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UNIVERSITY OF TORONTO

Capstone Project

Fostering Learning

Driving Improvements in Learning Outcomes for
Children in Low-resource Communities

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Executive Summary

Access to quality education amplifies individual potential, thwarts poverty traps, and increases opportunities to pursue fulfilling career paths. Access to quality education fosters literacy, numeracy, and analytical skills—fundamental tools needed to navigate through socio-economic mazes, to excel, not only in the educational system, but more broadly in an increasingly interconnected world. Low-income countries and communities have severely struggled to increase access to quality education, causing the educational gap between the developed and developing world to widen. Within this context, if the education sector maintains its current trajectory, by 2030 half of all children and youth will lack the basic secondary-level skills needed to succeed, with a disproportionate effect on the developing world.[1] This calls for increased attention, resources, and solutions to better the education system. In particular, this can be achieved by focusing on how to drive the most effective and efficient improvements in learning outcomes.

Along these lines, the overall objective this report is to answer the following question: *how do we most efficiently measure and direct educational investments in low-resource environments in order to achieve meaningful learning outcomes*? To answer this, this report asks three questions, that when combined, provide a holistic framework for how to drive the strongest improvements in learning outcomes. Conceptually, these questions embody an input-output framework, where the first two questions focus on inputs—elements utilized to achieve better learning outcomes—and the third question addresses outputs, being what was produced from the input elements.

First, this report asks: *what is the best approach per dollar invested to drive improved learning outcomes for children in schools in low-resource settings*? Here, an iterative approach using the Problem-Driven Iterative Adaptation is recommended, as all areas of investment are interconnected. This will allow for a decentralized investment policy that allows institutes to invest into areas beneficial for their own services.

Second, this report asks: *which numeracy or literacy tools have driven the strongest improvements for learning outcomes for children*? Here, two mobile applications are identified, both of which drive the strongest improvements in learning outcomes for children based on the analysis; these applications are *onebillion* and *Khan Academy.* These apps are recommended as the best learning tools in the m-learning space because they show immediate and sustained learning gains with improvements in students' raw test scores. What is more, they have been used in diverse environments—maintaining analogous results in improvement despite the change in context, gender, or cognitive abilities.

Lastly, this report asks, *which indicators of school quality have the strongest links to improving learning outcomes for children*? This question seeks to parse out specific indicators which are more effective at determining improvements to learning outcomes and align them with indicators from *Pathways to Excellence*. Here, three steps are recommended: first, highlight *output* indicators as most likely to drive improved learning outcomes; second, incorporate a context-specific indicator ranking exercise into P2E self-assessment process; and third, formulate indicators related to equitable enrollment.

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[1] Brookings Institute, "Can we leapfrog? The potential of education innovations to rapidly accelerate progress," Center for Universal Education at Brookings (2018), https://www.brookings.edu/book/leapfrogging-inequality-2/.

Introduction

Universal access to quality education is a fundamental right, and the importance of access to education cannot be understated. Research clearly demonstrates the positive impact of education through its ability to reduce poverty and inequality, increase decision-making power among those that are marginalized and disadvantaged, and provide children and youth with greater opportunities for their future.[2] On a national level, education has also been shown to increase economic growth and stability and to promote peace.[3]

With rapid levels of economic growth and social change occurring around the world, access to education is increasingly becoming a priority among national governments and the international community, and progress is being made. However, despite the substantial progress that has occurred in recent years, according to the United Nations, 262 million children and youth between the ages of 6 to 17 still remain out of school around the world.[4] And of those that are in school, more than half are not achieving minimum levels of proficiency in reading and mathematics.[5] The factors that act as barriers to education and the achievement of learning outcomes are vast and numerous. The cost of school fees, lack of adequate infrastructure, limited qualified instructors, and social barriers are only a few examples of the challenges faced by individuals, particularly in low-resource communities.

Investment in education is necessary to break these barriers. However, investment must not only focus on the provision of education, but should also aim to generate a return on that investment through measurable learning and the acquirement of skills.[6] This, of course, is a challenge. Education encompasses so many elements and stakeholders that would benefit from investment -- including administrative capacity, community engagement, learning materials, school facilities etc. -- and is highly dependent on the context of a given region or community. As such, determining which investