goes on mathematics. A set of other subjects is practically always found (especially since the Second World War), with each subject taking 10 per cent of curricular time, or a bit less – social science, science, arts and physical education. Religious or moral education, and vocational education, are less universally present, and get only 5 per cent of the time. All other possible subjects – and many are found in one or another country at one or another time – take up in total less than twentieth of the curriculum in the typical case", John W. Meyer, David Kamens, and Aaron Benavot, *School Knowledge for the Masses: World Models and National Primary Curricular Categories in the Twentieth Century* (Routledge, 2017).
[7] "Lower Secondary School Starting Age (Years) | Data," accessed January 3, 2019, https://data.worldbank.org/indicator/SE.SEC.AGES?end=2016&start=1970&year_high_desc=true; "Secondary Education, Duration (Years) | Data," accessed January 3, 2019, https://data.worldbank.org/indicator/SE.SEC.DURS?view=chart&year_high_desc=true.
[8] "School Enrollment, Tertiary (% Gross) | Data," accessed January 3, 2019, https://data.worldbank.org/indicator/SE.TER.ENRR.
[9] "On average, OECD countries spend around two-thirds more per student at the tertiary level than at the primary level. However, R&D activities or ancillary services can account for a significant proportion of expenditure at the tertiary level. When these are excluded, expenditure per student on core educational services at the tertiary level is still, on average, 11% higher than at the primary, secondary and post-secondary non-tertiary levels.", '"Indicator B1 How Much Is Spent per Student", Education at a Glance 2014: OECD Indicators, accessed November 3, 2018, http://www.oecd.org/education/EAG2014-Indicator%20B1%20(eng).pdf.

is that the skills it teaches are more likely to be used, because they are directly relevant to a career. On the other hand, there may be a trade-off between better short-term job market success and reduced long-term success because the more general skills acquired at university or secondary school may help people adapt to new technologies or learn new skills.[10]

Non-formal and informal education

Prominent forms of education that are commonly considered either non-formal or informal include:

- Home-schooling[11]
- Self-learning (also known as autodidacticism)
- Alternative institutions - some educational institutions operate outside the formal education system and use non-traditional methods and curricula. Alternative schools are often based on specific pedagogical approaches.[12] More recently, the development of education technology has led to the establishment of alternative schools such as Khan Lab School and Minerva Schools that seek to integrate technology in their structure.

[10] "But, there may well be a trade-off with vocational education. If students have a limited set of skills, even if very appropriate for today's jobs, they might find that they are less adaptable to new technologies that are introduced. Such an issue is particularly important for developing countries that frequently experience very rapid growth and significant changes in production technologies. Some evidence in developing countries suggests that the tradeoff of easy labor market entry versus potential disadvantages later in the life cycle because of less adaptability can be significant", Eric A. Hanushek, "Economic Growth in Developing Countries: The Role of Human Capital," *Economics of Education Review* 37 (December 2013): 204–12, https://doi.org/10.1016/j.econedurev.2013.04.005.

[11] Around 3% of US students are home-schooled. "In 2016, about 1.7 million students (ages 5-17) were estimated to be home-schoolers, which translates to about 3.3 percent of all K-12 students. ", "NCES Blog | A Fresh Look at Homeschooling in the U.S.," accessed August 26, 2019, https://nces.ed.gov/blogs/nces/post/a-fresh-look-at-homeschooling-in-the-u-s.

[12] For example Montessori schools. "What Is Montessori Education?," accessed August 26, 2019, https://amshq.org/About Montessori/What Is Montessori.

- Professional certification
- Workplace training
- Online education courses
- Coding bootcamps

1.2 How do levels of education vary around the world?

International levels of education can be measured either in terms of access to education, such as years of schooling, or as learning outcomes, such as test scores or literacy.[13] Two decades ago the international focus was on improving access to education. The Millennium Development Goal for education, one of eight international development goals laid out by the UN in 2000, was that all children would complete a course of primary education.[14] Unfortunately, the increase in access to education that followed did not bring a commensurate improvement in learning outcomes. As a result, the focus has now shifted to learning outcomes. When the UN laid out their next set of development goals in 2015, the Sustainable Development Goals, they included a wider range of targets that focused on quality of education and the skills that should result from it, rather than just access.[15]

[13] For a comprehensive overview of international measures of education see "Measuring Education: What Data Is Available?," Our World in Data, accessed December 28, 2018, https://ourworldindata.org/measuring-education-what-data-is-available.
[14] "Target 2.A: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling", "United Nations Millennium Development Goals," accessed December 27, 2018, http://www.un.org/millenniumgoals/education.shtml.
[15] See 'Goal 4 Targets', *United Nations Sustainable Development* (blog), accessed December 27, 2018, https://www.un.org/sustainabledevelopment/education/.

1.2.1 Access

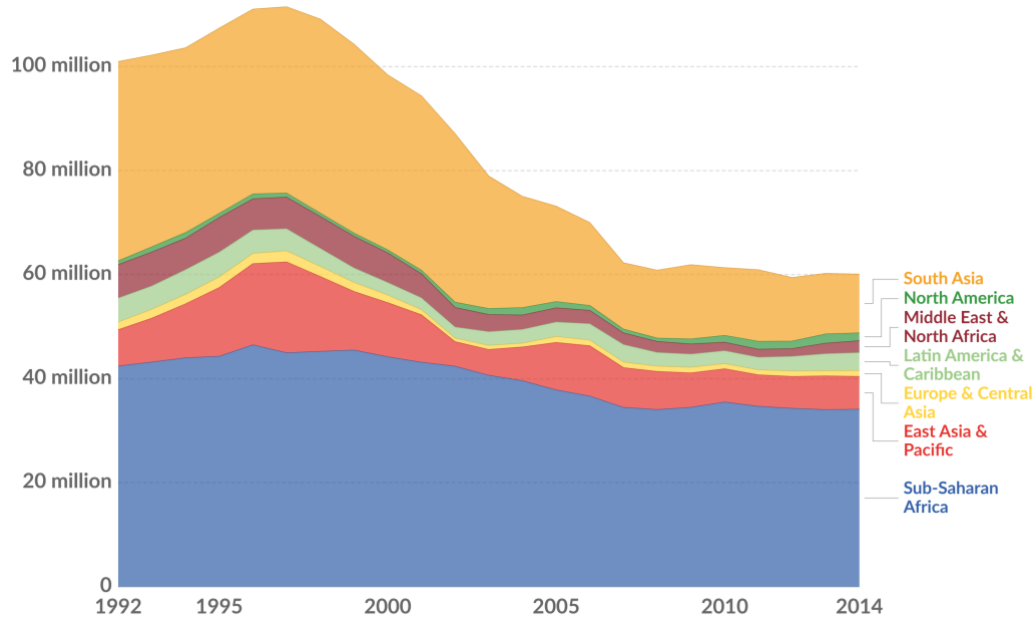
Access measures refer to measures of the amount of education received by students. Two of the most common measures of access to education are enrolment and attendance. Enrolment is whether a child is registered with a school, whereas attendance is whether a child attends a school. Although attendance is the more natural measure because it captures whether education has actually been received, data for enrolment is available for more countries.

How enrolment varies around the world

Enrolment captures whether a child is registered as a student at a school. At primary level, around 90% of children at primary school age are enrolled, globally.[16] This leaves around 60 million children of the relevant age that are out of primary school. Most of these (around 34 million) are in Africa,[17] where about half of out-of-school students are unlikely to ever enrol.[18] Although this number has dropped dramatically since 2000, more recently it has begun to plateau, as can been seen in Figure 1.

[16] "Worldwide, 91 per cent of primary-school-age children were enrolled in school in 2015.", "Primary Education," UNICEF DATA, accessed December 27, 2018, https://data.unicef.org/topic/education/primary-education/.
[17] Table E1, UNESCO Institute for Statistics and UNICEF, *Fixing the Broken Promise of Education for All: Findings from the Global Initiative on Out-of-School Children*, 2015.
[18] "The situation is most extreme in sub-Saharan Africa, where one-half of the 30 million out-of-school children will never enrol.", Document entitled 'A growing number of children and adolescents are out of school as aid fails to meet the mark', accessed October 31, 2018, http://unesdoc.unesco.org/images/0023/002336/233610e.pdf.

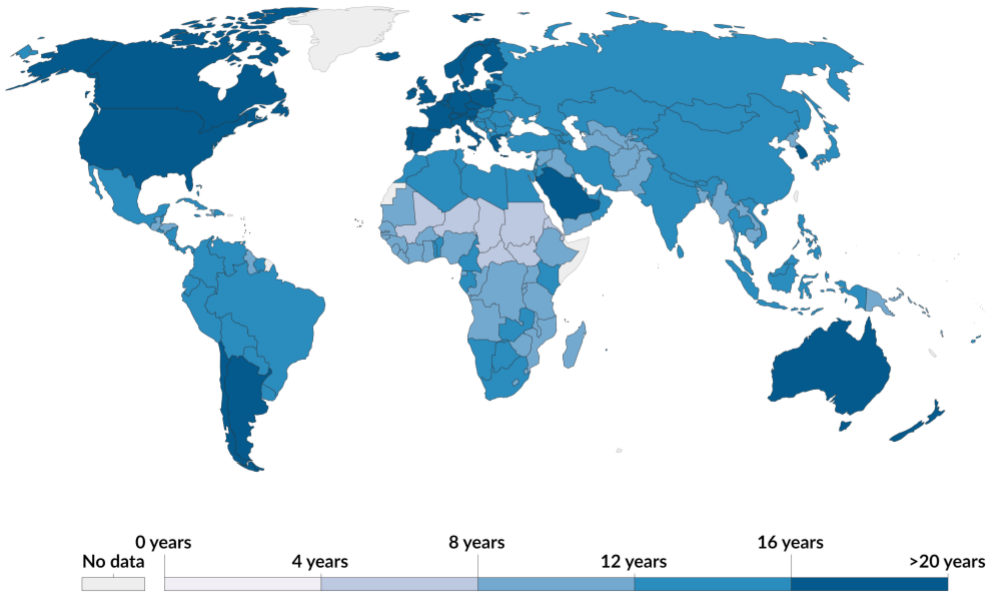
Figure 1: Out-of-school children of primary school age by world region



Source: 'Primary and Secondary Education', Our World in Data

By looking at enrolment rates at different levels of education, you can see how many years of education a pupil entering school today can expect to receive in different areas of the world. This number is called 'expected years of schooling' and is shown for different countries in Figure 2. You can see that students in most Western countries will receive more than 16 years of education, whereas students in some African countries will receive fewer than 8 years.

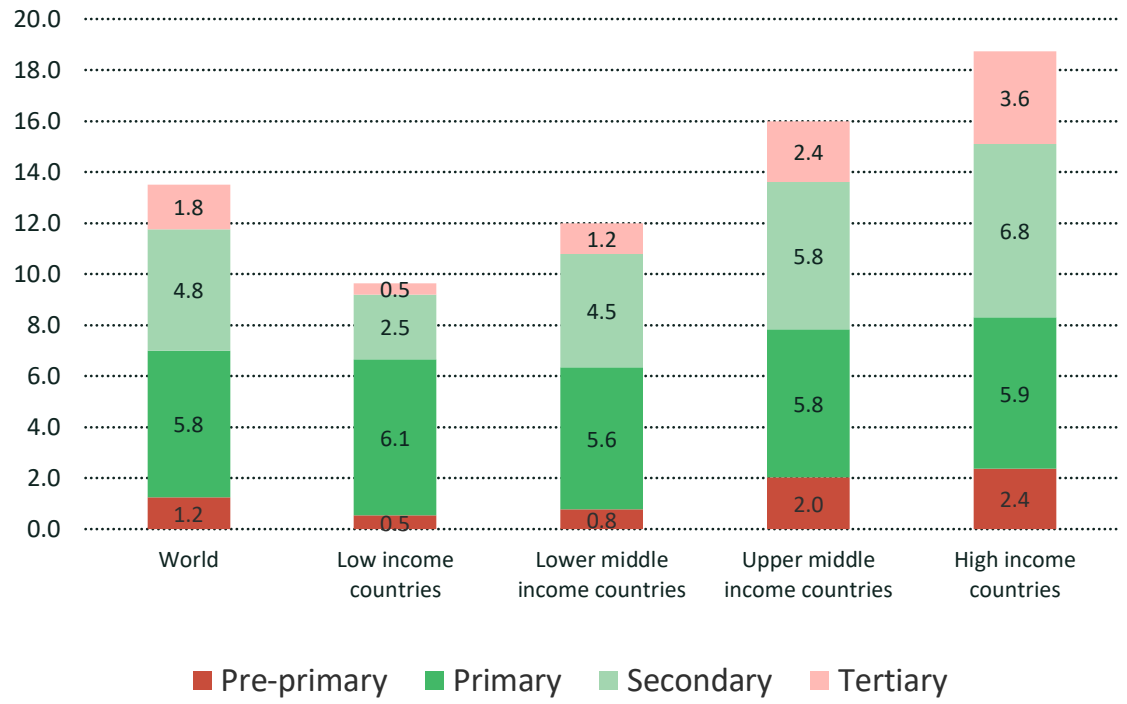
Figure 2: Expected Years of Schooling (2017) - the number of years of schooling that a child of school entrance age can expect to receive based on current enrolment rates



Source: 'Global Rise of Education', Our World in Data

Figure 3 shows more granular data based on different levels of education and country income levels. It shows that students in low-income countries can expect to receive around 8 fewer years of education than students in high-income countries. This is due to differences at secondary and tertiary level; surprisingly, students in low-income countries can expect to receive the same amount of primary education, on average, as those in high-income countries.

Figure 3: Expected years of schooling by education level and country income level



Source: UNESCO Institute for Statistics (UIS), http://data.uis.unesco.org, 'Secondary' data inferred by Founders Pledge

The reasons for lack of access

We have now seen that there are large differences in how much education children receive in different regions of the world, and that around 60 million children are out of primary school. Why do these children receive so much less education? According to the World Bank, the most common reasons that children lack access to education are:[19]

[19] See section 'Poverty, gender, ethnicity, disability, and location explain most remaining schooling disparities', "World Development Report 2018: Learning to Realize Education's Promise", World Bank, accessed December 28, 2018, http://www.worldbank.org/en/publication/wdr2018.

- **Conflict** - conflict reduces access to education by reducing the amount of resources available for teaching and by causing trauma to students. A third of all out-of-school primary school students are in conflict-affected states.[20]

- **Poverty** - poor families face a trade-off between spending money on their child's education and the money that child could earn if they worked instead. Because of this, children in low-income families are much less likely to attend school than children in high-income families.[21] The chances of a poor rural family sending their child to school are also more sensitive to the distance to their closest school.[22]

- **Discrimination** - females and children with disabilities are less likely to be enrolled in education.[23]

1.2.2 Learning outcomes

A second way to measure levels of education is to look at learning outcomes, which refers to the levels of skill or knowledge attained by students. Learning outcomes are a better measure of what we care about, because

[20] "Conflict-affected countries are home to more than a third of out-of-school children. Children in these countries are less likely to complete school—30 percent less likely for primary, 50 percent less likely for lower secondary.17
They have higher dropout rates, lower completion rates, higher gender disparities, lower literacy levels, and disproportionately high out-of-school numbers. Conflict can also erase past gains.", "World Development Report 2018"
[21] "On average, in developing countries there is a 32-percentage point gap between the chances of children in the poorest and richest quintiles completing primary school—with these wealth-related inequalities increasing in 10
of 25 such countries for which data are available", "World Development Report 2018"
[22] "For some poor households, distance to the nearest school is a predictor of school participation, especially where social norms or safety concerns make it difficult for children—particularly girls—to travel far from home", "World Development Report 2018."
[23] "Globally, girls are twice as likely as boys never to start school, which results in lower school completion rates"; "Children with disabilities face substantial obstacles to education—and substantially lower participation in school.", "World Development Report 2018"

the benefits of education result not from the amount of time spent being taught, but from what students learn.

How learning is measured

Learning outcomes for primary and secondary education can be compared between countries by looking at how their citizens score on standardised international tests. There are a number of prominent tests, including Programme for International Student Assessment (PISA) for maths, reading and science, Trends in International Mathematics and Science Study (TIMSS) for maths and science, and Progress in International Reading Literacy Study (PIRLS) for reading and literacy.[24] Self-reported literacy, which is sometimes defined as being able to read and write a simple statement about everyday life, is also a common metric.

When assessing the learning outcomes of an educational intervention, effects are commonly measured in terms of how much test scores were increased by. The size of this increase is usually expressed in the units of the standard deviation (a common measure of variability[25]) of scores across the whole population. For example, if a test had scores that ranged from 50 to 100 with a standard deviation of 10, then an intervention that increased average test scores from 70 to 75 would be associated with a 0.5 standard deviation increase in learning. Measuring effects in this way allows us to compare the learning effects of different interventions in a way that is independent of the scale of the test score. A rough rule of thumb used by economists for

[24] Other assessments include ASER, Uwezo, EGRA and EGMA. "Education Statistics | World Bank Learning Outcomes Query," accessed January 1, 2019, http://datatopics.worldbank.org/education/wQueries/qlearning.
[25] "Standard Deviation," in *Wikipedia*, December 27, 2018, https://en.wikipedia.org/w/index.php?title=Standard_deviation&oldid=875597396.

interpreting learning effects is that less than 0.1 standard deviations is small, 0.1 to 0.25 is promising, 0.25 to 0.4 is large, and greater than 0.4 is very large.[26]

This is the best and most commonly reported metric, but there are several limitations to comparing learning outcomes in standard deviations.[27] One of the most important limitations is that two populations may have different degrees of variation in their test scores. A one standard deviation increase in a population with test scores that vary widely is more meaningful than a one standard deviation increase in a population with scores in a narrow range, so using standard deviations does not give a fair comparison between these countries.

[26] " Economists studying education generally follow the rule of thumb that less than 10 percent of a standard deviation is small, 10 percent to 25 percent is encouraging, 25 to 40 percent is large, and above 40 percent is very large. ", Maya Escueta et al., “Education Technology: An Evidence-Based Review,” Working Paper (National Bureau of Economic Research, August 2017), https://doi.org/10.3386/w23744.

[27] Other potential problems with using test score standard deviations are: 1. Test miscalibration leading to learning effects not being picked up by the test. 2. Children being taught to the tests, so that the learning effects aren’t meaningful. 3. It can lead to comparisons of test scores in very different subjects and levels. 4. Scores can be sensitive to different scoring systems.

"Test scores are the most commonly used outcome measure for RCT’s in education, but the standards for psychometric practice in the RCT literature are quite mixed. The default method of measuring treatment effects in education is to express these effects in terms of standard deviations of normalized test scores (normalized relative to the control group). However, the tests used in many education studies are often not designed systematically, and details of test construction are often not reported (even in Appendices). This is problematic because measured treatment effects can be quite sensitive to the sampling of questions from the universe of feasible test questions. For instance, if the test is conducted at a level that is too
difficult for most students (floor effects), then measured treatment effects will be zero even if there was a meaningful impact on learning at a level that was below the level at which the test was given." 'Field Experiments in Education in Developing Countries', Karthik Muralidharan

Discussion of the use of test score standard deviations can be read in this blog post:
http://blogs.worldbank.org/impactevaluations/how-standard-standard-deviation-cautionary-note-using-sds-compare-across-impact-evaluations

How learning outcomes vary around the world

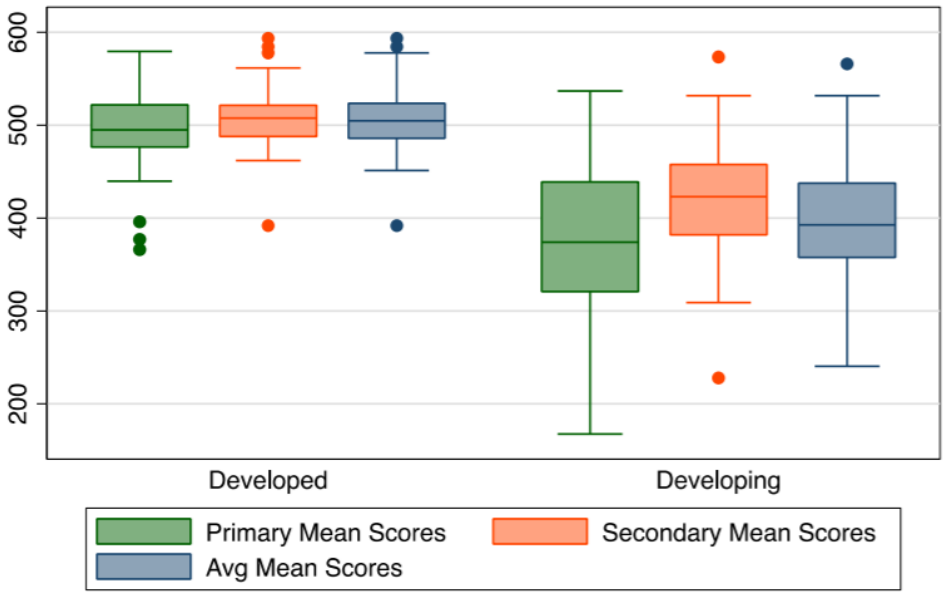
We now look at how countries differ on international tests and literacy rates. There are large differences in both international test scores and literacy rates between low-income countries and high-income countries, which are summarised below, with low-income countries having lower test scores and decreased literacy.

International tests

Comparing international test scores across countries is hard because less test data is available for poorer countries, but there have been attempts to make these comparisons by combining different tests. Figure 4 comes from one such attempt and compares a composite index of international test scores for developed and developing countries. It shows that the average score for developing countries is much lower than for developed countries, and the variance between developing countries is much higher.[28] It shows that average scores for developing countries are far below average scores for developed countries.

[28] Nadir Altinok, Noam Angrist, and Harry Anthony Patrinos, "Global Data Set on Education Quality (1965-2015)" (The World Bank, January 23, 2018), http://documents.worldbank.org/curated/en/706141516721172989/Global-data-set-on-education-quality-1965-2015.

Figure 4: Average international test score performance across 1965–2015 against development category



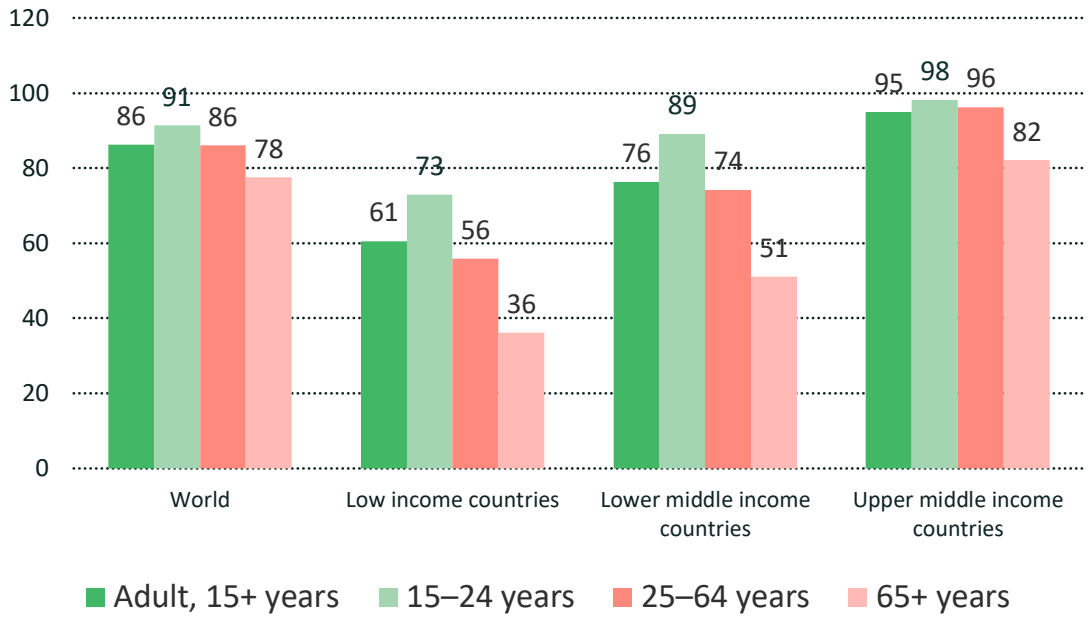
Source: Global data set on education quality (1965–2015), Altinok et al. 2018, World Bank Group

Literacy

Literacy levels show a similarly high level of variation to international test scores, as shown in Figure 5. Although most countries with literacy data have rates above 80%, the countries with the lowest rates, such as Chad, Guinea and Niger, still have rates well below 50%.[29] What is more, even for people who are in younger age brackets and have therefore grown up in modern education systems, over 25% of people in low-income countries are illiterate.

[29] "Literacy Rate, Adult Total (% of People Ages 15 and above) | Data," accessed December 29, 2018, https://data.worldbank.org/indicator/SE.ADT.LITR.ZS.

Figure 5: Literacy rates by age and country income group[30]



Source: UIS, data unavailable for high-income countries

The reasons for lack of learning

Although there are many reasons that time in school may not translate to learning, four main reasons highlighted by the World Bank are:[31]

[30] Data for high income countries is not available from this source.
[31] See section 'What is causing the learning crisis?' "World Development Report 2018."

- **Unprepared new students** - many disadvantaged children who start school already have learning deficits, due to malnutrition, illness, low parental support, chaotic environments and other effects of poverty. These deficits could lead to reduced learning in school.[32]

- **Unskilled or unmotivated teachers** - in some sub-Saharan African countries, students receive less than half the scheduled amount of teaching, in part due to teacher absenteeism. As well as this, teaching is often aimed at only the most able students, so that other students are not able to keep up.[33]

- **Lack of effective school management** - effective management of schools and school autonomy is lacking in many low-income countries, which can lead to worse education outcomes.[34]

- **Lack of education resources** - while the amount of available school inputs, such as classrooms and textbooks, has increased, it may not have kept pace with the increase in enrolment.[35] On the other

[32] "Chronic malnutrition, illness, the cumulative effects of material deprivation, low parental support, and the unpredictable, chaotic, or violent environments that can be associated with poverty all undermine early childhood development learning", "World Development Report 2018."
[33] "Unannounced visits to primary schools in six countries found that in public schools, on average, about one teacher in five was absent on a typical school day. Even when teachers are present in school, they may not be teaching. In seven Sub-Saharan countries, students receive only about two and a half hours of teaching a day—less than half the scheduled time.", "World Development Report 2018." An interesting illustrative example: "Guest [Lant Pritchett]: But I found even literally right in front of us[?] what the teachers would do during the day is it was a loss leader for their nighttime business of tutoring students for the exam. So, in the classroom they would say: 'In order to pass the exam, you'll need to know the following material'; but not actually teach it. Russ: This is marketing. Guest [Lant Pritchett]: It was a marketing device for their much more lucrative night job, which was individual or group tutoring lessons" http://www.econtalk.org/lant-pritchett-on-education-in-poor-countries/
[34] "The effective management of schools relies on capacity and autonomy for decision making at the school level, which are often lacking. Higher management quality and school leadership are associated with better education outcomes", "World Development Report 2018."
[35] "In many developing countries, the expansion of inputs has not kept pace with the explosion in enrollments", "World Development Report 2018."

hand, it should be noted that providing inputs on their own often does not lead to increased learning, as described in a later section on interventions.

Because what we care about is whether education leads to skills or knowledge being learned, and attending school may not lead to learning taking place, learning outcomes are a better measure of what we care about. For this reason, when evaluating interventions later in this report we have focused on interventions that improve learning rather than attendance.

1.2.3 Intelligence

Education is closely related to the field of intelligence. This section discusses IQ as measure of intelligence, the relationship between education and IQ, and current and historical trends in IQ.

How IQ is used to measure intelligence

IQ, the most common metric for assessing intelligence, can be assessed using several different tests.[36] What exactly is measured by IQ varies by the test used, but commonly includes working memory, verbal comprehension and mental processing speed.[37] Scores are normalised to have an average of 100 and a standard deviation of 15. Remarkably, scores from tests measuring separate components of intelligence, such as verbal comprehension and working memory, correlate greatly.[38]

[36] See 'Current tests' section, "Intelligence Quotient," in *Wikipedia*, December 27, 2018, https://en.wikipedia.org/w/index.php?title=Intelligence_quotient&oldid=875549615.
[37] For example the Wechsler Adult Intelligence Scale, one of the more rigorous tests, includes four components: verbal comprehension, perceptual organization, working memory and processing speed. See http://www.psychpage.com/learning/library/intell/wais_history.html
[38] See chapter 1, Garett Jones, *Hive Mind: How Your Nation's IQ Matters So Much More Than Your Own* (Stanford University Press, 2015).

Although IQ is the most common measure of intelligence and has predictive power in a range of areas, using IQ tests to measure intelligence is not uncontroversial. Criticisms of its use have included the possible existence of biases between different ethnic backgrounds and the extent to which tests depend on learned skills as opposed to innate intelligence.[39]

Relationship between education and IQ

National average IQ scores correlate highly with international education test scores. Comparing across countries, international test scores and national average IQ scores have a correlation of around 0.9, which is very high.[40] The correlation between individual IQ scores and school performance is slightly lower than for national scores but still substantial, ranging between 0.4 and 0.7.[41] While this correlation does not imply a causal relationship between IQ and school performance, together with the obvious overlap in skills required for IQ tests and maths, reading and science tests, it seems very likely that improving someone's IQ would also improve their school performance. For this reason, when considering which educational interventions philanthropists should focus on later in this report, we also include interventions that improve IQ.

[39] See chapter 5, Nicholas Mackintosh, *IQ and Human Intelligence* (OUP Oxford, 2011).
[40] "The correlation of EA (educational attainment) with measured IQ (N= 86 countries) is .917, and with measured+estimated IQ (N= 108 countries) is .907.", Richard Lynn and Gerhard Meisenberg, "National IQs Calculated and Validated for 108 Nations," *Intelligence* 38, no. 4 (July 2010): 353–60, https://doi.org/10.1016/j.intell.2010.04.007.
[41] "Correlations between IQ scores and formal tests of reading, mathematics, or other subjects, and between IQ and school exam performance or grades, range between 0.40 and 0.70", Mackintosh, *IQ and Human Intelligence*.

Education has also been found to increase IQ. One meta-analysis of studies looking at the effect of education on intelligence found an effect of around 1–5 IQ points for an extra year of education.[42] We have not looked deeply into this evidence.

Current and historical trends in IQ

IQ scores have been improving over the last century, a phenomenon known as the 'Flynn effect'. IQ scores are normalised so that the average remains 100 over time, but when the current-day population takes tests from previous years they score more highly than the population at the time. Over the last century, IQ scores have risen in rich countries by around two or three points each decade.[43] Increased levels of education is one of multiple hypothesised reasons for this change; others include changes in health and nutrition, and decreases in family size leading to more investment per child.[44]

Today, many people have IQs that are depressed for preventable reasons. Around 150 million children under the age of five are affected by stunting due to poor nutrition, which has negative effects on cognitive development.[45] The majority of these children are in Africa and Asia.[46] In addition we will see in later sections

[42] "Across 142 effect sizes from 42 data sets involving over 600,000 participants, we found consistent evidence for beneficial effects of education on cognitive abilities of approximately 1 to 5 IQ points for an additional year of education.", Stuart J. Ritchie and Elliot M. Tucker-Drob, "How Much Does Education Improve Intelligence? A Meta-Analysis," *Psychological Science* 29, no. 8 (August 1, 2018): 1358–69, https://doi.org/10.1177/0956797618774253.
[43] "In the rich countries, it appears that average IQ scores rose in every country for which data exist at a rate of perhaps two or three points per decade, an astonishing rate of increase.", Jones, *Hive Mind*, pg. 57.
[44] See section 'Hypothetical causes', Robert L. Williams, "Overview of the Flynn Effect," *Intelligence* 41, no. 6 (November 2013): 753–64, https://doi.org/10.1016/j.intell.2013.04.010.
[45] "Levels and trends in child malnutrition", World Health Organisation, accessed November 15, 2018, http://www.who.int/nutgrowthdb/jme_brochure2016.pdf?ua=1.
[46] "Levels and trends in child malnutrition", World Health Organisation

that iodine deficiency, which causes an IQ reduction in children of around four points, affects hundreds of millions of people.

For a deeper look at global education levels, we recommend reading the Our World in Data education series.[47]

1.3 Funding for education

There are four main sources of funding for education:

- **Domestic governments** - governments financing education for their own citizens.
- **Households** - recipients of education and their families paying for their own education.
- **Overseas aid** - foreign governments and multilateral organisations such as the World Bank providing aid to lower income countries.
- **Philanthropists** - foundations and the general public providing charitable donations.

Domestic governments are the largest funders of education, followed by households, who are particularly significant funders in low- and middle-income countries. Overall, our key takeaway is that there is 10–100x more education funding per student in high-income countries than in low-income countries. This means that educational activities are much more neglected in low-income countries, which is a reason for philanthropists to focus their efforts in these regions.

The main data sources for this section are the UNESCO Institute for Statistics (UIS) and the World Bank.

[47] "Global Rise of Education," Our World in Data, accessed January 1, 2019, https://ourworldindata.org/global-rise-of-education.

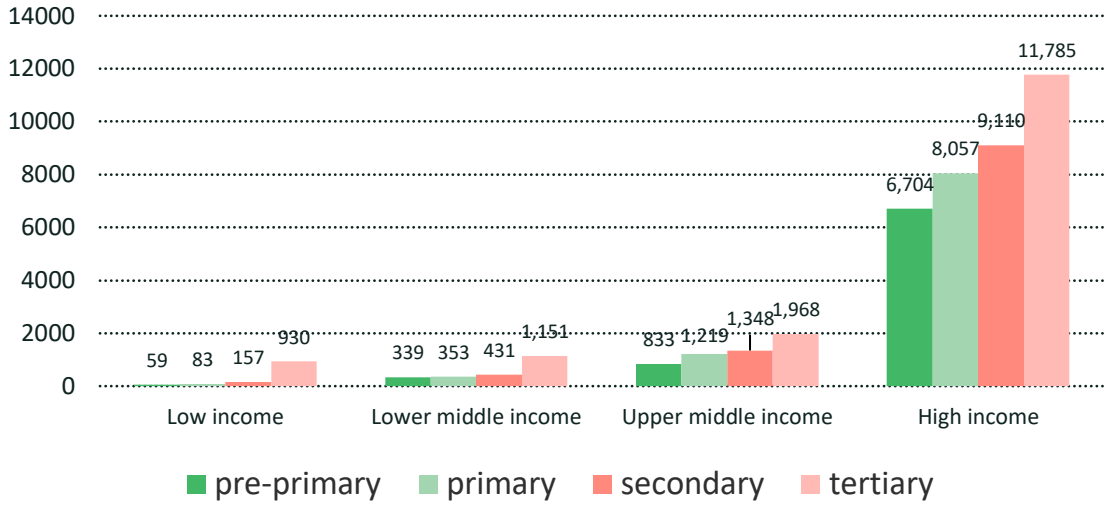
1.3.1 Domestic government

Domestic governments are the largest funders of education. Globally, governments spend around 4% of GDP, or $2.8 trillion, on domestic education each year.[48] Of this, around $2.2 trillion is spent in high-income countries, $500 billion in middle-income countries and $12 billion in low-income countries.[49] In nominal terms, low-income countries spend around $100 per student, compared to around $10,000 in high-income countries, a difference of a factor of a 100. Most of this is due to differences in GDP per capita, because high-income countries and low-income countries spend a similar amount on education as a percentage of GDP. The largest component of government spending is teacher compensation, which accounts for an average of 55% of government spending within public education institutions.

More details can be seen in this sheet, summarising UIS and World Bank data, and in Figure 8.

[48] These figures are based on world bank data that doesn't include countries constituting around 35% of the population and 25% of GDP. More than half of the excluded GDP and population is from China and Russia, which spend around 4% of GDP, or around $500 billion, on education.
[49] See sheet based on UIS data; total is not the sum of each country category due to rounding.

Figure 6: Government spending ($) per student (2013)



Source: calculated by author based on enrolment and spending data from UIS; only includes countries with both enrolment and spending data

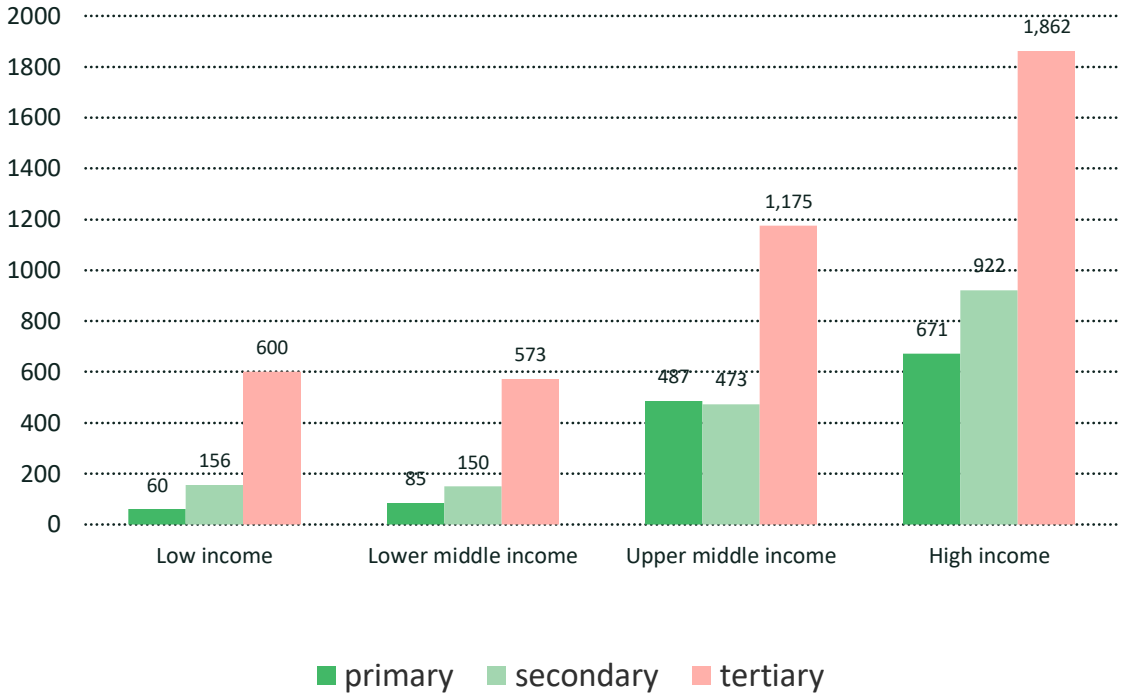
1.3.2 Households

Households are the second largest funders of education. Data on household spending is much sparser than data on government spending, but for the 41 countries with UIS data for 2013, total spending by households was around 1% of GDP, or $400 billion.[50] Across countries, the average amount spent by households on primary education was $460 per student. Household funding makes up a larger portion of total spending in low-income countries than in high-income countries.

More details can be seen in the same sheet as above.

[50] This includes both payments to educational institutions, such as tuition fees, and other purchases directly linked to education, such as uniforms and textbooks.

Figure 7: Household spending ($) per student (2013)



Source: UIS; data is only available for 41 countries, the majority of which are high-income

1.3.3 International aid

Of the $144 billion of official development assistance (ODA) provided to developing countries in 2016, around $12 billion went to education. Around $8 billion of that came from governments, with the remainder coming from multilateral organisations such as the World Bank.[51] International aid programmes that we have come across that appear particularly focused on effectiveness include USAID's Development Innovation Ventures and the UK's Department for International Development.

[51] OECD, Net ODA, https://data.oecd.org/oda/net-oda.htm#indicator-chart; OECD CRS, https://stats.oecd.org/Index.aspx

1.3.4 Philanthropy

Philanthropic funding can be split into funding from foundations and funding from individuals.

Foundations

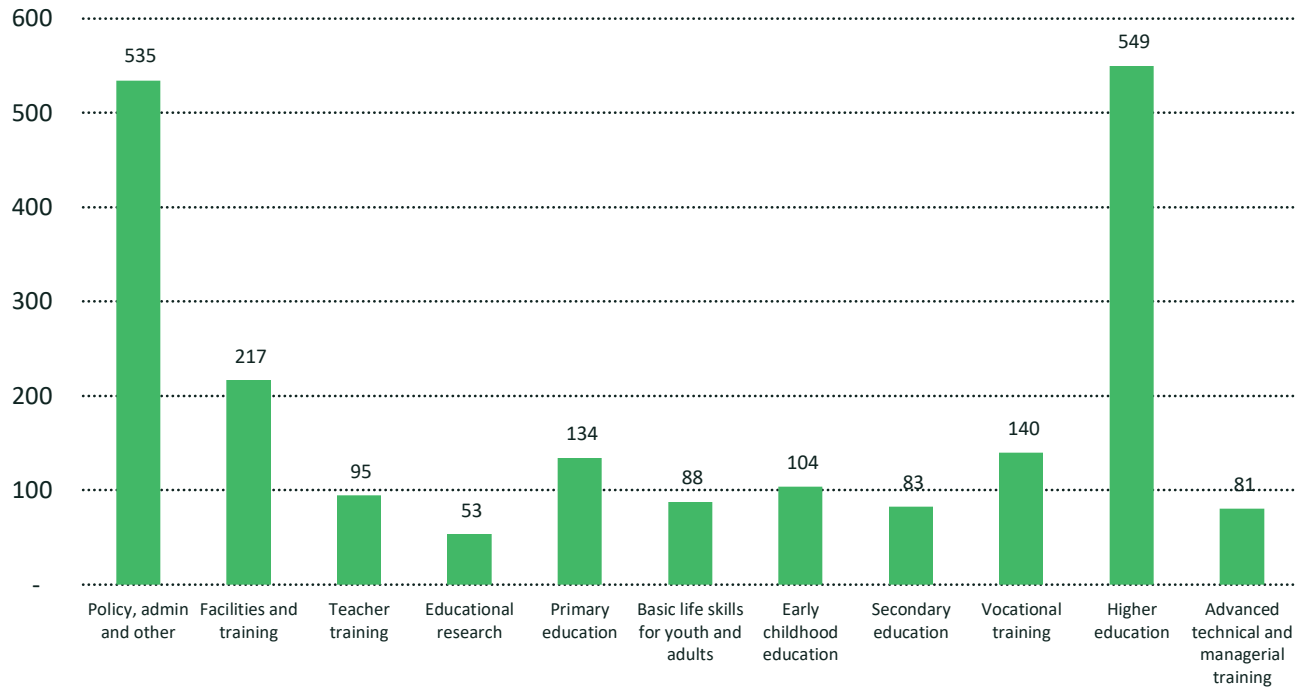
Of the $24 billion spent by foundations on development between 2013 and 2015, $2.1 billion went to the education sector, or around $0.7 billion annually.[52] Foundations spend around $4 billion each year within education in the US alone.[53]

Funding for development was spent largely on post-secondary education, and particularly higher education. The largest donor in this category was the Mastercard Foundation, which gave around $300 million during the period of 2013–2015 and is currently focused on reducing youth unemployment in Africa. Other prominent philanthropic organisations that fund education in low- and middle-income countries include:

- **Children's Investment Fund Foundation** - currently focuses on early childhood learning within education.
- **Global Innovation Fund** - an innovation fund that develops and scales innovations targeted at social impact and has made donations to multiple education organisations.
- **Co-Impact** - a recently announced $500 million fund that will invest in education activities including evidence-backed 'Teaching at the Right Level' interventions.

[52] OECD (2018), Private Philanthropy for Development, The Development Dimension, OECD Publishing, Paris, https://doi.org/10.1787/9789264085190-en
[53] See figure 2, "Philanthropy in K-12 Education," *The Learning Landscape* (blog), December 17, 2015, https://thelearninglandscape.org/philanthropy-in-k-12-education/.

Figure 8: Philanthropic giving to education in developing countries by purpose ($ million), 2013–15



Source: OECD (2018), Private Philanthropy for Development, The Development Dimension, OECD Publishing, Paris

Individuals

Data on how much individuals give to education in low- and middle-income countries is particularly hard to find but by some estimates the total is more sizeable than that of foundations. In 2017, giving by individuals made up 70% of the US' $410 billion in charitable giving. 14% of this total, or $57 billion, went to education.[54] However, it seems likely that most of this would have been to US organisations and therefore to groups who are relatively less neglected, educationally, on a global scale.

[54] "Giving USA 2018 Highlights" accessed November 6, 2018, https://www.csun.edu/sites/default/files/Giving-USA-2018-Highlights.pdf.

1.4 What are the main skills that education can teach?

Given that the case for funding education rests on imparting skills or knowledge that then provide a range of benefits, an obvious question that arises is what skills or knowledge education can be used to bring about. Here we give a very brief summary of the main categories, which are:

- **Basic skills** - primarily numeracy and literacy.
- **Academic knowledge** - knowledge in specific academic subjects such as chemistry or history.
- **Vocational skills** - skills that are specific to a certain profession.
- **General life skills** - decision-making and problem-solving; creative thinking and critical thinking; communication and interpersonal skills; self-awareness and empathy; coping with emotions and stress.
- **Specific life skills** - financial literacy and digital literacy.
- **Developmental traits** - early childhood education is often focused on cognitive development, rather than specific learning outcomes.

1.5 Should philanthropists focus on high-income countries or low-income countries?

A key decision that any donor must make is which regions to focus on. For donors focused on education this decision is particularly important, because educational interventions and levels vary so much between different regions. These variations are particularly prominent between countries of different income levels. This means that the most effective philanthropic activities in high-income countries are unlikely to translate to low-income countries, and vice versa. On balance, we believe that funding education in low-income countries is more promising than funding education in high-income countries, for most donors. The main reasons for this are outlined below.

- **Education is much more neglected in low- and middle-income countries** - around 10–100x less is spent per student in low-income countries than high-income countries. What is more, this difference is largely driven by differences in GDP per capita, since low-income countries spend a similar percentage of GDP on education to high-income countries, which suggests that it is explained by a lower capacity to fund, rather than differences in national education needs. Given that education is so much more neglected in low-income countries, educational gaps we see are likely to exist just because people or governments cannot afford to fill them, even if it would be valuable to do so.

- **The scale of the problem is larger** - partly because education receives so much less funding in these regions, there are tens of millions of children who still do not receive primary education, hundreds of millions who do not receive secondary education and non-negligible portions of the youth population that remain illiterate. It is much harder to find problems of this scale within high-income country education.

- **And it is more tractable** - whereas there are fairly clear cost-effective ways for funders to improve learning in low- and middle-income countries (see section 3), philanthropists in high-income countries have often struggled to have a robust impact. One well-known example of this comes from the US. Beginning in 2009, the Bill and Melinda Gates Foundation provided more than $200 million for a programme to improve teacher evaluation.[55] The programme introduced new measures of teaching effectiveness that were hoped to improve teaching and academic outcomes. Despite massive

[55] "The State of Education Philanthropy | AEI," *American Enterprise Institute - AEI* (blog), accessed October 7, 2019, https://www.aei.org/articles/the-state-of-education-philanthropy/.

investment, a report released by the RAND Corporation in 2018 showed that the effects of the change were minimal.[56] This shows that changes to education in high-income countries can often be hard to predict the results of, even for sophisticated philanthropists.

The main argument for focusing on education in high-income countries is that the indirect benefits of doing so could be larger than in high-income countries. This is because these economies allow workers to be much more productive than people in poorer countries, and so they can produce greater overall social and economic gains for their country and the world. This is true for the typical worker but may be especially important for those who produce important scientific discoveries or innovations that drive global progress. However, these economic benefits are also worth less than those that accrue to people in low-income countries because people in rich countries are already well off, so additional marginal money for them is less useful.

Overall, this is a difficult issue, but we believe that on balance the case for focusing on education in low-income countries is stronger.

1.6 Summary of education cause overview

In this section we gave an overview of education as a philanthropic cause area, by answering five questions. In summary:

[56] "Overall, however, the initiative did not achieve its goals for student achievement or graduation, particularly for LIM students. ... With minor exceptions, by 2014–2015, student achievement, access to effective teaching, and dropout rates were not dramatically better than they were for similar sites that did not participate in the Intensive Partnerships initiative.", Brian M. Stecher et al., "Improving Teaching Effectiveness: Final Report," Product Page, 2018, https://www.rand.org/pubs/research_reports/RR2242.html.

- **What are the different forms of education?**
    - Education can either be formal, non-formal or informal. The main categories of formal education are early-childhood, primary, secondary, higher and vocational. Prominent forms of informal and non-formal education are home-schooling, self-learning, alternative institutions, workplace learning, professional certification, online education courses and coding bootcamps.
- **How do levels of education vary around the world?**
    - Around 60 million children are not in primary school, with the majority of these in low- and middle-income countries. On international tests, average scores for low-income countries are below the worst scoring high-income countries.
- **Who are the main funders of education?**
    - Funding for education comes from four main sources: domestic governments, households, overseas aid and philanthropists. Domestic governments are by far the largest funder and spend around $3–4 trillion each year on education, or 4% of GDP. High-income countries spend around $10,000 per student each year, compared to $100 in low-income countries.

- **What are the main skills that education can bring about?**

- Very broadly, the main skills that education can bring about are basic skills, such as primarily numeracy and literacy, academic knowledge in specific subjects, vocational skills, general life skills, specific life skills and developmental traits.

- **Should philanthropists focus on high-income countries or low-income countries?**
  - Though it will vary by donor, it is likely that most donors will be able to have more impact in low-income countries. The main reason for this is that education is so much more neglected in these countries, where around 10–100x less is spent per student relative to high-income countries, and tens of millions of children still do not receive primary education.

2 The Benefits of Education

Although there is a strong intuitive case for the value of education, it is often not easy to define and measure its benefits. This section gives an overview of the benefits of education. The next section will then examine which interventions most cost-effectively bring about the educational outputs that lead to these benefits.

The benefits of education depend on which skills or knowledge are imparted, and the context of the beneficiary (e.g. which skills are most in demand). In this section we have focused most on basic skills and IQ. This is because:

- Most of the evidence on the effect of educational interventions on learning outcomes is for numeracy and literacy.
- Both basic skills and IQ affect a wide range of areas of people's lives, so we would expect them to be particularly useful.
- We were already aware of interventions that are effective at improving IQ.

The rest of this section examines the evidence for the long-term benefits of education (focussing on numeracy and literacy) and increased IQ.

2.1 The value of education

This sub-section looks at the benefits that education leads to. Where possible we have focused on numeracy and literacy, for the reasons given above, but in practice the evidence available is based on the effects of general education rather than specific skills, so we also include evidence for the benefits of general education as well.

The most-commonly proposed benefits to education are:

- **Productivity** - education can make beneficiaries more productive, by providing them with skills that make them more efficient workers and increasing the number of jobs they are able to access. This might lead to increased income and general wellbeing for the beneficiary, as well as the broader benefits of productivity to others.
- **Health** - education may improve health in three main ways: by improving the quality of health services provided by beneficiaries, by improving the ability of beneficiaries to understand and address their own health problems, and by increasing income available to beneficiaries for health expenditures.[57]
- **Crime** - education may reduce crime in at least three ways: by increasing the number and attractiveness of employment opportunities, by making beneficiaries more patient or risk averse, and by leading beneficiaries to socialise in groups less likely to commit crime, thereby reducing the likelihood that they will commit crime too.[58]
- **Citizenship -** education may have effects on citizenship and democracy in at least two ways: by instilling democratic values, either by explicit design within democratic education systems or by improving awareness of history and by improving the ability of citizens to make 'good' political decisions by increasing analytical skills. Three studies have found that education increases voting rates, which is one measure of these effects.[59]

[57] See Michael Grossman, "Education and Nonmarket Outcomes," 2005, https://www.nber.org/papers/w11582.pdf; and section 3 of Lance Lochner, "Non-Production Benefits of Education: Crime, Health, and Good Citizenship" (Cambridge, MA: National Bureau of Economic Research, January 2011), https://doi.org/10.3386/w16722.
[58] See section 2 of Lochner, "Non-Production Benefits of Education";
[59] See section 4 of Lochner, "Non-Production Benefits of Education."

- **Female empowerment** - education may have effects on the empowerment of women in a number of ways, such as increasing the opportunities available to women who receive it, reducing teenage marriage and pregnancy, and improving the health of women's children.[60]
- **Intrinsic value -** some people may place intrinsic value on education aside from the benefits it brings about**.**

The rest of this sub-section examines the evidence for the effects of education on income, health and female empowerment in more depth. Crime and citizenship are not included, because we initially found more evidence for the other benefits.

GiveWell, a research partner of Founders Pledge that rigorously evaluates giving opportunities, has looked into the evidence of whether developing world education has long-term benefits. This section is largely based on a summary and interpretation of their report. The experimental evidence and quasi-experimental evidence below comes from their report, whereas the other types of evidence do not.

2.1.1 Income

We now look at the different types of evidence for the effect of education on income. There are three main types of evidence for looking at the link between education and income:

[60] See the next section on interventions for four experimental studies looking at the effect of education on pregnancy and marriage in early adulthood;
"In developing countries, education, especially that of mothers, has been found to significantly differentiate levels of child mortality. In practically all countries, children of uneducated mothers have higher relative risks of dying in early childhood than the children of mothers with primary education.", United Nations Dept of Economic and Social Affairs Population Division, *Population, Education and Development* (United Nations, 2003).

- **Experimental evidence** - studies looking at what happens when individuals are randomly selected to be provided with different amounts of education.[61]
- **Quasi-experimental evidence -** studies looking at what happens when two groups with similar characteristics happen to be provided with different amounts of education. This sort of evidence is often less robust than experimental evidence, because the groups are more likely to have hidden differences that explain results.
- **Observational evidence** - this includes cross-country growth regressions, which compare average test scores for countries with the subsequent growth they experience, and micro-Mincer regressions, which compare the amount of education that individuals have received with their earnings later in life.

There are strengths and weaknesses to each of these types of evidence. Broadly, the experimental evidence does well on establishing causality between the education received and the subsequent income increase, but its results do not generalise well to other contexts and there are very few studies available. In contrast, the observational evidence is more generalisable because it is usually based on larger and more diverse groups of individuals, but it does badly on establishing causality because it is very hard to reliably take account of the important differences between individuals who receive more education and those who receive less. We place most weight on the experimental evidence.

[61] For descriptions of different evaluation types see J-PAL's summary: "Impact Evaluation Methods", J-PAL, accessed January 14, 2019, https://www.povertyactionlab.org/sites/default/files/resources/2016.08.31-Impact-Evaluation-Methods.pdf.

Experimental

Two experimental studies provide evidence for the link between secondary education and long-term incomes. The first is a study looking at the long-term effects of scholarships in Ghana whereas the second is a study looking at the long-term effects of scholarships in Colombia.

Secondary school scholarships in Ghana (Duflo, Dupas and Kremer 2017)

The first study looked at the long-term effects of providing scholarships for four years of secondary high school for students in Ghana. This study selected 2064 individuals who had gained admission to secondary school but not enrolled by the end of the first term, and randomly assigned a third of the individuals to receive a full scholarship for four years. The effects it found that are relevant to income were:

- **Attainment** - four years after graduation, 74% of scholarship winners completed secondary high school versus 47% of non-winners. They experienced 1.26 years more education.
- **Test scores** - about one year after graduation, scholarship winners scored 0.14 standard deviations higher on the reading test, 0.12 standard deviations higher on maths tests, and 0.15 standard deviations higher overall.
- **Income -** four years after graduation, scholarship winners on the vocational track had 24% higher monthly earnings than non-winners (statistically significant at the 10% level). (Students on the academic track were more likely to be enrolled in tertiary education if they won the scholarship, which makes income comparisons with non-winners not possible).

If the entire income increase was due to the maths and reading skills gained then this would imply an income effect of well over 100% for each standard deviation increase in test scores.

GiveWell place significant emphasis on the results of this study.[62] Their main concerns are:

- It is a working paper, so the results are preliminary. Significantly, this means that results on the effect on income are currently only available for students on the vocational track.
- The level of generalisability of the results is low, because the evaluation took place in a particularly challenging labour market.
- The effects may have taken place through non-educational channels. For example, when a family would have sent their child to school even without the scholarship, then the payment represents an income transfer to the family.
- The estimates do not take account of any effects on individuals outside the study. For example, providing a subset of individuals with a benefit that helps them gain employment may make other individuals less likely to have employment.

Vouchers for private secondary schools in Colombia (Bettinger et al. 2014/Bettinger et al. 2017)

The second study looked at the long-term effects of providing scholarships for private school to socially disadvantaged students by lottery in Colombia. The effects it found relevant to income are:

- **Income** - total formal sector earnings at age 30 are 8% greater for lottery winners, significant at the 7% level.

[62] "We place significant emphasis on the results of Duflo, Dupas, and Kremer 2017 because it is a well-designed randomized controlled trial with high quality long-term data on outcomes. Although we believe it provides the best available evidence on the long-term effects of an education intervention on labor market outcomes, we interpret its results with caution for a number of reasons…", https://www.givewell.org/international/technical/programs/education#Secondaryschoolscholarshipsinghana

- **Learning outcomes -** this paper did not include any learning outcome effects, but a previous paper looking at the same trial did and found that three years after the lottery winners scored 0.2 standard deviations higher on tests.[63]

If the entire income increase was due to increased learning outcomes then this would imply an income effect of 40% for each standard deviation increase in test scores.

GiveWell place less weight on this second paper than the first because the benefits are less certain to have come from education. There are a number of mechanisms that could explain the increase in income, some of which are educational and some of which are not. For example, for lottery winners who would have attended school anyway (of which there were many), the scholarship represented an income transfer to the family. This transfer may be important in explaining the long-term income effects.

Quasi-experimental

GiveWell looked at six papers that used quasi-experimental methods to examine the links between primary or secondary education and long-term income or labour market outcomes. These studies can be seen here.

Generally, these support a positive relationship between education and labour market outcomes. The main exception to this is a scholarship programme in Cambodia that increased years in school but had no effect on test scores, employment or earnings. Additionally, one paper looking at school-building in Indonesia found

[63] "Three years after the lotteries, winners were about 10 percentage points more likely to have finished 8th grade, primarily because they were less likely to repeat grades, and scored 0.2 standard deviations higher on achievement tests. ", Ric et al., “Vouchers for Private Schooling in Colombia : Evidence from a Randomized Natural Experiment,” 2001.

that while direct beneficiaries had increased wages, the programme led to decreased wages for non-beneficiaries (i.e. negative spillover).

Observational

The two types of observational evidence we looked into are:

1. Cross-country growth regressions
2. Micro-Mincer regressions

GiveWell did not include observational evidence in their report and place less weight on it. One economist suggested to us that these approaches are considered out of date by most development economists. However, they are still used by groups such as the World Bank (for example, in the World Development Report 2018).[64]

Cross-country growth regressions

If there are income gains for individuals, and those gains do not correspond to losses for other individuals, then there must also be income benefits for countries in the aggregate. So, one way we can estimate whether learning outcomes lead to increased income is to compare countries' average test scores with their subsequent growth rates.

[64] "World Development Report 2018."

This approach has the advantage of accounting for any negative effects on individuals who did not receive education (negative spillovers) because it looks at the income effect across whole countries, rather than at the individual level.

The main source we have used for this type of evidence is a book called *The Knowledge Capital of Nations*, by Eric Hanushek, which looks at the relationship between cognitive skills and growth. The book's approach is described in more depth in the appendix, but its central approach is to:

1. Create a measure of cognitive skills across countries from international test scores.
2. Regress growth on cognitive skills, controlling for economy openness and security of property rights, to get an estimate for the effect of learning outcomes on economic growth.
3. Separately address objections related to causality in a number of ways, to argue that the relationship between cognitive skills and growth established found above is mostly causal.

This approach results in an estimate that a 25-point increase in scores on PISA, a prominent international test, for the entire population (a quarter of a standard deviation) would lead to GDP being on average 6% higher over an 80-year period, or that wages for all workers would be 12% higher.[65]

There are a number of potential problems with this approach and its applicability to intervention cost-effectiveness analyses, including:

[65] "Over the entire period – with low initial impacts as students first have to enter the labor force – GDP would be 6 percent higher on average. This increase is roughly equivalent to an average wage increase of 12 percent for all workers over this period.", Eric A. Hanushek and Ludger Woessmann, *The Knowledge Capital of Nations: Education and the Economics of Growth* (MIT Press, 2015).

- There is uncertainty amongst economists over whether education causes growth, growth causes education, or both are caused by something else. Current tools and data are insufficient to resolve this.[66]
- The estimates are at the aggregate level and only refer to what would happen if the test scores of an entire country were increased. Therefore, they are not directly applicable at the individual level. This is because the results were calculated by looking at differences between countries rather than individuals, so increasing the test scores of an individual may not have the same income effect.
- The estimates rely on many different assumptions, such as the length of the period analysed. Although some of these assumptions were tested by Hanushek, this still makes us less confident in the estimates, particularly because we do not feel well qualified to judge the assumptions used.
- Developing countries are underrepresented and the very poorest countries are not included, due to lack of test score data.

Micro-Mincer regressions

Micro-Mincer regressions take a large group of individuals and regress their income against the number of years of schooling they have received and the number of years of labour market experience they have.

We looked at three papers that use micro-Mincer regressions, which are discussed below:

- Comparable Estimates of Returns to Schooling Around the World - this study carries out micro-Mincer regressions across 139 different economies, and finds that the average rate of return to a year of

[66] This was told to us in conversation

schooling is 10%, higher for women (11.7% versus 9.6%) and highest for tertiary education (10.6% - primary, 7.2% - secondary, 15.2% - tertiary).

- Coping with Change: International Differences in the Returns to Skills - this study carries out micro-Mincer regressions across OECD countries, but uses cognitive skills, as measured by PIAAC (a prominent international test), instead of years of schooling. The study finds that across all 32 countries, a one standard deviation increase in numeracy skills is associated with a 20% increase in earnings. It also finds that returns are larger in countries that have grown faster recently.
- Returns to Skills Around the World: Evidence from PIAAC - this study, which preceded the previous study, found that on average a one standard deviation increase in numeracy skills, as measured by PIAAC, is associated with an 18% wage increase among prime-age workers. Eight countries have returns between 12% and 15%, while six are above 21%, with the largest return being 28% in the US.

The main problem with these regressions is that it is difficult to account for confounders—factors that affect both the dependent variable (cognitive skills) and the independent variable (income). Confounders could lead to us interpreting the relationship between the dependent and independent variable as causal, when in fact both variables are caused by a third variable. In this case, it might be that a third factor, such as intelligence, explains *both* increased years of schooling and increased income later in life.

To deal with this problem, the studies also carry out the regressions with additional control variables included, such as parental education and educational attainment. However, ensuring that all the most important variables are included is very challenging. For this reason, we place much less weight on these studies than the experimental evidence above.

Signalling

We have now seen that education leads to increased income for the beneficiaries who receive it. However, we do not yet know whether education increases overall income (across the whole population), because gains for one individual may lead to reduced income for other individuals. The reason that this could occur is because education's effect on income comes in part from signalling an individual's *pre-existing* skills to prospective employers, rather than providing new skills that make them more productive. We now explain the signalling account of education and look at the arguments for it.

It is easiest to explain the signalling account of education with an example. Imagine a student graduates from a prestigious university and is looking for a job. She applies for a job in which she will not use any of the skills gained from her degree. The prospective employer receives her application, compares her to another candidate from a less prestigious university, and sensibly decides to hire the candidate with the more prestigious degree. What has been the effect of the candidate's university education on aggregate income in this case? At first glance the first candidate's degree increased her income, because she has received a higher paying job as a result. However, the second candidate missed out on the role, so now has a lower paying job. This means that the overall effect on income will only be positive if the first candidate is more productive in her role as a result of the education. But, since the job does not use any of the skills gained from her degree, no additional income is created as the result of her studies.

If this were true, it would make education a hugely wasteful endeavour, since it would mean that education does not actually make beneficiaries more productive. The case for the signalling effects of education has been laid out in *The Case Against Education*, by Bryan Caplan. Caplan believes that as much as 80% of the private benefits to education derive from signalling, though most of his arguments apply to high-income countries and so are less relevant to this report.

Five of the main arguments for the signalling account of education, taken from Caplan's book, are described below. These are the returns to irrelevant degrees, the sheepskin effect, credential inflation, slow employer learning and personal versus national income discrepancy.

Returns to irrelevant degrees

Some degrees have much less direct use within jobs. For example, it is hard to imagine that content learned in subjects such as history or French will be directly used in most jobs. They may of course have value outside of the workplace, but we would expect that degrees that are not directly useful in most jobs would not increase income very much. However, Caplan finds that degrees that are less directly useful professionally in fact still pay handsomely, which suggests that education is not rewarded because of the skills it teaches but for some other reason.

One response to this argument is that while these subjects are not directly useful, they still teach thinking skills, and this is why they are financially rewarded. Caplan's counter-response is that research shows that when people take 'reasoning tests' that measure thinking skills before and after their degrees, their scores do not improve, so irrelevant degrees also do not teach thinking skills.

The sheepskin effect

If education increases income by making graduates more productive, then each year of a degree should have a similar effect on a student’s future income, since learning should be spread evenly across each year. But students who complete the last year of their degree have disproportionately higher pay compared to students who stop studying before finishing their degree. This finding has been demonstrated across a variety of times

and places.[67] Caplan estimates that 60% of the pay increase from education comes from years in which a student receives a diploma. This suggests that most of the increase in pay from education is attached to receiving the degree, rather than skills learnt.

One objection to the sheepskin effect is that employers may be using the diploma as a signal that a student has successfully learnt the skills taught on the course, rather than as a signal for pre-existing skills. If an employer is using the diploma as a signal for skills learnt on the course, then the diploma may signal that skills from all years of the course have been gained rather than just the final year, which would justify increased pay associated with the final year.

Credential inflation

The amount of education being received has been increasing across the last few decades, far outpacing the growth of higher-skilled jobs.[68] This means that many workers have more education than they need for their job. Caplan estimates that around 20–35% of workers are "malemployed" i.e. the education of the worker exceeds the education and skill required to perform the job.[69] Furthermore, workers who are overqualified are paid more than workers in the same job who have less education. It is hard to understand why employers would pay more for workers with excess education, unless it is signalling pre-existing skills that are relevant to the job.

[67] Page 44, Fabian Lange and Robert Topel, "The Social Value of Education and Human Capital," n.d., 70.
[68] "A longer-run study for 1972-2002 gets nearly the same ratio: average education rose by 1.75 years, but growth of higher-skilled jobs drove only 19% of the increase", Bryan Caplan, *The Case against Education: Why the Education System Is a Waste of Time and Money* (Princeton University Press, 2018), 103.
[69] Caplan, 102.

Employers learn slowly

If an employer could learn which employees are productive very quickly after they started work, it would be hard for signalling to account for a large portion of the income gains to education. This is because two candidates who were equally productive but had different educational credentials would quickly be sorted into the same pay grade. To address this potential objection Caplan argues that it takes employers a long time, up to ten years, to learn how productive a new employee is. This means that it is unlikely that employers evaluate more educated employees as more productive once they have started employment, and therefore pay them more (though it does not rule out that education makes workers more productive).

Personal versus national returns to education

Caplan estimates that a year of personal education (i.e. for an individual) raises personal income by 8–12%. If this income gain for one individual had no effect on another individual's income, then we would expect a year of national education (i.e. for the whole population) to raise national income drastically as well. However, Caplan estimates that a year of national education only actually raises national income by 1–3%, which means that there is a big discrepancy.[70] The fact that we see a discrepancy suggests that a large portion of the private income gain comes from others.

Evidence for the 'personal versus national income' argument also comes for a well-known paper by Lant Pritchett called *Where Has All The Education Gone?*[71] In this paper Pritchett describes how, despite large

[70] Caplan, 117.
[71] Lant Pritchett, *Where Has All the Education Gone?*, Policy Research Working Papers (The World Bank, 1999), https://doi.org/10.1596/1813-9450-1581.

personal income gains to those who receive education, large amounts of education have failed to lead to additional economic growth.

Pritchett proposes three possible reasons to explain this discrepancy. First, schooling may not increase someone's productivity but still serve as a signal to employers of some positive characteristic like ambition or innate ability. This is the signalling account. Second, a lack of demand for educated labour may have caused the rate of return of education to fall rapidly. Finally, the third possibility is that education does raise productivity, and that there is demand for this more productive educated labour, but that this labour may be used on activities with negative social effects. This would mean that individual wages would go up, but overall economic output would not. Pritchett believes that each of these reasons contributes to the discrepancy, and that the importance of each reason varies by country.

Our overall view on signalling

We expect that the sizes of the signalling effects vary across different levels of education. While it seems plausible that the signalling effects are large for higher education, the concern seems less pressing for basic literacy and numeracy skills, developmental benefits such as increases in IQ and vocational skills that will be used heavily in employment, because they all seem very likely to increase productivity. Caplan does not disagree with this, though he does believe that all levels of education, including primary and secondary, have a number of courses that are not useful.[72] The education interventions that we find most promising in the next section focus on basic numeracy and literacy skills, and IQ, and so our key recommendations are much less

[72] "School obviously teaches some broadly useful skills – especially literacy and numeracy. High schools often include a few vocational electives – auto shop, computer programming, woodworking. Most colleges offer some career-oriented majors – engineering, computer science, pre-med. But what about all the other courses? All the other majors?", Caplan, page 2.

affected by signalling. Caplan's arguments also apply most directly to high-income countries, which are less relevant in our case.

Three education experts who we asked about the signalling effects of education placed less weight on their importance than Caplan and thought that signalling would account for less than 50% of the income gains to education, placing most emphasis on estimates towards the lower end. Reasons they gave for placing less weight on signalling than Caplan include:

- Caplan tends to use 'years of education' as his main measure of human capital, but this does not take account of the quality of education received.
- There are clear examples where the amount of education required for a credential has been lowered and this has led to a decreased income premium. Since the credential remains identical, this suggests that the skills gained on the degree do affect the income increase it results in.[73]

Overall, our key takeaways from examining the signalling theory of education are:

- We guess that signalling accounts for between 5% and 50% of the private income gains for primary and secondary education.[74]
- Although there is disagreement about the extent of signalling generally, most would agree that it is much less relevant in the cases of basic numeracy and literacy skills, vocational skills and IQ.

[73] For example: Carolina Arteaga, "The Effect of Human Capital on Earnings: Evidence from a Reform at Colombia's Top University," *Journal of Public Economics* 157 (January 1, 2018): 212–25, https://doi.org/10.1016/j.jpubeco.2017.10.007.
[74] Anonymous, in conversation, August 2019; Anonymous, in conversation, July 2018; Anonymous, in conversation, May 2018. Eric Hanushek has also publicly argued against Caplan's conclusions here: http://hanushek.stanford.edu/events/education-worth-it

- However, donors should be wary of funding education that will solely provide a credential, without imparting any valuable skills or knowledge.

A summary of the effect of education on income

In summary:

- In this sub-section we looked at three types of evidence for the effects of education on income: experimental studies (such as randomised controlled trials), quasi-experimental studies and observational evidence (such as cross-country growth regressions and micro-Mincer regressions).
- In general, all types of evidence find a positive effect of education on the income of beneficiaries. The effect of one year of education ranges from around 5% to 20%, and the effect of a one standard deviation increase in test scores ranges from around 10% to 40% (though some estimates are much higher).
- Though we place most weight on the experimental studies, all the evidence we found had major uncertainties attached:
    - Experimental studies looking at the long-term effect of education are very rare, and their results are not very generalisable to new settings.
    - Observational studies struggle to account for variables that are related to both education levels and income, such as parental income, and so struggle to prove that differences in income are *caused* by differences in education.
    - Quasi-experimental studies share all these problems, though to a lesser extent in each case.

- Overall, based on the income effect sizes of test score increases from each type of evidence, our best guess is that the average private income gain (to the student) from a one standard deviation increase in literacy and numeracy test scores (i.e. moving a student from the 50th percentile of the population to the 84th percentile) is around 20%. This is very rough, since the true gain depends on lots of factors that are hard to distinguish.

- Finally, we looked at how personal income gains may not lead to an *overall* income gain across the whole population, because education may simply 'signal' pre-existing skills rather than making people more productive. Though this effect is highly dependent on the type of education being received, we roughly estimate that this accounts for around 5% to 50% of the income gains from primary and secondary education.

2.1.2 Health

Education may also be beneficial by improving the health of its beneficiaries and others. At least three mechanisms have been proposed for how it might do this, which are:[75]

- By improving the quality of health services provided by beneficiaries to others.
- By improving the ability of beneficiaries to understand and address their own health problems.
- By increasing the income available to beneficiaries to spend on health expenditures.

[75] See Michael Grossman, "Education and Nonmarket Outcomes," 2005, https://www.nber.org/papers/w11582.pdf; and section 3 of Lance Lochner, "Non-Production Benefits of Education: Crime, Health, and Good Citizenship" (Cambridge, MA: National Bureau of Economic Research, January 2011), https://doi.org/10.3386/w16722.

The evidence for the effect of education on health is mixed, and we think the overall evidence for the health effects of education is weaker than for the income effects.

Experimental evidence

We are aware of two experimental studies that tested the health effects of education.

- The first study is the secondary school scholarship programme in Ghana included in the previous section on income. This paper found that eight years after students received scholarships, both females and males engaged in more preventative health behaviours and males had less exposure to sexually transmitted infections. GiveWell compared the size of the health effects from this study with the income effects from it and estimated that they provide less than 1% of the value of the income effects.
- The second study looked at the effect of school subsidies on health outcomes of primary school students in Ghana. Sexually transmitted infections were reduced seven years after the start of the intervention, but only if the intervention was combined with the government's HIV curriculum.

These two studies did not find strong evidence for the health effects of education, so GiveWell's conclusion is that there is only weak evidence that education programmes improve health. Given this, we think the experimental evidence for health effects is weaker than the experimental evidence for income effects.[76]

[76] "Overall, we think there is only weak evidence that education programs improve health outcomes.", "Education in Developing Countries," GiveWell, accessed October 10, 2018, https://www.givewell.org/international/technical/programs/education.

Other evidence

There is also evidence for the health effects of education from non-experimental studies, which suggest a modest positive effect of education on health. We place much less weight on these studies than the experimental evidence, because it is hard to know whether the education caused the health benefit, or if they were both caused by something else.

Lochner (2011) reviews non-experimental studies published between 2006 and 2010 that look at the effect of education on health outcomes and health behaviours.[77] These studies use quasi-experimental approaches to try to estimate the effect of a year of education on a health outcome (such as mortality) or a health behaviour (such as smoking). The majority of the studies do not find a statistically significant effect.[78] Given this, and the experimental evidence above, we think the overall evidence for the effects of education on health is weaker than for income.

A summary of the effect of education on health

In this section we looked at two types of evidence for education's effect on health. These were experimental studies, which did not find strong evidence for an effect, and longitudinal studies, which also did not find a strong effect. Based on these findings, we think the overall evidence for the effects of education on health is weaker than for income.

[77] Lochner, "Non-Production Benefits of Education."
[78] See table 7. Of 39 estimated effect sizes, 15 are significant. Lochner.

2.1.3 Teenage pregnancy and marriage

Education may have effects on female empowerment in a number of ways, such as increasing the opportunities available to women who receive it, reducing teenage marriage and pregnancy, and improving the health of women's children. This sub-section examines the evidence for the effects on teenage marriage and pregnancy. Overall, we think that education is likely to lead to a meaningful reduction in early pregnancy and marriage. The importance of this reduction relative to the income gains from education will depend on the donor's values.

Experimental evidence

Experimental evidence for the long-term effects of education on early pregnancy and marriage comes from four studies: scholarships in Ghana, scholarships in Colombia, subsidies in Kenya and cash transfers in Malawi. Briefly, in all four cases education led to reduced teenage or early adulthood pregnancy, as well as to reduced early marriage in Kenya.

The results of these four studies are summarised here:

- Scholarships in Ghana (Duflo et al. 2017) - this randomised trial tested the long-term effects of secondary school scholarships on students in Ghana and found large effects on women's marriage and fertility outcomes at age 25. Female scholarship winners were less likely to have ever lived with a partner (34% to 25%), less likely to have ever been pregnant (58% to 48%), less likely to have had an unwanted first pregnancy (57% to 45%) and had 0.217 fewer children on average.
- Scholarships in Colombia (Bettinger et al. 2014) - this randomised trial tested the long-term effects of secondary school vouchers on students in Colombia and found large effects on the proportion of girls who had a child in their teenage years (23.4% to 19.1%). These effects disappeared by the age of 30,

suggesting that education leads to delayed motherhood, rather than an overall reduction in the number of children.

- Subsidies in Kenya (Duflo et al. 2015) - this randomised trial tested the effects of a school subsidy programme and teacher training to promote abstinence until marriage on upper school primary students in Western Kenya. The study found that it reduced the teenage pregnancy rate for girls (16% to 13%) and that this difference in fertility persisted seven years after the intervention (49% versus 46%), although the difference is no longer statistically significant at this time. The subsidies reduced the probability a girl was married at age 21 (from 39% to 35%).
- Cash transfers in Malawi (Baird et al. 2010) - this randomised trial evaluated the Zomba Cash Transfer Programme, which offers cash transfers and payment of school fees to young women who stay in or return to school. For girls who were not in school to begin with, the programme had large reducing effects on the probability of early marriage (27.7% to 16.4%), the probability of teenage pregnancy (16.2% to 11.1%) and self-reported sexual activity. The effects were much smaller for girls who were already in school.

GiveWell examined these studies and believe they do provide evidence for the effect, although they are uncertain about the mechanism that leads to the effect. This is because education may reduce teenage pregnancy because girls delay pregnancy while in school or by causing a permanent change in preference. If the former is true, then education will lead to a delay in having children, whereas if the latter is true, it will lead to lower fertility in the long term.

A summary of the effect of education on teenage pregnancy and marriage

In this section we looked at the experimental evidence for the effect of education on early pregnancy and marriage. These studies support a positive relationship, with reductions of teenage or early pregnancy ranging from 3 to 10 percentage points, and reductions of early marriage of 4 to 11 percentage points. One uncertainty around these results is that the mechanism for the relationship may not be educational. Overall, we think that education is likely to lead to a meaningful reduction in early pregnancy and marriage. The importance of this reduction relative to the income gains from education will depend on the donor's values.

2.1.4 Summary of the benefits of education

There is a wide range of benefits to education that have been proposed, including improvements in productivity, health, crime, citizenship and female empowerment. Some also value education as an intrinsic good in itself. In this section we looked at the evidence for the effect of education on income, health and teenage pregnancy and marriage (which is related to female empowerment). We found that the evidence was strongest for income, for which we estimate that a one standard deviation increase in test scores would lead to a 20% increase in income in later life, and for early pregnancy and marriage, where reductions due to additional education are around 5 percentage points.

2.2 The value of increasing intelligence

We now look at the benefits of increased IQ, which is the most prominent measure of intelligence. An increase in IQ would bring about significant impacts on life outcomes such as income, work performance and

education.[79] The evidence for these benefits is described in more depth below. This evidence usually consists of non-experimental studies that attempt to control for factors such as parental socioeconomic status. We consider this evidence to be much less informative than experimental evidence, which we have been unable to find for these effects. Based on this evidence, we value the benefits of a one standard deviation increase in IQ roughly similarly to a one standard deviation increase in educational test scores.

2.2.1 Effect of IQ on education

One the most prominent benefits of increases in IQ is the increase in educational improvements that it leads to. There are two main ways to demonstrate this effect. Firstly, the skills that IQ tests evaluate are so closely related to educational attainment measures such as numeracy and literacy that it seems intuitively very likely that increasing intelligence will also improve performance on educational test scores. IQ tests commonly include vocabulary tests and arithmetic tests. In addition to this, international education test scores, such as PISA, are considered so related to cognitive ability that they are sometimes used by economists as proxies for it.[80]

The second reason to believe that increases in IQ lead to improvements in educational attainment is that studies show IQ predicts educational attainment, even after accounting for a student's parental socioeconomic status. The correlation between individual IQ scores and school performance is in the range of

[79] James Flynn, one of the most prominent intelligence researchers and namesake for the Flynn effect, has said in conversation with GiveWell that "No one in the academic community studying IQ would claim that a gain of four IQ points would not have a significant impact on life outcomes... There is overwhelming evidence from a wide variety of experimental and observational studies that IQ has an independent effect on a wide range of life outcomes"
James Flynn 10-17-2014 (Public).Pdf," accessed November 19, 2018, https://files.givewell.org/files/conversations/James%20Flynn%2010-17-2014%20(public).pdf.

[80] For example, see the following paper. Eric A. Hanushek and Ludger Woessmann, "The Role of Cognitive Skills in Economic Development," *Journal of Economic Literature* 46, no. 3 (September 2008): 607–68, https://doi.org/10.1257/jel.46.3.607.

0.4 to 0.7.[81] Moreover, IQ is also predictive of educational test scores, because IQ scores at one age correlate with educational test scores at a later age. At least two studies have examined the correlation between the IQ scores of British children at age 11 with their educational test scores at age 16, and found it to be around 0.5.[82] Finally, this correlation also does not result solely from parental socioeconomic status. This is because (surprisingly) parental socioeconomic status only has a correlation with educational achievement of around 0.2–0.3, which means that it cannot account for the entirety of the correlation between IQ and educational attainment.[83] There is also evidence from high-income countries that parental socioeconomic status does not explain much of the current variance in children's educational outcomes or IQ.[84] It is not clear how far this is true of low-income countries, but the finding does suggest that parental socioeconomic status at most weakly confounds the relationship between IQ and educational attainment.

[81] "Correlations between IQ scores and formal tests of reading, mathematics, or other subjects, and between IQ and school exam performance or grades, range between 0.40 and 0.70", Mackintosh, *IQ and Human Intelligence*.
[82] " First, the correlation between IQ and educational attainment is not just a correlation between two concurrent measures: IQ scores at one age predict educational attainment at a later age. The IQ scores of kindergarten children predict their performance on tests of reading 2 or 3 years later (Hom and Packard, 1985). In Britain, the correlation between 1 1-year-old IQ scores and later educational attainment, including performance on school examinations at age 16, is about 0.50 (Vernon, 1947; Mackintosh and Mascie-Taylor, 1986). ", Mackintosh, 46.
[83] See table 6; Karl R. White, "The Relation between Socioeconomic Status and Academic Achievement," *Psychological Bulletin* 91, no. 3 (1982): 461–81, https://doi.org/10.1037/0033-2909.91.3.461;
"The second, even more important point, is that the correlation between IQ and educational attainment cannot be explained away by arguing that it is simply a consequence of the fact that both are a by-product of some other, more important factor... The argument is a popular one, and may contain some truth. But it cannot be the whole story-because the correlation between family background, however measured, and educational attainment, however measured, is not nearly as high as many people suppose. Different studies have reported widely differing estimates of the strength of this relationship,
but the most systematic analysis of, mostly American, data suggest that the correlation is no more than 0.20-0.30 (White, 1 982)" Mackintosh and Mackintosh, *IQ and Human Intelligence*, 46.
[84] Bryan Caplan, *Selfish Reasons to Have More Kids: Why Being a Great Parent Is Less Work and More Fun Than You Think*, First Trade Paper Edition edition (Basic Books, 2012), chap. 2.

Given that an improvement to someone's intelligence is also likely to lead to educational improvements, we think this also provides suggestive evidence that increased intelligence would also lead to the benefits to education that we have already seen, such as income and female empowerment.

2.2.2 Effect of IQ on income

Some studies estimate the effect of IQ, or other measures of cognitive skill, on income. We have not examined the literature in depth but have looked into two of the most widely cited studies that we have found. These studies are summarised below and suggest a modest increase in income of the order of 10% from a 15-point IQ increase, which is also in line with estimates from IQ experts.[85] We are not aware of any experimental evidence on this question.

The first study is a meta-analysis of studies that have investigated the effect of IQ on income (and socioeconomic success more broadly). Only longitudinal studies were included, which are studies that compare intelligence at one point in time with income for the same person later in life. In all cases the interval between intelligence measurement and income measurement had to be at least three years. In addition, the intelligence measurement took place before the age of 25 and the income measurement took place after the age of 20 (with the intelligence measurement always taking place before the income measurement). This study resulted in an estimated correlation between intelligence and income of 0.20.[86]

[85] "On balance, the evidence implies that there is a small, but significant, relationship between the two.", Mackintosh, *IQ and Human Intelligence*, 52.
[86] "The overall correlations were .56 (between intelligence and education), .43 (between intelligence and occupation), and .20 (between intelligence and income). Exclusion of the samples that were too old (over 18) at the time of testing or too young (below 30) at the measurement of success resulted in somewhat larger correlations: .56, .45, and .23, respectively", Tarmo Strenze, "Intelligence and Socioeconomic Success: A Meta-Analytic Review of Longitudinal Research," *Intelligence* 35, no. 5 (September 2007): 401–26, https://doi.org/10.1016/j.intell.2006.09.004.

However, this is not an estimate of the causal effect of IQ on income, since the correlation also results from other variables that are correlated with intelligence, such as parental income.

The second study takes estimates of the effect of cognitive skills on income from 24 studies. These studies all control for years of schooling and parental socioeconomic status. The criteria for study inclusion are not described in detail. The mean of the estimates is 0.07, implying that increasing cognitive performance by one standard deviation, or 15 IQ points, is associated with a 7% increase in income.[87]

Other studies that provide estimates of the effect of intelligence on income, which we have not looked into in depth, typically find a similar effect, roughly of the order of 1% for each extra IQ point.[88]

2.2.3 Effect of IQ on work performance

Increases in intelligence also have substantial effects on work performance. Although it varies by the role, IQ scores have found to be one of the best predictors available for general job performance. We have not looked into individual studies on intelligence and work performance, but instead rely on the overview given in the book *IQ and Human Intelligence* by Nicolas Mackintosh, which is a leading text on intelligence. Mackintosh

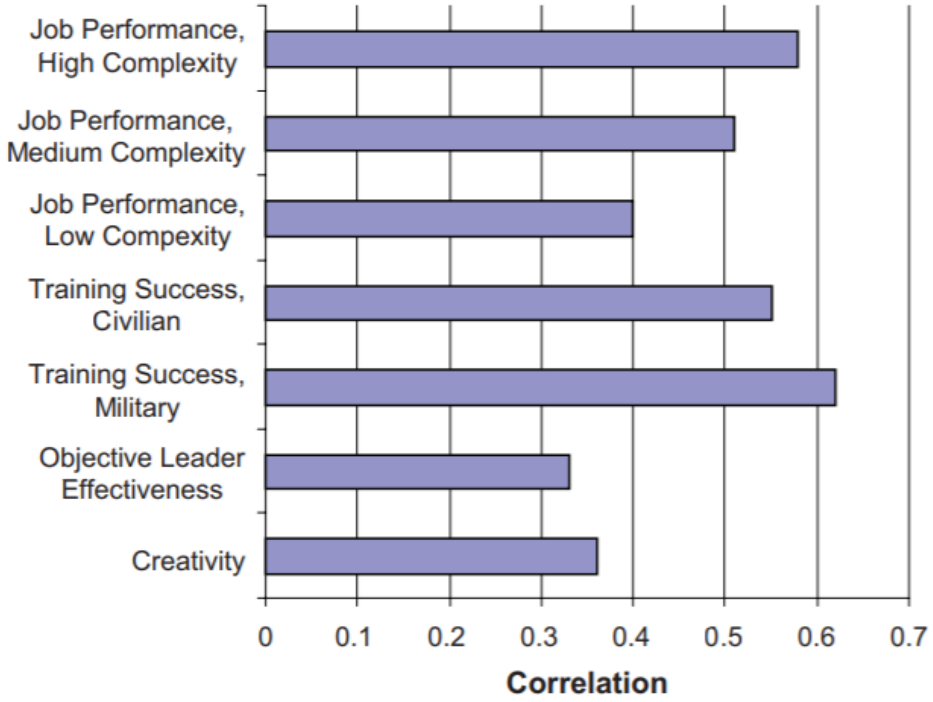
[87] "The mean estimate of βc′ is 0.07 and the median is 0.08, suggesting that a standard deviation difference in cognitive performance is associated with something less than a ten percent increase in wages, and is in this respect roughly equivalent to a year of schooling.", Samuel Bowles, Herbert Gintis, and Melissa Osborne, "The Determinants of Earnings: A Behavioral Approach," *Journal of Economic Literature*, n.d.

[88] Four other studies are: Derek A. Neal and William R. Johnson, "The Role of Premarket Factors in Black-White Wage Differences," *Journal of Political Economy* 104, no. 5 (October 1, 1996): 869–95, https://doi.org/10.1086/262045; Jeffrey S. Zax and Daniel I. Rees, "IQ, Academic Performance, Environment, and Earnings," *The Review of Economics and Statistics* 84, no. 4 (November 1, 2002): 600–616, https://doi.org/10.1162/003465302760556440; John Cawley et al., "Cognitive Ability, Wages, and Meritocracy," in *Intelligence, Genes, and Success: Scientists Respond to The Bell Curve*, ed. Bernie Devlin et al. (New York, NY: Springer New York, 1997), 179–92, https://doi.org/10.1007/978-1-4612-0669-9_8; Jere R. Behrman, Harold Alderman, and John Hoddinott, "Hunger and Malnutrition," Hunger and malnutrition, 2004, http://bases.bireme.br/cgi-bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&src=google&base=REPIDISCA&lang=p&nextAction=lnk&exprSearch=183100&indexSearch=ID; Scott D Grosse et al., "Economic Gains Resulting from the Reduction in Children's Exposure to Lead in the United States.," *Environmental Health Perspectives* 110, no. 6 (June 2002): 563–69.

finds that the correlation between IQ scores and measures of job performance are between 0.15 and 0.6, varying widely by the job in question.[89] Correlations for different characteristics can be seen in Figure 9 (taken from a separate study). This means that IQ scores are a better predictor of performance than biographical data (such as age), level of education, college grades, interviews and references. We are uncertain about how to value this effect relative to the income effects.

[89] "That there is a significant relationship between IQ and various measures of job performance is now indisputable, and there is good evidence that the magnitude of the relationship varies with the demands of the job.", " Hunter and Hunter (1984) report correlations that have been adjusted or 'corrected' to take account of the unreliability of the measures being correlated and the restriction in the range of test scores of those in the running for different types of job. The correlations they report range from 0.25 to 0.60 for different jobs. Hartigan and Wigdor (1989), analysing similar data sets, apply fewer, more conservative corrections and report correlations in the range 0.15 to 0.30. There is no need to argue here the merits and pitfalls of such statistical manipulations. Although they can be justified for certain purposes, it is usually more sensible to err on the side of caution. In this case, caution implies that IQ scores are not very good predictors of the efficiency with which people perform their jobs" Mackintosh, *IQ and Human Intelligence*, 52.

Figure 9: Correlation between cognitive ability and measures of work performance



Source: 'Fact and Fiction in Cognitive Ability Testing for Admissions and Hiring Decisions', Kuncel and Hezlett, 2010

2.2.4 Summary of the benefits of increased intelligence

In summary:

- Intelligence has been shown to have effects on a wide range of life outcomes. In this section we looked at the evidence for the effect of increased intelligence, as measured by IQ, on educational performance, income and job performance.
- The evidence for these effects usually consists of non-experimental studies that attempt to control for factors such as parental socioeconomic status. We consider this evidence to be less informative than experimental evidence, which we have been unable to find for these effects. In addition to this

evidence, the skills associated with intelligence (and measured by IQ tests) overlap heavily with the skills required in both educational and professional settings, which suggests that IQ is likely to be valuable in these settings.

- Of these effects, intelligence has the largest effect on educational performance, with a correlation of around 0.5 between IQ at one age and educational scores at later ages. The effect of increased IQ on income is usually found to be of the order of 1% for each extra IQ point. Finally, intelligence is also likely to have a positive effect on job performance, with correlations between IQ scores and scores of job performance ranging between 0.15 and 0.6.
- Overall, based on the high correlation between IQ scores and educational attainment and the similar sizes of effect of increased intelligence and education on income, we consider a persistent increase in IQ of one standard deviation to be of roughly similarly value to a persistent increase in educational test scores of one standard deviation.

2.3 Summary of the benefits of education

In this section, we have given an overview of the main benefits that can come from the outputs of education, focusing primarily on basic skills and IQ. The main benefits of education that we have looked into are increased productivity, improved health and certain types of female empowerment. Of these, we think there is most evidence for increased productivity, for which we use income as a proxy. As a rough rule of thumb, we estimate that a one standard deviation increase in numeracy and literacy scores creates additional income of around 20%. Other benefits we found less evidence for are decreased crime and improved citizenship.

Estimating the benefits of education has several challenges, so we do not have high certainty in our overall conclusion. The main challenges of estimating the benefits of education are:

- The benefits often occur a long time after the intervention takes place.
- Education can take place in many different forms and contexts, and the benefits depend highly on which of these forms and contexts it takes place in.
- Education has complicated interdependencies with other important variables (such as productivity and health), which makes it very hard to know whether education *causes* a benefit, even when it is correlated with it.

The main benefits of increased intelligence that we have looked into are education, income and job performance. The evidence for these benefits usually consists of non-experimental studies that attempt to control for factors such as parental socioeconomic status. We consider this evidence to be less informative than experimental evidence, which we have been unable to find for these effects. Based on this evidence, we value the benefits of a one standard deviation increase in IQ roughly similarly to a one standard deviation increase in educational test scores.

3 The Best Education Interventions

This section gives an overview of the interventions that donors could fund in the area of education, and which of them are most promising. In this report we have focused on interventions in low- and middle-income countries, because we think there are strong arguments (covered above) that this is where donors can have the most impact. Donors interested in specific high-income countries may wish to contact us directly for advice focused on high-income countries.

Based on the evidence presented in this section, we ultimately think that the most promising interventions are 'Teaching at the Right Level' interventions, which consist of calibrating education more precisely to the level of the student, and salt iodisation, which is an effective way to reduce iodine deficiency and its harmful cognitive effects.

This section is structured as follows:

1. Our general selection process
2. What interventions could donors fund in low- and middle-income country education?
3. Which interventions are most cost-effective?
4. Discussion of evidence for other interventions

3.1 General selection process

We have used two main approaches to evaluate interventions:

- **Direct evidence of benefits** - find interventions with direct evidence of long-term benefits, e.g. a randomised controlled trial that shows that an intervention increases income for students.

- **Evidence of educational outcomes** - find interventions with evidence of impact on educational outcomes and then find evidence that those outcomes lead to long-term benefits e.g. a randomised controlled trial that shows that using an intervention improves reading test scores, and then other evidence that suggests reading skills lead to increased income.

Where it is available, evidence of the first type, which shows a direct effect of an intervention on a long-term benefit (such as income), provides the most reliable support for an intervention because it is directly applicable to the intervention. The link between increased test scores and long-term benefits depends greatly on the context of the education, so the second approach provides less certainty of impact. However, most available evidence on interventions is on educational outcomes rather than long-term benefits. Therefore, we consider both types of evidence.

At primary and secondary level, the two types of educational output that an intervention will most commonly have evidence for are attendance, measured as years of schooling, and learning outcomes, measured as test score increases (most commonly numeracy and literacy). We place more weight on interventions with evidence of learning outcomes rather than attendance outcomes because it is a more direct measure of what we care about.

3.2 What interventions could donors fund in low- and middle-income country education?

The main interventions we have found that donors could fund in low- and middle-income country education are listed below, by level.

- Primary and secondary:
    - Demand-side - interventions that increase demand for education

        - Merit-based scholarships
        - Conditional or 'labelled' cash transfers
        - Literacy classes for mothers
        - Providing households with information on the returns to schooling
    - School inputs - providing additional resources to schools
        - Building new schools
        - Providing school meals
        - Increasing the number of teachers
        - Increasing hours of teaching
        - ‘Multi-level’ learning materials
        - Providing textbooks or flipcharts
        - Building libraries
    - Pedagogy - changes to the way that students are taught
        - 'Teaching at the Right Level' interventions
        - Tech-based interventions
    - Governance - changes to how an education system works
        - Changes to employment policy
        - Increasing teacher accountability
        - Decentralising decision-making to schools or communities

        - Making schools single-sex
- Early childhood:
    - Stimulation-based interventions
    - Providing additional pre-school education
- Vocational:
    - The Educate! programme providing business skills training to secondary students
    - Samasource's programme to train people in poverty with basic digital skills and provide them with work

In addition to interventions that are specific to a given level of education, interventions that donors could fund that cut across all levels of education are:

- Research:
    - Evaluating promising interventions
    - Research into the long-term effects of education
- Education technology:
    - Providing access to technology
    - Computer-assisted learning
    - Online learning
    - Tech-enabled behavioural interventions
- Health-based:

- Salt iodisation
- Deworming
- Vitamin A supplementation
- Iron supplementation

3.3 Which interventions are most cost-effective?

Of the interventions we have found, we think the most cost-effective interventions are:

- 'Teaching at the Right Level' (TaRL)
- Salt iodisation

These interventions are described and evaluated below. Overall, we think that salt iodisation has the strongest evidence of cost-effectiveness, followed by TaRL.

3.3.1 Teaching at the Right Level (TaRL)

In many countries, students' learning levels are below the expected level for their grade, so there is a misalignment between the teaching they receive and their learning level. One category of intervention with repeated evidence of success is that based on the pedagogical approach of 'Teaching at the Right Level'. The central principle behind TaRL is to teach to the level of the student, rather than the level laid out by the curriculum. The principles behind TaRL were developed by the education charity Pratham in the early 2000s. There are now multiple studies showing that interventions that use this approach are an effective way to improve learning outcomes. In some cases, the costs of these interventions can be quite low. TaRL interventions are the educational interventions that we think have the most evidence of effectiveness on learning outcomes.

What is it?

TaRL is a pedagogical approach based on teaching to the current education level of the student, rather than the level laid out by the curriculum. There are several different interventions that have this principle at their core:

- Tracking pupils by ability, so that classes have less variety of level and teaching can be more precisely calibrated to the class.
- Remedial classes for underperforming pupils, so that pupils can keep up with the curriculum taught in regular classes.
- Personalised software, which can target content very precisely to a user's education level.

What is its effect on test scores?

The evidence for these types of interventions comes from nine studies. These studies are summarised in the table below.

Paper	Location	When	Description	Subjects and curriculum	Duration and when	Short-term learning outcomes
Balsakhi	Mumbai and Vadodara, India	2001 to 2004	Local youth paid small stipend to work with academically weak children in pull-out classes	Language, maths. Curriculum developed by Pratham, focusing on core competencies from grades 1 and 2	2 hours per day within school, but outside the regular classroom (over the course of the school year)	- Average test scores (across all students) increased by 0.14 standard deviations (SD) in first year, 0.28 SD in second year - Gains came from children sent to Balsakhi (0.6 SD on overall test score in the second year)

Community-based classes	India, Jaunpur district in eastern Uttar Pradesh	2005 to 2006	Unpaid village volunteers trained to teach basic reading and encouraged to hold classes	Reading (Hindi), maths	2 hours per day, outside of school hours (2–3 months of the school year)	- Children in the villages that received intervention 3 are 1.7% more likely to read at least letters (significant at the 5% level) - Children who could not read at baseline are 7.9% more likely to be able to read letters at endline
Read India 1 (Bihar)	Bihar	2008 to 2010	Unpaid village volunteers trained to provide extra teaching to children who need help outside of school	Reading, writing, maths	Around 60 teaching days, outside of school hours (over the course of each school year)	- 0.125 SD in Language, 0.105 SD in maths - Insignificant effects without volunteers (i.e. materials and teacher training)
Read India 1 (Uttarakhand)	Uttarakhand	2008 to 2010	Unpaid village volunteers trained to provide extra teaching to children who need help during school	Reading, writing, maths	Around 50 teaching days, during school hours (over the course of the school year)	- Insignificant effects
Read India 1 (summer camps)	Bihar, Summer Camps	2008	Remedial education provided in a 1-month summer camp, by government teachers	Reading, writing, maths	3-4 hours a day, 5 days a week, for 1 month (during the summer)	- 0.09 SD's in language, 0.07 SD's in maths
LEP	India, Haryana	2012 to 2013	Pupils regrouped in school by learning level, for 1 hour a day	Reading. Pratham curriculum.	1 hour per day, within the regular classroom (over the course of the school year)	- 0.15 SD on language (reading + writing), no effect on maths

Learning Camps	India, Uttar Pradesh	2013 to 2014	Children were grouped by level and given intensive teaching on short camps	Reading, maths	3 hours per day within school, but outside the regular classroom. 10- or 20-day camps (50 days total instruction) occurring in 1–2 month intervals.	- 10-day camp: 0.7 SD on both language and maths - 20-day camp: 0.6 SD on both language and maths
TCAI	Ghana	2010 to 2013	Teachers and community assistants (TCAs) taught basic skills to children academically behind, in 4 different specifications	Native language, English, maths	2 hours per day within school, during the regular school day or after school	- Remedial TCAs, during school: 0.142 - Remedial TCAs, after school: 0.133 - Normal curriculum TCAs: 0.107 - Teacher training: 0.083
Extra Teacher	Kenya	2005 to 2007	Schools provided with extra contract teacher and split classes by children's initial test scores	Language, maths	Within school, within the regular classroom (over the school year)	- 0.22 SD

The raw average effect across all studies was around 0.3 standard deviations. If the Learning Camps study in Uttar Pradesh is treated as an outlier and excluded, then the raw average is around 0.16 standard deviations. This makes no adjustment for the number of hours of teaching received in each study.

How cost-effective is it?

The cost of the intervention depends on the version that is carried out. We found cost data in two of the studies included above. J-PAL found a cost for the Balsakhi programme of around $4 per student per year. As we will see in the next section, costs provided by charities themselves for their programmes were similar. Pratham give a rough cost for their Read India programme of around $10 per student per year. These costs would imply a rough cost-effectiveness of around 1 standard deviation increase in test scores per $100. These are impressive results.

What are the key parameters of 'Teaching at the Right Level' interventions?

TaRL interventions can vary in many ways. The main parameters of how they can vary are:

- Substitutive versus additional - is the education provided additional or replacing other teaching that would be received?
- Provider - who carries out the teaching and assessing? What training is received?
- Student selection - is the teaching directed towards weak students or all students?
- Duration - how many hours of teaching is received?
- Concentration - is the instruction provided in concentrated bursts, such as in intensive learning camps, or throughout the school year?

Summary of 'Teaching at the Right Level'

TaRL interventions are those based on the principle of teaching to the level of the student, rather than the level laid out by the curriculum. This can be done by tracking pupils by ability rather than age, providing remedial classes to students who have fallen behind, or using software that personalises education to the level of the student. There are now multiple studies showing that interventions that use this approach are an

effective way to improve learning outcomes. The effect of these interventions on learning outcomes is in the region of 0.1–0.3 standard deviations per student. Costs for TaRL interventions vary by the specific implementation used but are in the region of $10–100 per student each year. TaRL interventions are the educational interventions that we think have the most evidence of effectiveness on learning outcomes.

3.3.2 Salt iodisation

This section is based heavily on GiveWell's research on universal salt iodisation.

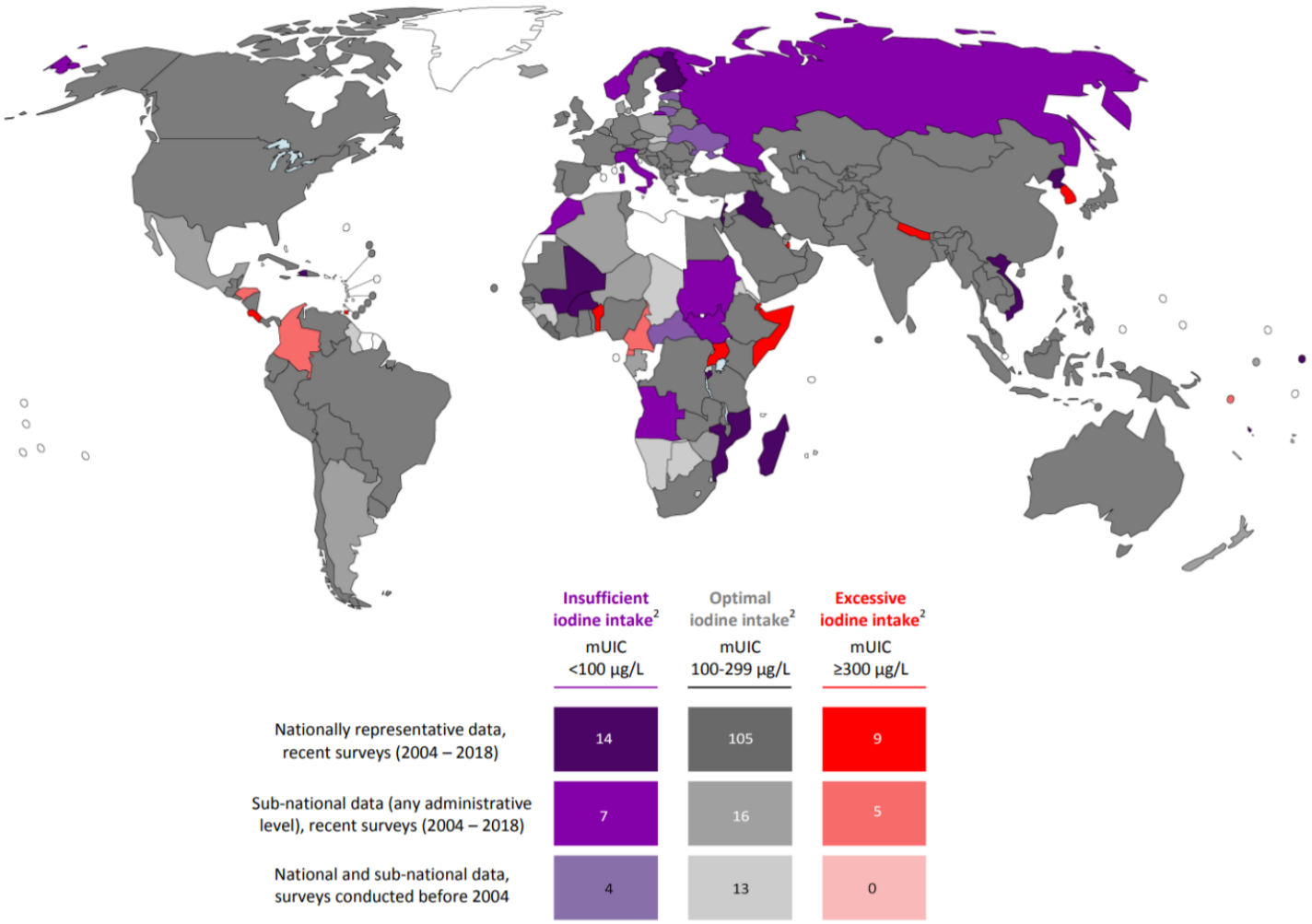
Evidence suggests that iodine deficiency in children reduces IQ by around four points, enough to move someone from the 50th percentile of their population to the 40th.[90] Iodine deficiency is widespread. Worldwide, 187 million people experience goitre caused by iodine deficiency,[91] and around 246 million children are iodine deficient.[92] As shown in Figure 10, according to the charity Iodine Global Network (IGN) 21 countries are classified as iodine deficient, based on surveys taken since 2004. Salt iodisation is a cheap solution to this problem and is one of GiveWell's priority interventions. For donors who are interested in education for the learning outcomes and improved life outcomes that it produces, we think salt iodisation is the most cost-effective intervention available, even though the intervention itself is not educational in nature.

[90] By convention 15 IQ points represents 1 standard deviation. Assuming scores are distributed normally implies that a reduction of 4 points from the mean score would put someone at the 40th percentile

[91] 187m people experience goitre due to iodine deficiency, see table 1 - Theo Vos et al., "Years Lived with Disability (YLDs) for 1160 Sequelae of 289 Diseases and Injuries 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010," *The Lancet* 380, no. 9859 (December 15, 2012): 2163–96, https://doi.org/10.1016/S0140-6736(12)61729-2.

[92] Michael B. Zimmermann and Maria Andersson, "Update on Iodine Status Worldwide," *Current Opinion in Endocrinology, Diabetes and Obesity* 19, no. 5 (October 2012): 382, https://doi.org/10.1097/MED.0b013e328357271a.

Figure 10: Global scorecard of iodine nutrition in 2019 based on median urinary iodine concentration (mUIC) in school-age children



Source: The Iodine Global Network, IGN: Zurich, Switzerland, 2019

What is the intervention?

Salt iodisation programmes consist of salt manufacturers fortifying their salt with iodine. Salt iodisation is one of the main approaches used internationally for preventing iodine deficiency.[93]

What is the short-term effect of iodine deficiency on IQ?

Two meta-analyses (Angermayr and Clar 2004 and Taylor et al. 2013) identify six randomised controlled trials evaluating the effect of iodine supplementation on children's IQs. These studies provided iodine supplementation to children aged between 5 and 12 years. Iodine levels, measured as urinary iodine concentration, and cognitive function, measured with a different set of tests in each study, were evaluated at between 4 and 22 months after the start of supplementation. For the four studies for which GiveWell were able to calculate a treatment effect, the average effect was 0.34 standard deviations. Of these four however, only two had treatment groups that were no longer iodine deficient at the time of the cognitive tests. For these two studies the effects were 0.19 standard deviations and 0.29 standard deviations. The average, 0.24 standard deviations, equates to four IQ points.

GiveWell note that publication bias is particularly likely for IQ effects. This is because there are multiple IQ tests that can be used, and because effects on IQ are particularly publishable.

[93] "One of the best and least expensive methods of preventing iodine deficiency disorder is by simply iodizing table salt, which is currently done in many countries. It represents one of the easiest and most cost-effective interventions for social and economic development.", "WHO | Sustaining the Elimination of Iodine Deficiency Disorders (IDD)," WHO, accessed October 8, 2019, https://www.who.int/nmh/iodine/en/.

What is the long-term effect of iodine deficiency in childhood on IQ?

GiveWell are uncertain about whether the positive effects of salt iodisation in childhood would persist over the long term. If iodine deficiency hinders cognitive *development* then the benefits may persist, but if it simply hinders cognitive skills, then the benefits may remain only while the child is not iodine deficient. Alternatively, a third possibility is that iodine may provide a short-term boost to IQ that disappears even if the child remains iodine sufficient.

Most of the evidence that GiveWell look at comes from long-term evaluations of early childhood education programmes. The results of these suggest that IQ increases may fade out over time, though there is some dispute around these findings.[94] GiveWell are uncertain how well this evidence generalises to iodine supplementation. In our view the evidence from these evaluations does not provide much information on the long-term effect of salt iodisation, because it only shows the effect of educational interventions on IQ and not on iodine deficiency. We are not aware of any experimental evidence that looks directly at the long-term effect of iodine deficiency on cognitive development.

[94] "It is true that the High/Scope Perry Preschool program had a statistically significant effect on children's IQs during and up to a year after the program, but not after that. This pattern has been found in numerous other studies, such as those in the Consortium for Longitudinal Studies (1983).", Lawrence J Schweinhart et al., "The High/Scope Perry Preschool Study Through Age 40," n.d., 21; "Our review finds mixed, but generally positive, evidence regarding Head Start's long-term benefits. Although studies typically find that increases in IQ fade out over time, many other studies also find decreases in grade retention and special education placements. Sustained increases in school achievement are sometimes found, but in other cases flawed research methods produce results that mimic fade-out. In recent years, the federal government
has funded large-scale evaluations of Head Start and Early Head Start. Results from the Early Head Start evaluation are particularly informative, as study participants were randomly assigned to either the Early Head Start group or a control group. Early Head Start demonstrated modest improvements in children's development and parent beliefs and behavior", W Steven Barnett and Jason T Hustedt, "Head Start's Lasting Benefits," 2004, 9.

Even if the cognitive effects do not persist, then other benefits from increased IQ in children, such as the benefits of improved educational attainment, may do. In addition, the costs of salt iodisation programmes are low enough that they would remain cost-effective if iodine fortification was required throughout adulthood.

Do salt iodisation programs increase iodine levels?

A systematic review (Abudou et al. 2014) that looked at 38 studies evaluating salt iodisation programmes found that nearly all of them increased urinary iodine concentration, a common measure of iodine level. GiveWell have looked into four of the individual studies. Having investigated the evidence, GiveWell believe there is a reasonably strong case that countrywide salt iodisation efforts have successfully reduced iodine deficiency, and we agree with this view.

How cost-effective are they?

Iodisation programmes cost around $0.02–0.10 to fortify enough salt for one person per year. GiveWell estimate that this puts them in the range of their top charities.[95] A cost-effectiveness model is available in their salt iodisation intervention report.

3.4 Discussion of evidence for other interventions

This section discusses the broader evidence for the effectiveness and cost-effectiveness of educational interventions that we have not prioritised, in six areas:

- Primary and secondary education

[95] "Salt iodization appears to be within the range of cost-effectiveness of our priority programs", GiveWell's Salt Iodization Intervention Report

- Early childhood education
- Vocational education
- Research into education
- Education technology
- Health-based interventions

Although we have looked for interventions in all these areas, we focused most heavily on primary and secondary education, because this is the area in which we found the most evidence available on the effectiveness of interventions and because we are particularly confident in the benefits of basic numeracy and literacy skills, which are most relevant to primary education.

3.4.1 Primary and secondary

This section gives an overview of direct interventions at primary and secondary level in low- and middle-income countries. Indirect interventions such as funding research are covered separately in later sections. The interventions with the most evidence of a positive effect on learning outcomes are TaRL interventions, which are interventions that aim to calibrate instruction more precisely to the level of the user.

The three main sources we have used for this section are a literature review on improving school education outcomes (Glewwe et al. 2015), J-PAL learning outcome cost-effectiveness evaluations, and a J-PAL bulletin on attendance. The Glewwe et al. literature review is the most extensive of these but does not include detailed cost-effectiveness figures, unlike the J-PAL sources. Where cost-effectiveness estimates are not provided for an intervention, it is because we were unable to easily find cost-effectiveness data.

Primary and secondary interventions can be broken down into the following categories:[96]

- **Demand-side** - interventions that increase demand for education, either by increasing the perceived returns or reducing the costs.
- **School inputs** - providing additional educational inputs, such as textbooks or new schools.
- **Pedagogy** - using new ways of teaching to improve learning.
- **Governance** - making changes to how the education system works.

The main interventions in each of these categories are discussed below. Figure 11 shows the large variation in the cost-effectiveness of different educational initiatives.

[96] Following the categorisation used in Glewwe et al (2015)

Figure 11: Cost-effectiveness of selected education programmes, based on learning outcomes

Source: J-PAL, 'Conducting Cost-Effectiveness Analyses'

Demand-side

Demand-side interventions are those that increase demand for education, either by increasing the perceived returns or reducing the costs. In general, demand-side interventions can be very effective at increasing attendance, but the effect on learning outcomes depends on the education that is received. The most promising interventions in this area are:

- **Merit-based scholarships** - scholarships are financial aid for students to further their education. Scholarships are sometimes awarded based on academic merit, which means that the payments are only made if certain test scores are achieved.
    - Of the four studies in Glewwe et al. (2015) that look at the effect of merit-based scholarships on learning outcomes, three found a significant positive effect. These three studies also include cost-effectiveness figures, and these figures range from an increase in test scores of 0.5 to 10 standard deviations per $100.[97] There is also direct evidence that scholarships increase income in two papers that showed that secondary school scholarships increased earnings after graduation.[98]

[97] Paul Glewwe and Karthik Muralidharan, "Improving School Education Outcomes in Developing Countries: Evidence, Knowledge Gaps, and Policy Implications," accessed October 10, 2018, http://econweb.ucsd.edu/~kamurali/papers/Published_Book_Chapters/School_Education_Developing_Countries.pdf.
[98] "For students admitted to vocational tracks (comprising 60% of the sample) scholarships did not increase tertiary education, which simplifies the interpretation of labor market outcomes. In this subsample, scholarships increased the likelihood of earning money by 8.8 percentage points (16%) and increased total earnings by 19%." Esther Duflo, Pascaline Dupas, and Michael Kremer, "The Impact of Free Secondary Education: Experimental Evidence from Ghana," n.d., 88. "The authors estimate that lottery winners had higher average formal sector earnings between 8 and 14 years after secondary school completion…", "Education in Developing Countries."

- The learning effects and income effects of scholarships depend heavily on the type and quality of the schooling that is being funded, so results generalise particularly badly. For this reason, we think these studies do not provide that much evidence that scholarships in general increase learning, although they do provide evidence that scholarships increase demand for education and attendance. For this reason, we prioritise TaRL over providing merit-based scholarships.
- Scholarships may be costlier than the very best interventions because they involve paying for every component of a child's education, rather than just the most impactful parts.

- **Providing information on the returns to education** - people make decisions about education based on what they think the benefits of it are. Providing information to families about the returns to education can prevent them underestimating its benefits and increase the amount of education they choose to receive and the effort they put into it.
  - There are three studies we know of that look at the effect of providing information on time in school or learning outcomes. The first, in Madagascar, found doing so increased test scores by 0.2 standard deviations (although it found a statistically insignificant effect on attendance).[99] J-PAL found the cost-effectiveness for this trial to be more than 100 standard deviations for $100, which is very high. The second, in the Dominican Republic, found that students who received information had completed 0.2 more years of schooling four years later. The third, in

[99] Trang Nguyen, *Information, Role Models and Perceived Returns to Education: Experimental Evidence from Madagascar," Mimeo,* 2008.

China, found that for a 45-minute information session on the increase in earnings from education there were no statistically significant effects on dropout rates or test scores.

- Although there is one very high cost-effectiveness estimate for providing information on returns to schooling, we are more confident in the effect of TaRL and salt iodisation because they have been studied and carried out much more extensively, and because one of the three returns to schooling studies found no effect.

Other interventions in this area include unconditional and conditional cash transfers. As shown in Figure 11, these have modest effects on learning outcomes.

School inputs

'School inputs' are interventions that provide additional conventional educational inputs, such as textbooks or new schools. In general, providing school inputs on their own is not as cost-effective as interventions in the other categories, unless it is supplemented with related instruction. Inputs with experimental evidence showing an effect on learning outcomes are:

- **Building new schools** - providing new schools is the intervention in this category that has the most evidence of effectiveness. Building new schools improves access by reducing the distance to the

nearest school, which is an important indirect cost of education.[100] This works best when access is extremely limited. Five out of five studies in Glewwe et al. (2015) found significant effects on time in school, across a wide range of countries and contexts. Two of these studies also investigated learning outcomes and both found a significant effect. For one of these studies, in which community schools were set up in Afghanistan, cost data was included and J-PAL estimated an increase in test scores of around one standard deviation per $100. These schools were created using existing resources rather than created from scratch. Overall, we think the evidence for the effectiveness of TaRL interventions is stronger, but would be interested to hear of efforts to provide low-cost schooling in areas where it is not currently received.

- **Providing school meals** - providing school meals led to a statistically significant improvement in test scores in three of four studies looking at it. Effects on learning outcomes ranged from 0.1 to 0.25 standard deviations.
- **Increasing hours of teaching** - making the day longer is one way to increase the amount of schooling received. Increasing hours of teaching in the day led to a statistically significant improvement in test scores in two of two studies.

[100] " Five high quality studies have examined the impact of building new schools on time in school. Each of these five studies examined a different country, so evidence is available from Afghanistan, Burkina Faso, Indonesia, Mozambique and Pakistan. Building new schools reduces a very important indirect cost of attending school, the distance to the nearest school. ", Glewwe and Muralidharan, “Improving School Education Outcomes in Developing Countries: Evidence, Knowledge Gaps, and Policy Implications.”

Inputs the provision of which does not have much effect include providing textbooks, flipcharts or laptops, and building libraries. Inputs with mixed or slim evidence include reducing the pupil-teacher ratio and providing 'multi-level' learning materials that aim to cater to each individual.

Pedagogy

Pedagogical interventions are interventions that use new ways of teaching to improve learning. In general, pedagogical interventions have the potential to be very cost-effective, although there is considerable variation and changes that have intuitive appeal can be ineffective. The main interventions we know of in this area are:

- ‘Teaching at the Right Level’ (evaluated above)
- Technology-based interventions
    - At primary and secondary, the main intervention included in this category is computer-aided learning, in which a computer is used to assist the pupil’s learning. Glewwe et al. (2015) include nine studies investigating the effects of computer-based interventions on learning. These find a wide range of impacts, which is unsurprising given the obvious importance of *how* the computers are used.
    - Education technology across all levels of education, rather than just primary and secondary, is included in a later sub-section. As well as this, one software program with strong experimental evidence is called Mindspark, which is produced by a company called Educational Initiatives. The evidence for Mindspark is explored in more depth in section 4 on recommended charities.

Governance

Governance interventions aim to improve learning by making changes to how the education system works. Changes can be beneficial in low- and middle-income countries because education systems in these regions sometimes have weak governance. One symptom of this is high teacher absentee rates, which can be as high as 25%.[101] Examples of changes to governance with evidence available are:

- Changes to employment policy
- Increasing teacher accountability
- Decentralising decision-making to schools or communities
- Making schools single-sex

The most effective governance interventions focus on improving teaching: paying teachers based on performance or using shorter-term renewable contracts.[102] This fits with our overall impression that quality of teaching is widely considered crucial to effective education.[103] Performance-based pay, in which a component of teachers' pay is based on their pupils scores, has been shown to have a significant effect on learning

[101] "Another striking measure of weakness of school and teacher governance in developing countries is the high rate of teacher absence from schools. Chaudhury et al. (2006) present results from a multi-country study where enumerators made unannounced visits to public schools to measure teacher attendance and activity, and report an average teacher absence rate of 19%, with teacher absence rates of 25% in India and 27% in Uganda. In India, Kremer et al. (2005) report that not only were 25% of teachers absent from work, but another 25% were in school but not teaching and thus only about half of the teachers were found to be actually engaged in teaching activities.", Glewwe and Muralidharan, 58.
[102] See table 10 and 11, Glewwe and Muralidharan, 112.
[103] For example, see: Eric A Hanushek, Marc Piopiunik, and Simon Wiederhold, "The Value of Smarter Teachers: International Evidence on Teacher Cognitive Skills and Student Performance," Working Paper (National Bureau of Economic Research, December 2014), https://doi.org/10.3386/w20727.

outcomes in multiple settings, by increasing teacher effort.[104] Using teachers who are on short-term renewable contracts has also been found to improve test scores, even though they are paid less and have not received as much training.[105]

The main problem with governance interventions is tractability. Problems of governance are generally less tractable than other educational problems because of the political barriers that need to be bypassed. Changes can often be controversial with important stakeholders such as teachers' unions, so even if a policy such as performance-based pay improves learning outcomes, there may be strong political opposition to such a change.[106] Partly because of this, even sophisticated philanthropists have sometimes not been able to succeed in this area. The Bill and Melinda Gates Foundation has invested billions of dollars implementing large-scale changes to education systems in the US, such as making schools smaller and increasing teacher accountability, but has had an uncertain effect.[107]

[104] "Nevertheless, the demonstrated low levels of teacher effort in developing countries (manifested by high rates of absence) have led both policy makers and researchers to consider the possibility that introducing performance-linked pay for teachers may improve outcomes. Four high quality studies have been conducted on this topic in recent years in developing countries. As seen in Table 10, one of these studies examined the impact of this type of education policy on students' time in school. All four studies examined the impact of this type of intervention on test scores (see lines 4-5 in Table 11); most of which have found significantly positive impacts ",Glewwe and Muralidharan, pg. 64.

[105] See table 11. Glewwe and Muralidharan, "Improving School Education Outcomes in Developing Countries: Evidence, Knowledge Gaps, and Policy Implications."

[106] "Nevertheless, scaling up the insights from this body of evidence into policy is non-trivial because of political challenges. This is best highlighted by Bold et al. (2014) who conduct a similar study in Kenya to the one conducted by Duflo, Dupas, and Kremer (2015) and find that the contract teacher program that they studied had a positive impact on student learning when implemented by a non-profit partner, but that it had no impact when implemented by the government (partly because the program itself was not implemented). In practice, the scaling up of contract teacher programs has been politically challenging because of pressure from contract teacher unions (especially when a large number of contract teachers are hired) to get "regularized".", Glewwe and Muralidharan.

[107] Dylan Matthews, "Billionaires Are Spending Their Fortunes Reshaping America's Schools. It Isn't Working.," Vox, October 30, 2018, https://www.vox.com/future-perfect/2018/10/30/17862050/education-policy-charity.

3.4.2 Early childhood

The most promising educational intervention we found in early childhood is providing stimulation-based activities, such as play-based activities with the child's mother. The one other educational intervention we have come across is simply providing additional pre-school. Nutritional supplementation is a common non-educational intervention in this area.

Overall, we have not found any interventions during early childhood that are as promising as the best educational interventions we know of. Our main uncertainties around stimulation-based interventions are whether their high cost could be sufficiently reduced at scale, whether their positive cognitive effects persist and how meaningful the cognitive measures used in previous studies are.

The rest of this section evaluates the evidence for the benefits of stimulation interventions.

Psychosocial stimulation

The early childhood education interventions we have found with the most evidence of effectiveness are those based on providing psychosocial stimulation to young children. We know only of one meta-analysis that found that interventions that provide psychosocial stimulation to pre-primary infants increase short-term cognitive outcomes. There is also experimental evidence that stimulation increases income and long-term cognitive outcomes for stunted children, although there is also evidence that cognitive gains fade out over time. Overall, we are less confident in the cost-effectiveness of stimulation interventions than TaRL and salt iodisation. Our main uncertainties are whether the high cost could be sufficiently reduced, whether the effects persist and how meaningful the cognitive measures used in the studies are.

What is it?

Psychosocial stimulation interventions consist of play sessions, educational games and other games based on labelling things in their environment.[108] These can either be delivered in home visits, group sessions or clinic appointments.

What are the short-term cognitive effects?

Evidence that providing stimulation does have a short-term effect on cognitive outcomes comes from a 2015 meta-analysis. This meta-analysis of 21 stimulation intervention studies (Aboud et al. 2015) found a moderate- to large-effect size of 0.42 on short-term cognitive outcomes, which is of roughly comparable size to the benefits of iodine supplementation.[109] The intervention settings included home visits, group sessions and clinic appointments. In most of the studies included, the cognitive tests were standard tests of mental development such as the Bayley or Griffiths scales. Two of our main uncertainties around this meta-analysis are which components of the programmes are most important and a lack of understanding of the cognitive tests used.

[108] "Mothers were encouraged to converse with their children, to label things and actions in their environments and to play educational games with their children", P. Gertler et al., "Labor Market Returns to an Early Childhood Stimulation Intervention in Jamaica," *Science* 344, no. 6187 (May 30, 2014): 998–1001, https://doi.org/10.1126/science.1251178.
[109] " A systematic review and meta-analysis of 21 interventions aimed at enhancing stimulation and 18 interventions that provided better nutrition—all conducted since 2000—revealed that stimulation had a medium effect size of 0.42 and 0.47 on cognitive and language development, respectively, whereas nutrition by itself had a small effect size of 0.09.", Global Health and Development in Early Childhood, F. Aboud and A. Yousafzai

In one of the studies, in Pakistan in 2009–10, the cognitive outcomes were sustained two years later.[110] However, in one study in Colombia published after the meta-analysis, benefits were not sustained two years after the end of the intervention.[111]

What are the long-term effects?

We know of one experimental study (Gertler et al., 2014) looking at the long-term effects of psychosocial stimulation. In addition to this, evidence comes from long-term evaluations of early childhood programmes in the US, though these do not focus on psychosocial stimulation specifically. Overall, we remain uncertain about the long-term effects of stimulation interventions.

- **Gertler et al. 2014**
    - In Jamaica in 1986–87, stunted children aged 9–24 months were provided with psychosocial stimulation in the home, and then followed up with at five points over the next 20 years.
    - Cognitive tests[112] were given 0, 4, 8, 14 and 20 years after the intervention. At all five points the effect on scores was positive and statistically significant. IQ was also measured in the most recent follow-up and was 0.6 standard deviations higher than the comparison group.

[110] "Children who received responsive stimulation (with or without enhanced nutrition) had significantly higher cognition, language, and motor skills at 4 years of age than children who did not receive responsive stimulation.", Aisha K. Yousafzai et al., "Effects of Responsive Stimulation and Nutrition Interventions on Children's Development and Growth at Age 4 Years in a Disadvantaged Population in Pakistan: A Longitudinal Follow-up of a Cluster-Randomised Factorial Effectiveness Trial," *The Lancet Global Health* 4, no. 8 (August 1, 2016): e548–58, https://doi.org/10.1016/S2214-109X(16)30100-0.
[111] "We found no evidence that a scalable PS intervention benefited children's development 2 years after it ended.", Alison Andrew et al., "Impacts 2 Years after a Scalable Early Childhood Development Intervention to Increase Psychosocial Stimulation in the Home: A Follow-up of a Cluster Randomised Controlled Trial in Colombia," *PLOS Medicine* 15, no. 4 (April 24, 2018): e1002556, https://doi.org/10.1371/journal.pmed.1002556.
[112] Using the Bayles/Griffiths scales

Income was also measured 20 years later. For the 105 participants that they were able to follow up with, the intervention increased earnings by 25%, constituting a full catch up to a non-stunted comparison group. [113]

- Generalisability seems likely to be particularly low for this study because the intervention took place in the home, which we would expect to vary between contexts more than classrooms. This also means that whether the scaled version of the intervention would match the tested intervention is more uncertain.

- **Other evidence**

  - Additional evidence comes from long-term evaluations of early childhood programmes in the US. These programmes are Head Start, a US early childhood programme, and HighScope, an early childhood education approach developed in 1970. These programmes did not focus specifically on providing stimulation but provide suggestive evidence because some of the activities involved in early childhood programmes are likely to provide stimulation. This evidence seems to suggest that some of the cognitive gains fade out over time whereas other

[113] "The authors reinterviewed 105 out of 129 study participants 20 years later and found that the intervention increased earnings by 25%, enough for them to catch up to the earnings of a nonstunted comparison group identified at baseline (65 out of 84 participants).", Gertler et al., "Labor Market Returns to an Early Childhood Stimulation Intervention in Jamaica."

benefits persist to adulthood, but there is uncertainty around these results.[114] We have not looked into these studies in depth.

Overall, we remain uncertain about the long-term effects of stimulation interventions.

How cost-effective is it?

The cost per child per year from an intervention mimicking the intervention in the Jamaica study was estimated at $500.[115] Assuming the benefits of stimulation interventions are comparable to the benefits of salt iodisation programmes, this would imply that providing stimulation is around 100x less cost-effective than salt iodisation. However, the cost of this intervention may be able to be reduced by carrying out the intervention in a group setting.

3.4.3 Vocational

Vocational interventions are those that teach job-specific skills. These skills can be taught in many different formats, including apprenticeships, work experience and after-school clubs. GiveWell provide a brief overview of the experimental evidence for vocational training programmes and conclude an uncertain effect,

[114] “It is true that the High/Scope Perry Preschool program had a statistically significant effect on children’s IQs during and up to a year after the program, but not after that. This pattern has been found in numerous other studies, such as those in the Consortium for Longitudinal Studies (1983).”, Lawrence J Schweinhart et al., “The High/Scope Perry Preschool Study Through Age 40,” n.d., 21;
" Our review finds mixed, but generally positive, evidence regarding Head Start’s long-term benefits. Although studies typically find that increases in IQ fade out over time, many other studies also find decreases in grade retention and special education placements. Sustained increases in school achievement are sometimes found, but in other cases flawed research methods produce results that mimic fade-out. In recent years, the federal government has funded large-scale evaluations of Head Start and Early Head Start. Results from the Early Head Start evaluation are particularly informative, as study participants were randomly assigned to either the Early Head Start group or a control group. Early Head Start demonstrated modest improvements in children’s development and parent beliefs and behavior", W Steven Barnett and Jason T Hustedt, “Head Start’s Lasting Benefits,” 2004, 9.
[115] “The program cost about $500 per year per child, which could be further reduced at scale...” https://www.povertyactionlab.org/sites/default/files/publications/514%20CCT%20Integrated%20Early%20Childhood%20Development%20in%20Colombia.pdf

because generalisability is particularly low for vocational programmes.[116] In addition to the papers included in GiveWell's report, we are aware of two other vocational programmes. The first is the programme of the non-profit Samasource, who train people in poverty with basic digital skills and then provide them with work. We plan to keep up to date with an on-going trial of this programme even though a previous non-randomised evaluation found an income effect that did not cover the programme's costs.[117] The second is the programme of the charity Educate!, which is described below.

The Educate! programme

The vocational intervention we looked into most deeply is a vocational programme run in Ugandan secondary schools by Educate!. Selected pupils are provided with 80 minutes a week of intensive business skills training in topics that include sales, project management and saving. Pupils are also provided with mentorship from alumni of the programme and encouraged to set up student business clubs. Evidence for their programme comes from a randomised controlled trial run in Uganda that found it increased income at the end of the programme by over 100%, and a more recent quasi-randomised controlled trial that found increased income at the end of the programme by 95%.

Our main uncertainties about these results are related to high attrition, the meaningfulness of the reported income, the persistence of the income effect and potential negative spillovers to non-participants. Overall, we

[116] "However, as we discuss in more detail below, we think that it is difficult to draw general conclusions from individual evaluations of education interventions, and these challenges are particularly acute for vocational training programs, given the wide variety of programs available within and between countries.", "Education in Developing Countries."
[117] "Samasource Impact Audit Report", Impact Matters, accessed November 19, 2018, https://static1.squarespace.com/static/5b58d0731137a607b648ed4c/t/5b61e67f8a922d20d3b15404/1533142667126/Samasource+Impact+Audit+Report_v9.pdf; "The Impact of a Tech-Centered Vocational Training and Employment Program for Youth in Kenya," Innovations for Poverty Action, February 20, 2018, https://www.poverty-action.org/study/impact-tech-centered-vocational-training-and-employment-program-youth-kenya.

think the strength of evidence is stronger for TaRL interventions and salt iodisation, but we plan to keep updated on follow-up studies to the randomised controlled trial.

3.4.4 Research

One ‘meta-intervention’ a donor could fund is research into the effectiveness of educational interventions.

There are two main types of research we considered. The first type is research into the effectiveness of specific promising interventions. For example, running a randomised controlled trial looking at the learning effect of a specific educational software program. Research of this type could result in new effective interventions and direct funds to it from less impactful opportunities. The second type is following up on previously run randomised controlled trials to assess the long-term effects. This would provide valuable new information on the long-term effects of education, given the lack of experimental evidence we have seen on the long-term effects of education.

The impact of research in this area seems highly dependent on the intervention and context of the research project, and we are not aware of any organisation funding or choosing research based on criteria that we would find sufficient to entirely outsource the decision to them. Given this, we think research projects would be best evaluated on a case-by-case basis. We are in contact with organisations that have fundable research projects in education, such as J-PAL's Post-Primary Education Initiative and the Education Endowment Foundation, so donors who are particularly interested in funding research in this area should contact us.

3.4.5 Education technology

Broad categories of education technology interventions, as laid out in a recent review looking at more than 100 experimental studies, include:[118]

- **Access to technology** - simply providing students with access to computers or the internet.
- **Computer-assisted learning** - software to deliver educational content such as 'adaptive-learning software', either in or outside the classroom.
- **Tech-enabled behavioural interventions** - using technology to encourage certain behaviours, such as:
    - Nudges to encourage parental engagement in early childhood
    - Encouraging the sharing of information with parents e.g. automated updates
    - Nudges to complete important tasks
    - Intensive college application assistance
    - Mindset changes e.g. building healthy attitudes by encouraging students to think about setbacks
- **Online learning** - learning online usually consists of online courses, most notably massive online courses (MOOCs), which have expanded rapidly in recent years.

[118] Escueta et al., "Education Technology."

The review found that computer-assisted learning, particularly when it includes personalisation, and behavioural interventions are the most promising of these.[119]

The main benefits of technology-based interventions are:[120]

- **Cheap to scale** - distribution and scale-up has the potential to be cheap, once the software has been developed and hardware is in place. (On the other hand, the poorest students are currently unlikely to have access to the necessary hardware, which could make distribution more expensive).
- **Easy to upgrade** - improvements to software can be scaled across many students easily, in contrast to improvements to teachers via training.
- **Personalised to the user** - software programs are well suited to personalising content to the user, and far cheaper than providing individual tutors.
- **Quick feedback loops** - the gap in time between learning, assessment and feedback can be made much shorter.
- **Stimulating content** - content has the potential to be made more stimulating, via interactive modules or games.

[119] "From our review, computer-assisted learning and behavioral interventions emerge as two areas that show considerable promise. Especially when equipped with a feature of personalization, computer-assisted learning can be quite effective in helping students learn, particularly with math.", Escueta et al.

[120] Page 54, Glewwe and Muralidharan, “Improving School Education Outcomes in Developing Countries: Evidence, Knowledge Gaps, and Policy Implications,”.

- **Well-suited to experiments -** the learning effects of software can often be tested and improved more easily than conventional interventions, because results are stored digitally, and the content viewed by each user can be controlled more easily.[121]

The development of effective educational software programs does not seem likely to be neglected, because there are enough beneficiaries with the ability to pay to incentivise companies to create them. Indeed, one estimate puts 2017 global investment in education technology companies at over $9 billion.[122] However, adapting and distributing effective software to those without the means to pay is not incentivised for. This would suggest that philanthropic funding should focus on the distribution of technology rather than its development. While we do not prioritise the distribution of technology as an intervention generally, our charity recommendation of Educational Initiatives is based on the evidence that its 'adaptive-learning' software, Mindspark, leads to learning outcomes.

3.4.6 Health-based interventions

Some health interventions have a clear and direct effect on educational outputs, in which case we think it makes sense for donors interested in education to consider them as potential funding opportunities. Health interventions are often much cheaper than other educational interventions because they tend to be less labour intensive. Whereas many educational interventions require regular interaction between the student

[121] We have been told this by the ed-tech company Educational Initiatives, and in the case of MOOCs this argument has been outlined in: Anne Lamb et al., "Addressing Common Analytic Challenges to Randomized Experiments in MOOCs: Attrition and Zero-Inflation," in *Proceedings of the Second (2015) ACM Conference on Learning @ Scale*, L@S '15 (New York, NY, USA: ACM, 2015), 21–30, https://doi.org/10.1145/2724660.2724669.
[122] "Investments blazed past the $8 billion threshold and easily reached the $9 billion threshold, which is unprecedented.", Sam S Adkins, "Metaari's Analysis of the 2017 Global Learning Technology Investment Patterns," 2017, 30.

and teacher, deworming pills or nutritional supplements are very cheap and only need to be provided a handful of times each year.

The main health interventions with evidence on educational outputs are:

- **Salt iodisation (evaluated above)**
- **Deworming**
    - Some studies have found a large effect of deworming on school attendance. However, two meta-studies both found that deworming probably does not have an effect on school attendance or cognition.[123] Although one study has found long-term income effects in a trial in Kenya, the mechanism for this increase is not clear so may not be because of increased education or improved cognition.[124] Overall, we think the link between deworming programmes and education is too uncertain to include them for consideration as educational interventions, though we are aware that there is disagreement between experts on this question.

[123] "Public health programmes to regularly treat all children with deworming drugs do not appear to improve height, haemoglobin, cognition, school performance, or mortality. We do not know if there is an effect on school attendance, since the evidence is inconsistent and at risk of bias", David C. Taylor-Robinson et al., "Public Health Deworming Programmes for Soil-transmitted Helminths in Children Living in Endemic Areas," *Cochrane Database of Systematic Reviews*, no. 9 (2019), https://doi.org/10.1002/14651858.CD000371.pub7,
"For schistosomiasis, mass deworming might be effective for weight but is probably ineffective for height, cognition, and attendance.", Vivian A. Welch et al., "Mass Deworming to Improve Developmental Health and Wellbeing of Children in Low-Income and Middle-Income Countries: A Systematic Review and Network Meta-Analysis," *The Lancet Global Health* 5, no. 1 (January 1, 2017): e40–50, https://doi.org/10.1016/S2214-109X(16)30242-X.
[124] "The study's headline effect is that as adults, those in the treatment group worked and earned substantially more,63 with increased earnings driven largely by a shift into the manufacturing sector.64 … While the participants were still in school, the treatment group experienced small, non-statistically significant positive effects on school performance (though not on general intelligence).67", "Combination Deworming (Mass Drug Administration Targeting Both Schistosomiasis and Soil-Transmitted Helminths)," GiveWell, accessed October 8, 2019, https://www.givewell.org/international/technical/programs/deworming.

- **Vitamin A supplementation**
    - One study has found that providing vitamin A supplementation (alongside deworming medication and iron supplements) increased pre-school participation rates by 5.8 percentage points (see Roll Call).
- **Iron supplementation**
    - One study has found that providing iron supplementation (alongside deworming medication and vitamin A supplements) increased pre-school participation rates by 5.8 percentage points (see Roll Call).
    - A separate route to educational impact is that, in a similar manner to iodine fortification, providing iron supplements to children improves their mental development. A meta-analysis found that iron supplementation had an effect on mental development scores of 0.3 (measured in standardised mean difference), which is relatively high.[125] This effect is most pronounced in anaemic children, but also appears in children with sufficient iron intake. GiveWell have also looked into iron supplementation and may recommend charities in this area

[125] Hps Sachdev, Tarun Gera, and Penelope Nestel, "Effect of Iron Supplementation on Mental and Motor Development in Children: Systematic Review of Randomised Controlled Trials," *Public Health Nutrition* 8, no. 2 (April 2005): 117–32.

in the future, although they believe it is unlikely that iron supplementation permanently increases cognitive ability in children.[126]

3.5 When should donors focus on education?

One of the most important questions a philanthropist must answer, before deciding which charities or activities to fund, is deciding which cause area/s to focus on. Given this, it is important for any funder to consider not just *which* educational activities to fund, but *whether* to focus on education above other areas. This is important because for most donors, the reasons to focus on education are not based on its *intrinsic* importance but because of the benefits it brings about, which may be achieved more effectively in other ways. Now that we have reviewed the benefits to education and the most promising educational interventions, we are able to evaluate this question.

On balance, we believe that for most donors, global health and economic empowerment will likely be a more effective way to bring about the benefits they care about. The main reasons for this are:

- **Interventions in other areas are very effective at bringing about the benefits of education** - many of the reasons that donors often have for funding education, such as improving the livelihoods of recipients or to create opportunity, also apply to the best global poverty interventions more generally.

[126] "Iron Supplementation for School-Age Children," GiveWell, accessed October 11, 2019, https://www.givewell.org/international/technical/programs/iron-supplementation.

The best global poverty interventions, such as distributing malaria nets or nutritional supplements to children, have been shown to be highly cost-effective at saving lives or improving quality of life.[127]

- **Long-term benefits of education are less certain than the benefits of global health interventions** - we have seen that the evidence for the link between educational outputs and life outcomes is uncertain, because of the challenges that come from measuring a long-term effect that is interrelated with many other variables, and that educational interventions tend to be more expensive than health interventions. Given this, and the fact that there are very cost-effective global poverty interventions with large funding gaps, we think donors can have more impact by giving to them. These areas are discussed on our research page.

- **Educational interventions tend to cost more than global health interventions** - delivering the best health interventions is relatively straightforward, because there are few cost components and the interventions only need to be delivered relatively infrequently. This means that the most cost-effective interventions can be delivered cheaply. On the other hand, educational interventions tend to need more frequent delivery (often daily) and have more components. This means that costs of the best interventions are in the region of $10+ per beneficiary per year. This would be warranted if the benefits of educational interventions outweighed the benefits of health interventions, but we have seen that this is most likely not the case.

[127] For example, as of July 2019 GiveWell estimate that funding malaria nets will save a life for around $4,600. See cost-effective analysis. https://docs.google.com/spreadsheets/d/1_bNbnVaAUQSq4fIzGBU_wVWojmwZrvQKzjSRx92y6wc/edit#gid=1364064522

However, there are exceptions to this. Three reasons that education could still be a promising focus area for some donors are:

- **A donor has particularly strong beliefs about the benefits of education** - we are uncertain about the long-term benefits of education because of the challenges listed in the previous section. If a donor does not share this uncertainty and is particularly confident that education does reliably produce large benefits, then the best donation opportunities may still be competitive with the best global poverty opportunities.
- **A donor believes that education is intrinsically valuable** - a donor may believe that providing education is valuable for its own sake, and not because of the benefits it brings about. In this case it is much more likely that education could be a high-impact cause to donate within. In this case, donors may still want to weigh the intrinsic importance of education against the intrinsic importance of other goods, such as health. The research team at Founders Pledge would be happy to discuss the philosophical questions surrounding these judgments.
- **A donor knows of grant opportunities within education that are more effective than the best organisations we have found** - a donor may have knowledge of specific opportunities that we are not aware of, and that they are very confident are more cost-effective than our recommended organisations. In this case, it could be that donations to these organisations are competitive with the best global poverty opportunities. From our research, we think that any such organisation would have to be carrying out a novel intervention that either drastically reduces the cost per student or is exceptionally effective at bringing about useful skills.

3.6 Summary of the best education interventions

This section has given an overview of the interventions a donor could fund in low- and middle-income country education, and which of them we think are most cost-effective. We have focused most on primary and secondary education, but also include early childhood education and vocational education, and cross-cutting activities such as research, health-based interventions and tech-based interventions. In summary:

- The interventions that we believe have most evidence of cost-effectiveness are:
    - **TaRL interventions** - which are based on the principle of teaching to the current education level of the student, rather than the level laid out by the curriculum.
    - **Salt iodisation** - which consists of salt manufactures adding iodine to their salt to reduce iodine deficiency and its harmful effects on cognitive abilities in children.
- Other promising interventions include:
    - Building low-cost schools in areas where access is very low
    - Merit-based scholarships
    - Providing households with information on the returns to education
    - Low-cost ways of encouraging additional stimulation for young children
    - Iron supplementation
    - Research to find and evaluate new approaches to improving education
- At primary and secondary level:

    - Demand-side interventions, such as scholarships, are often effective ways to increase the amount of education received, but learning effects depend on the type of education received.
    - Providing school inputs, such as textbooks, is usually not that effective as a way a to improve learning outcomes.
    - Pedagogical changes (i.e. new approaches to learning) have the potential to be very effective although ideas with intuitive appeal can still often be ineffective.
    - Governance interventions can be effective but can also be controversial with key stakeholders and therefore less tractable.
- Within early childhood education, some evidence suggests stimulation-based programmes have large effects on cognitive outcomes, but these effects are uncertain and costs for the programmes are high.

Having examined this evidence, we were able to answer the important question of whether donors should focus on education above other causes. For most donors, we think it is likely that they will have more impact by donating within global health and economic empowerment, because there are highly cost-effective interventions in those areas that bring about very similar benefits to education.

4 Recommended Organisations

The organisations we recommend in the area of education are:

- Global Alliance for Improved Nutrition (GAIN) ‘s Universal Salt Iodization programme, which carries out various activities to achieve universal salt iodisation.
- Iodine Global Network (IGN), which carries out various activities to achieve universal salt iodisation.
- Educational Initiatives (EI), an education company that distributes a personalised adaptive learning (PAL) software program called Mindspark to low-income government schools in India.

Our recommendations of GAIN and IGN are based heavily on the work of our research partner GiveWell.

Overall, we expect that GAIN and IGN are more cost-effective than EI. We also think that our recommended organisations in this area are less cost-effective than the best organisations we know of in other areas, such as GiveWell’s top charities.

4.1 General selection process

Our process for choosing these recommended organisations was:

1. **Generate longlist** - generate a longlist of education organisations including any charities that could plausibly be considered educational. These were found through suggestions from aligned organisations and experts, online searches and other resources we were reviewing separately. This longlist included around 72 organisations.

2. **Reduce to shortlist** - reduce longlist to a shortlist by excluding organisations that neither ran a priority intervention nor had direct experimental or quasi-experimental evidence of effectiveness of their programme. This shortlist included eight organisations.
3. **Reduce to recommended organisations** - reduce shortlist to our recommended organisations based on considerations related to either the intervention or the organisation. The main considerations related to the intervention were effectiveness and cost-effectiveness. The main considerations related to the organisation were ability to deliver the intervention effectively, room for more funding, transparency, reputation, and strength of monitoring and evaluation.

4.2 Global Alliance for Improved Nutrition (GAIN) - Universal Salt Iodization (USI) programme

Our recommendation of GAIN is based heavily on GiveWell's research, which can be found here. GAIN is a GiveWell 'standout charity'. This means GiveWell have reviewed GAIN's work and believe it stands out from the vast majority of organisations they have considered, though they are not as confident in GAIN's impact as they are in their 'top charities'.[128]

4.2.1 What do they do?

GAIN's Universal Salt Iodization (USI) programme carries out a wide range of activities to try to achieve universal salt iodisation. These include advocacy, technical assistance, supplying equipment, training government officials and salt producers, and monitoring.

[128] GiveWell standout charity report, Global Alliance for Improved Nutrition (GAIN)—Universal Salt Iodization (USI)

GAIN's activities broadly fall into three categories:[129]

- **Knowledge leadership** - research and advocacy to increase understanding of iodine deficiency and salt iodisation, much of which is done in close partnership with the IGN.
- **Regional engagement in East Africa** - largely supported by GiveWell-directed funds.
- **Country-specific projects** - in Mozambique, Tanzania, Ethiopia, Nigeria and Bangladesh.

Knowledge leadership

Research and advocacy efforts carried out by GAIN to achieve universal salt iodisation include:

- **Global Fortification Data Exchange (GFDx)** - in collaboration with IGN and others, GAIN launched GFDx, which aggregates global fortification data, including iodisation data.
- **Commissioned the SIMPLIFY ("Salt Iodization: Meeting the needs of Pregnancy, Lactation and Infancy") study** - GAIN co-designed and commissioned a study to evaluate the effects of salt iodisation during the first 1,000 days of a child's life. The study showed that salt iodisation does provide adequate intake for pregnant women and breastfeeding infants when there is high coverage, but weaned children aged six months to two years may require targeted iodine, since the foods they consume may not contain salt. GAIN is now disseminating the results. This study cost $350,000.

[129] Greg S Garrett and Chelsea Tabart, “A Conversation with Greg S. Garrett, June 8, 2018,” n.d., 7.

- **Best practices document** - in collaboration with others, GAIN published a guidance document on good practices for regulatory monitoring of fortified foods and for bringing monitoring of salt iodisation under those same policies and practices.
- **Regression analyses** - GAIN published and disseminated the results of new regression analyses this year in the *Journal of Nutrition* looking at the effects of various factors (e.g. poverty, iodised salt packaging) on urinary iodine concentration.

Regional engagement in East Africa

Overall, about 80% of GAIN's regional work is technical assistance and 20% deals with more policy-related issues (e.g. ensuring that penalties imposed for failing to iodise salt are severe enough that industry actors do not prefer to pay the fine rather than iodise). GAIN's main regional activities in East Africa are:

- Structuring the governance of fortification alliances to incorporate salt iodisation.
- Strengthening governance structures and networks (in close partnership with IGN).
- Developing fortification policy and standards.
- Working with industry and governments to improve their quality assurance and quality control (QA/QC) capacity

Country-specific projects

GAIN's country-specific activities vary widely between different countries, so GiveWell looked at their activities in more depth in four countries: Ethiopia, India, Bangladesh and the Philippines. Their work in each of these countries is summarised below, to illustrate the sorts of activities GAIN carry out.

- Ethiopia - GAIN’s activities in Ethiopia have included:
    - Helping set up a revolving fund for potassium iodate to be sold to salt producers.

  - Donating equipment to governments and salt producers.
  - Advocating for the government to improve salt iodisation.
  - Helping salt producers improve iodisation.
  - Supporting a national survey of iodine nutrition.
- India - GAIN's activities in India have included:
  - Advocating for increased government attention to their iodine programme.
  - Developing a computerised system to record salt iodisation information.
  - Providing technical assistance to iodine labs.
  - Helping salt producers improve their iodisation practices.
  - Increasing iodised salt production capacity.
- Bangladesh - GAIN's activities in Bangladesh have included:
  - Procuring potassium iodate to start a revolving fund.
  - Providing technical and financial support for a national micronutrient survey.
  - Advocating for revised salt law and stricter enforcement.
  - Working with selected mills to improve iodisation quality.
  - Promoting the use of kits to determine at a local level whether salt is iodised.
  - Creating TV programmes to educate households on importance of iodised salt.
- Philippines - GAIN's activities in the Philippines have included:
  - Visiting salt producers to monitor iodisation levels and provide training.

- Replacing broken iodisation equipment.
- Purchasing equipment for testing iodine content of salt.
- Organising national meetings to discuss technical salt iodisation topics.

Activities in other countries can be seen in conversation notes between GiveWell and GAIN here.

4.2.2 How effective is the intervention?

The evidence for salt iodisation programmes is laid out in more detail in the intervention section above. Salt iodisation programmes probably lead to reduced iodine deficiency, which reduces IQ in children by around four IQ points.

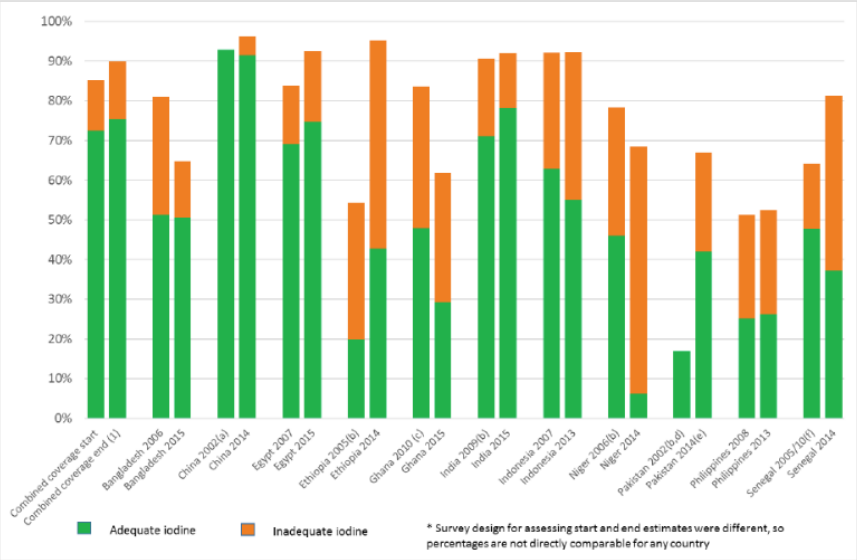
4.2.3 Does the organisation effectively deliver the intervention?

Because GAIN's work is spread across many countries and varies widely from country to country, it is difficult to evaluate its effectiveness. Based on GiveWell's review, we believe it is likely that GAIN has increased iodisation rates, though this is highly uncertain.

The key findings on the impact of GAIN from GiveWell's review, which was published in November 2016, are summarised below.

- At the time of GiveWell's review, GAIN had recently worked on iodisation in 17 countries. For the period that GiveWell looked at, iodisation data was available for 11 countries, and for these the changes in iodisation rates are shown in the table below. Overall, this shows a 2.5 percentage point increase in access to iodised salt, although there were very large differences across countries.

Figure 12: Trend in national household coverage with inadequately and adequately iodized salt (total represents salt with any iodine)



Source: GiveWell GAIN review

- GiveWell looked in more depth at four case study countries: Ethiopia, India, Bangladesh and the Philippines.
- GiveWell looked most deeply at GAIN's impact in Ethiopia. GiveWell concluded that GAIN's activities likely played a role in the increase in access to iodised salt in the country, but they do not yet have confidence about the extent of GAIN's impact.
- In India, iodisation rates increased while GAIN worked there, and GiveWell find it plausible that GAIN had significant impact on these iodisation rates, though they are not convinced it did.
- GiveWell are even more uncertain about GAIN's impact in Bangladesh and the Philippines. Discussion is available in their report.

- Overall, GiveWell's main concern about GAIN is that they have not been able to fully understand their impact because their activities vary so much by country and because for some of their activities, such as advocacy, attribution of impact is challenging.

4.2.4 How cost-effective are they?

GiveWell carried out a rough cost-effectiveness model for GAIN's USI programme and concluded that it was not significantly more cost-effective than their top charities but have still not ruled out that it could be as cost-effective as their top charities.

According to our rough cost-effectiveness calculation which can be seen here, GAIN are more cost-effective than the best conventional education charities we know of, though these calculations are highly uncertain, and we have modelled their impact solely based on the impact of direct salt iodisation efforts.

4.2.5 Room for more funding and future plans

GAIN believe they could use an additional $2 million per year. This would likely mainly be used to focus on high-burden countries:[130]

- Nigeria - carry out an assessment of volumes and quality of salt from different regions of Nigeria, and get better data on salt importation. GAIN would then work with salt producers to encourage small producers to move towards a cooperative model.

[130] Greg S Garrett, "A Conversation with Greg S. Garrett, September 30, 2016," n.d., 7.

- Egypt - GAIN have previously worked in Egypt using funding from the Bill and Melinda Gates Foundation, and salt iodisation has since slipped. Re-entry would first consist of a new assessment of the current landscape.
- India - GAIN have previously worked in India in partnership with UNICEF, but there are still states with low coverage that GAIN would go back to.

GAIN would also enter other high-burden countries where it is not active, such as Pakistan, Afghanistan, Angola, Tajikistan and Ghana. Any funding used for other countries that GAIN is currently active in would be focused on embedding policy, improved engagement with civil society and conducting new assessment surveys in each country.

4.3 Iodine Global Network (IGN)

Our recommendation of IGN is based heavily on GiveWell's research, which can be found here. IGN is a GiveWell 'standout charity': this means GiveWell have reviewed IGN's work and believe it stands out from the vast majority of organisations they have considered, though they are not as confident in IGN's impact as they are in their 'top charities'.[131]

4.3.1 What do they do?

IGN aims to reduce iodine deficiency globally by advocating for national salt iodisation programmes, tracking progress, and providing global and country-specific guidance on related issues. Much of their work is carried out through regional coordinators who are each responsible for their own regions. IGN currently have activities in twelve of the nineteen iodine deficient countries.

IGN's activities can roughly be divided between:

- Regional work - country-by-country work focused on monitoring ongoing national iodine status (measured primarily by median urinary iodine concentration (UIC)) and working to increase the supply of iodine where intakes are sub-optimal. This work is carried out by 10-12 regional coordinators. IGN plan to focus on 10-15 specific countries over the next year.
- Salt in processed foods - work to increase the use of iodized salt in processed foods and condiments, including communication with major salt producers in Africa and communication with food producers.

[131] GiveWell standout charity report, Iodine Global Network

(IGN wish to note that these activities are undertaken in close collaboration with WHO and the George Institute, to align public health messages of salt reduction and salt iodization)

- Maintenance of the Global Fortification Data Exchange

IGN have also told us that they undertake scientific research, though we know less about this work.

IGN's regional work varies widely across different countries, so GiveWell's review looked at IGN's activities in more depth in three countries: Sudan, Ethiopia and India. Their work in each of these countries is summarised below.

- Sudan - IGN's activities have included:
    - Running workshops with government officials and salt producers to advocate for a salt iodisation project and advise on implementation.
    - Training salt producers on salt iodisation.
    - Providing lab equipment to producers to test their salt.
- Ethiopia - in the mid-2000's IGN supported the Micronutrient Initiative in a push to improve salt iodisation in Ethiopia, focusing on reduced importation of non-iodised salt. By 2010, Ethiopia was producing much of its own salt. Around this time the Ethiopian Ambassador to Senegal realised the importance of iodisation, and so brought together the salt producers and health minister to discuss iodisation. In 2011, Ethiopia passed legislation requiring iodisation by salt producers and began enforcing in 2012, leading to iodisation coverage rates of over 80% of households.

- India - IGN credits their regional coordinator in South Asia with leading efforts that led to the reinstatement of a ban on non-iodised salt, by setting up a meeting between the Director of UNICEF and the prime minister of India to discuss the matter.

More recent information for ten selected countries is also available in IGN's 2018 annual report, which can be found here. This information is summarised below.

- Angola (insufficient iodine intake) - as of 2016, 82% of salt in Angola contains some iodine. IGN are carrying out a national survey of iodine levels.
- Burundi (insufficient iodine intake) - IGN have supported a national survey of population iodine status, which identified regions in the country with sub-optimal iodine intake. They are now working with the government of Burundi (as well as Tanzania) to develop a strategic plan to improve the country's iodine status.
- Caribbean Islands (optimal iodine intake) - in 2018 IGN, with support from other groups, conducted the first ever survey of iodine nutrition in nine Caribbean countries. The results of this survey suggest that school-age children have adequate iodine intakes in these countries. IGN now hopes to work to ensure that optimal iodine intake is sustained.
- China (optimal iodine intake) - China recently reformed its salt industry to allow non-iodised salt to be sold in areas where water has sufficiently high iodine content. IGN is supporting the China Ministry of Health and the China National Salt Industry Corporation to ensure the reform's guidelines are followed correctly.
- Israel (insufficient iodine intake) - in 2016, a survey carried out by IGN and the Israeli Ministry of Health found the country had low iodine intake. IGN is working with the Ministry of Health to assess

whether it could be legislated that commercially sold bread only includes iodised salt. IGN would then work with the ministry to assess the impact of this change.

- Lebanon (insufficient iodine intake) - even though iodised salt coverage was high in 2004 (95%), a 2014 national survey revealed sub-optimal iodine intake. Since these results, IGN has focused on helping the country's four major salt producers improve their iodisation practices. A survey will be administered in the last quarter of 2019 to measure the resultant changes.
- Madagascar (insufficient iodine intake) - even though Madagascar introduced mandatory salt iodisation in 1995, political instability led to declines in coverage. IGN facilitated the procurement of a large amount of potassium iodate (the compound used in iodised salt) for the country. IGN and other partners plan to continue focusing on improving iodisation capacity and quality monitoring among salt producers.
- North Korea (insufficient iodine intake) - in 2017 IGN sent a consultant to work with salt producers and propose improvements to the country's iodisation equipment. Additional visits have been planned to explore implementation of the improvements.
- Sudan (insufficient iodine intake) - Sudan has very low iodised salt coverage (34% in 2014), in part due to a lack of modern processing technology and many small salt producers. IGN helped the government purchase three salt processing units, which now iodise 40% of the nation's salt. IGN are now assisting Sudan to purchase three additional units. IGN believe that Sudan will achieve optimal iodine nutrition very quickly, now that the country has the necessary infrastructure.
- Tanzania (optimal iodine intake) - IGN have recommended the consolidation of salt production by small-scale producers. This work is ongoing.

In addition to their national efforts, IGN also carry out international activities. These include:[132]

- Global review of double-fortified salt - IGN is facilitating a global consultation to assess the feasibility of fortifying salt with iron as well as iodine.
- The Global Fortification Data Exchange (GFDx) - in 2017, IGN launched the GFDx, in partnership with the Food Fortification Initiative and Global Alliance for Improved Nutrition. GFDX works to standardise the data collected across large-scale food fortification programmes and provide the most up-to-date information on national fortification programmes on its website. This work was supported by a grant from the Bill and Melinda Gates Foundation.

4.3.2 How effective is the intervention?

The evidence for salt iodisation programmes is laid out in the intervention section. Salt iodisation programmes probably lead to reduced iodine deficiency, which reduces IQ in children by around four IQ points.

4.3.3 Does the organisation deliver the intervention effectively?

Because IGN's work is spread across many countries, varies widely from country to country, and is usually focussed on advocacy, monitoring or technical assistance rather than direct implementation, it is hard to evaluate its effectiveness very precisely. Based on GiveWell's review and what we have seen, IGN are a well-respected, transparent organisation that has a strong track record of involvement in iodisation programmes.

[132] Dr Jonathan Gorstein and Chelsea Tabart, "A Conversation with Dr. Jonathan Gorstein, June 22, 2018," n.d., 9.

GiveWell's review was published in 2014 and they confirmed their view of the organisation had not changed in an update published in September 2016. IGN are currently a GiveWell standout charity. In the review GiveWell found that:

- Organisations that partner with and fund IGN, including UNICEF and GAIN, claim that the organisation's work is often important for achieving the implementation of iodisation policies. Two of IGN's board members who work for implementing agencies noted that IGN's global coordinating role is important, although GiveWell have not looked deeply into this role.
- GiveWell believes IGN is a strong organisation. IGN has a strong track record of involvement in iodisation programmes in numerous countries over many years and has been recognised as a helpful ally by implementing agencies. IGN has communicated clearly with GiveWell, responded thoughtfully on critical questions and consistently been very transparent. We have also found this to be the case in our interactions with IGN. GiveWell have not seen strong methods of self-evaluation by IGN.
- GiveWell's main concern about IGN is that they have not been able to fully document demonstrable impact, although they believe they may have had significant impact.

4.3.4 How cost-effective are they?

GiveWell do not provide cost-effectiveness analysis for IGN, because the complex nature of their work makes it difficult to do so. We would guess it is in the same region as the cost-effectiveness of GAIN.

According to our rough cost-effectiveness calculation, which can be seen here, IGN are more cost-effective than the best conventional education charities we know of, though these calculations are highly uncertain, and we have modelled their impact solely based on the impact of direct salt iodisation efforts.

4.3.5 Room for more funding and future plans

IGN's total budget for 2020 is around $2.3 million, which has been entirely procured or committed. IGN have told us they could use an additional $1.2 million. IGN expect their budget to decrease to a lower level in 2-3 years' time, when they will focus on maintaining efforts rather than reducing existing burdens. Additional funding would mainly be used for:

- The recruitment of additional national coordinators
- Convening large-scale salt producers to explore how the producers can assist in salt iodization efforts.
- Discussion with food industry groups, including a series of roundtables, to identify how to ensure that salt used in processed foods and condiments contains iodine. IGN would also build technical capacity to monitor compliance among the salt industry and food industry.

IGN's country-specific future plans are included for specific countries above, and broadly fall into the following categories:

- Monitoring iodine status, by administering surveys
- Technical assistance for governments and salt producers, to help them implement salt iodisation

As can be seen in conversation notes between GiveWell and IGN in 2019, IGN have recently received a grant of $700,000 from the Bill and Melinda Gates Foundation, which will be used to expand their work on processed foods and condiments in new countries, convene a global consultation on the feasibility of double-fortified salt and continue work on the Global Fortification Data Exchange.

5 Appendix

5.1 Reading list

- On education in low- and middle-income countries:
    - GiveWell Education Report
    - Improving School Education Outcomes in Developing Countries: Evidence, Knowledge Gaps, and Policy Implications, Paul Glewwe and Karthik Muralidharan
    - World Development Report 2018 (WDR 2018)—LEARNING to Realize Education's Promise, World Bank
    - The Our World in Data Education series
    - Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty (Chapter 4 - Top of the Class), Abhijit V. Banerjee and Esther Duflo
    - The Rebirth of Education: Schooling Ain't Learning, Lant Pritchett
- On educational interventions in high-income countries:
    - A review of interventions in developed countries, Roland Fryer
- On education and growth:
    - Knowledge Capital of Nations, Eric Hanushek
- On signalling:

    - The Case Against Education, Bryan Caplan

- On IQ:
    - IQ and Human Intelligence, Nicholas Mackintosh
    - Intelligence: Knowns and Unknowns
    - Intelligence: All That Matters, Stuart Ritchie
- On nature versus nurture:
    - G is for Genes, Robert Plomin
    - Selfish Reasons to Have More Kids: Why Being a Great Parent Is Less Work and More Fun Than You Think, Bryan Caplan
- On the future of education:
    - Podcast: The Future of Education, Skills and the Economy, David Deming on the Future of Work podcast
    - Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns, Clayton Christensen
        - Summary Article
- On national educational success cases:
    - Cleverlands, Lucy Crehan

- On education reform:
    - World Class, Andreas Schleicher

5.2 Organisation shortlist

The education charities that made our shortlist were:

- Educate!
- Pratham
- J-PAL's Post-Primary Education Initiative
- Effective Intervention
- Young 1ove
- Educate Girls

In addition, we previously planned to recommend Evidence Action's Winning Start programme, but are no longer because it is currently uncertain whether it will continue.

5.3 Cross-country growth regressions

In section 3, the main source we used to look at regressions between country-level test scores and economic growth is a book called *The Knowledge Capital of Nations*, by Eric Hanushek, which looks at the relationship between cognitive skills and growth. Its approach is described in more depth here.

The books central approach is:

1. Combine international standardised tests (e.g. PISA) to create a measure of cognitive skills across countries.

2. Regress average growth between 1960–2000 on average cognitive skills for that period (or earlier periods in some specifications) to estimate a coefficient for the effect of cognitive skills on growth. These regressions include 'control variables' for economy openness and security of property rights because more educated countries also have more open economies and we only want to include the effect of education, rather than other traits that are correlated with education.

3. Separately address objections related to causality, to argue that relationship between cognitive skills and growth established found above is mostly causal. There are four arguments used:

    a. Instrumental variables - cognitive skills known to come from non-growth sources still have a positive association with growth. This shows that at least some of the correlation between skills and growth does not come from growth causing increased skills.

    b. Intertemporal changes in growth - the *trend* in cognitive skills is strongly related to the *trend* in growth, as well. This provides another approach in support of the approach above.

    c. US immigrant earnings - immigrants in the US labour market (and therefore different education systems) have wages that reflect the quality of education in their place of origin.

    d. Growth accounting - a 'development accounting' approach, which breaks GDP differences between countries into the difference due to *capital* (both human and physical) and the difference due to *efficiency* show that a portion of growth comes from human capital.

To estimate the effect on GDP of increasing PISA scores by 25 points, the author starts by developing two projections: in the first, growth is calculated using a baseline growth rate; in the second, growth is calculated estimating the growth rates that would be implied by a 25-PISA point increase (using the coefficient

estimated above). He then takes the difference between these two projections. The resulting estimate suggests that GDP would be on average 6% higher over an 80-year period, or that wages for all workers would be 12% higher.[133]

Potential problems with this approach and its applicability to intervention cost-effectiveness analyses are:

- According to the authors, there is still uncertainty amongst economists over whether education causes growth, growth causes education or both are caused by something else. Current tools and data are insufficient to resolve this.[134]
- The estimates are at the aggregate level and only refer to what would happen if the test scores of an entire country were increased, so are not directly applicable at the individual level. This is because the results were calculated by looking at differences between countries rather than individuals, so increasing the test scores of an individual may not have the same income effect.
- The estimates rely on many different assumptions, such as the length of the period analysed and the type of model used for the relationship between education and growth. While some of these assumptions are tested by Hanushek, this still makes us less confident in the estimates, particularly because we are not well qualified to judge the assumptions used.
- Developing countries are underrepresented and the very poorest countries are not included, due to lack of test score data.

[133] "Over the entire period – with low initial impacts as students first have to enter the labor force – GDP would be 6 percent higher on average. This increase is roughly equivalent to an average wage increase of 12 percent for all workers over this period.", Hanushek and Woessmann, *The Knowledge Capital of Nations*.
[134] This was told to us in conversation

5.4 Educational Initiatives (EI)

In our initial research of this problem, we identified Educational Initiatives as an organization implementing a highly effective solution. Though they are not currenty one of our recommended funding opportunities in this space, you can read our initial review below. We'll continue to update this report as we get new information.

EI is an Indian educational software company that produces the software program Mindspark, which uses TaRL principles to improve learning outcomes.

5.4.1 What do they do?

Amongst other activities, EI produces an educational software program called Mindspark. Mindspark is a 'adaptive-learning' program, which tailors questions to the accuracy of the student's previous answers. In addition to their for-profit business, EI started deploying Mindspark in low-income government schools in 2017.

The software

Mindspark is personalised adaptive learning software that teaches language (currently available for Hindi, Guajarati, Telugu, Marathi and English) and maths. Its key features are:

- High-quality educational content - Mindspark has a bank of over 45,000 questions that have been developed through field testing.[135]
- Adaptive to education levels - content presented to each student are based on their prior performance and 'learning path'.
- Adaptive to conceptual misunderstandings - students at the same level may have different types of misunderstandings, and Mindspark diagnoses the errors a student makes into patterns of mistakes of a certain type.
- Continuous engagement - pupils are constantly interacting with the system through questions and games, rather than passive activities such as instructional videos, in order to boost engagement.

Mindspark works in the following way:

1. After a brief orientation, the student takes an initial screening test to determine their starting learning level.
2. The student answers problems developed by education specialists. The content for maths and Hindi is organised differently. For maths, as an example, the problems are divided into:
    a. ‘topics’ (e.g. whole number operations)
    b. ‘teacher topics’ (e.g. addition)
    c. ‘clusters’ (e.g. addition in a number line)

[135] “Mindspark, developed by Educational Initiatives, an Indian company, simply draws on a bank of 45,000 questions and the 2m answers generated every day.”, “Technology Is Transforming What Happens When a Child Goes to School,” *The Economist*, July 22, 2017, https://www.economist.com/briefing/2017/07/22/technology-is-transforming-what-happens-when-a-child-goes-to-school.

d. ‘student difficulty levels’ (e.g. moving from one place to another on the number line)

3. The student’s mistakes are grouped into predetermined clusters e.g. the student consistently rounds down instead of up. These clusters are based on both educational expertise and data analysis of the millions of student answers that EI have gathered in the past.
4. The student is provided with problems to address specific learning gaps until solved, at which point they progress to new levels of difficulty.

No machine learning algorithms are currently used or needed, since clusters of conceptual misunderstanding are based on pedagogical theory and simple data analysis rather than artificial intelligence, although it could be incorporated in the future. EI has setup a team to look into what forms of artificial intelligence could usefully be employed in its software.

More details on how the software works are available in appendix D of the Delhi randomised controlled trials discussed below.

The programme

As part of EI’s programme, schools with students in grades 1–8 (aged 6–14) receive Mindspark software for 35–40 minutes each day in language and maths. Facilitators are provided to help the schools use the software, and in some cases hardware is also provided. Initially, this intervention was rolled out to around 70 schools in Rajasthan and then expanded to 200 schools in six states in 2018–19 (Himachal Pradesh, Chhattisgarh, Andhra Pradesh, Uttarakhand and Madhya Pradesh). In 2019–20, the distribution also covers Gujarat, Uttar Pradesh and Telangana (see below).

Table 1: Schools and states EI are working in

# of schools by state	2018–19	2019–20

Rajasthan	105	105
Himachal	44	50
Chhattisgarh	21	21
Andhra Pradesh	20	320
Uttarakhand	6	6
Madhya Pradesh	4	4
Gujarat	0	15
Uttar Pradesh	0	55
Telangana	0	100
Total	**200**	**676**

Source: Email correspondence with EI

EI's monitoring consists of:

- Daily reports on school-level usage. EI might make phone calls to schools based on these reports to diagnose reasons for fluctuations.
- Monthly reports on which topics children are struggling most with, and other information on average student usage and engagement.
- Semi-annual review (roughly) of learning gains based on a pre-post analysis.

Schools and government officials are provided with dashboards to allow them to track progress.

5.4.2 How effective is the intervention?

Two randomised controlled trials have found a statistically significant effect of Mindspark usage on maths and language test scores. There is also a quasi-experimental evaluation that we have not looked into deeply and place much less weight on, which found a statistically significant effect of using Mindspark in schools on

maths scores, and a randomised controlled trial of a different but similar software program that found a statistically significant effect on learning outcomes, which we also place less weight on.[136]

Overall, based on these trials we estimate an effect on test scores of around 0.10 standard deviations per child per year in both Hindi and maths.

Muralidharan et al. (2018)

The first study is a high-quality randomised controlled trial run in Delhi (Muralidharan et al. 2018) that provided lottery winners with access to after-school Mindspark centres. Winners received 90 minutes of Mindspark usage, six days a week for 4.5 months. This led to an increase in centre test scores of 0.36 standard deviations and 0.22 standard deviations in maths and Hindi respectively, directly at the end of the programme. Effects on *school* test scores were smaller, and only significant for Hindi. The authors suggest this is due to school tests being calibrated to too high a difficulty to pick up the effect.

This study is not directly applicable to current EI distributions. The main differences between the intervention in this study and the actual programme are:

- The trial provided additional education rather than substituting for other education.
- In the study instruction took place off school campus and without school teachers.

Other limitations of this study are:

[136] Abhijit Banerjee et al., "Remedying Education: Evidence from Two Randomized Experiments in India," NBER Working Papers (National Bureau of Economic Research, Inc, December 2005), https://ideas.repec.org/p/nbr/nberwo/11904.html.

- No longer-term tests were carried out, so we do not know how likely the effects are to persist.
- The intervention only lasted for 4.5 months so effects may not persist with repeated use.

Muralidharan et al. (ongoing)

The second study is an ongoing randomised controlled trial in Rajasthan (Muralidharan, Singh) that started in 2017 and is providing Mindspark in around 40 treatment schools in four districts covering 6500 students. These districts are Churu, Jhunjhunu, Udaipur and Dungarpur. Both urban and rural areas are included. Students in treatment schools use the software for around 1 class period each school day, in place of regular instruction.

The student population, regions and intervention design are all representative of EI's current Mindspark deployment. In particular:

- Instructional time substitutes for other education, rather than being additional.
- Instruction takes place on school campus, with government school teachers.
- Usage per session is representative of the time received in the programme.

Midline results after the second year show a treatment effect across all grades of 0.21 standard deviations on both maths and Hindi test scores.

Our main uncertainties around this randomised controlled trial are:

- Although it is being carried out by well-respected education economists, we have only seen high-level midline data for this study so have been unable to examine its results deeply. The study will end in April 2020.

- Pupils receive less regular instruction, and we are unsure about the extent to which negative effects would be captured by the tests used in this randomised controlled trial.

5.4.3 Does the organisation deliver the intervention effectively?

Our impression is that EI provide the intervention effectively and in a similar way to the randomised controlled trial carried out in Rajasthan, is particularly focused on ensuring its programme leads to learning outcomes relative to most organisations we have spoken to and is sophisticated in the way it monitors and evaluates its impact. EI is very well placed to scale the intervention within India.

The main reasons we think EI effectively deliver their programme are:

- **Track record** - EI has had success at scaling their low-income school programme to reach over 200 schools in six states. EI has also achieved government buy-in to their programme. The government has provided memorandums of understanding for EI to provide Mindspark in five states covering around 100,000 schools.
- **Strength of measuring and evaluation** - EI's measuring and evaluation is strong and the nature of the data that they gather makes it very well suited to measurement and analysis. EI have daily, weekly and monthly processes for responding to specific changes to learning measurements from schools. Based on results that the software feeds to them automatically, they can provide tailored advice to schools about how their software should be used.
- **Transparency** - EI have provided meaningful answers in all our interactions, and monitoring and evaluation data down to school-level.

- **Commitment to evidence** - EI is very evidence-focussed and regularly use experiments to improve their software and programme. They have a good understanding of the evidence for their programme and had already considered many of our questions prior to our asking them.
- **Reputation** - EI have a strong reputation. For example, they have received one grant from Global Innovation Fund, who are a credible impact-focused funder and have partnered with J-PAL and well-respected education economists to carry out randomized controlled trials looking at their impact. They also have success as a for-profit business, having received substantial VC funding including $25 million in 2018.[137]

5.4.4 How cost-effective is EI?

According to our cost-effectiveness calculation, which can be seen here, EI's low-income school programme is about as cost-effective as the best conventional education charities we know of but less cost-effective than our recommended salt iodisation charities, though these calculations are highly uncertain. Our best guess is that EI bring about a total increase in test scores of 0.5 standard deviations for each $100 donated to them, based on the evidence above and the costs outlined below.

EI estimate a total cost of around $25–50 per child per year. The three main components of this are the hardware, the facilitators placed in schools and the software itself. In some cases, hardware would be provided by the government.

[137] "Gaja Capital Bets $25 Mn On Edtech Company Educational Initiatives," *Inc42 Media* (blog), July 27, 2018, https://inc42.com/buzz/gaja-capital-bets-25-mn-on-edtech-company-educational-initiatives.

For each additional school, EI's costs are:

- Rs. 200,000 (~$3,000) per year for implementation (cost of facilitators, travel, training expenses and project management)
- Rs. 100,000 (~$1,500) per year for software license fees (product development)
- Rs. 600,000–700,000 (~$9,000–10,000) one-off cost for hardware (where necessary, and which lasts for 5 years)
- Rs. 50,000 (~$1,000) per year for maintenance, replacement of broken hardware and other costs

In 2018–19, EI's total cost was $1.2 million, including 20 schools that required hardware. EI says that each school typically includes around 200 students, which means that this equates to a cost per student served of $31.

5.4.5 Room for more funding and future plans

EI plan to continue expanding Mindspark to additional government schools in India. For 2019–20, EI need to raise approximately $2 million to reach the full number of schools in their plans.

More broadly, EI also have memorandums of understanding to provide Mindspark in states covering roughly 100,000 additional government schools. EI believe they could absorb an additional $10 million in the next 12 months and $30 million in the subsequent year. EI base their ability to absorb this amount of funding on the following:

- The core dependence is on software, which is hosted on Amazon Web Services and could easily double in capacity.

- EI have high organisational capacity more generally, such as staff and other overheads.
- Mindspark now has evidence of effectiveness, which makes scaling easier because stakeholders are more likely to buy in to the programme.

There is also interest from groups in expanding Mindspark to other regions, such as Bangladesh and Latin America, although EI have significant room to expand within India before this will be a priority for them.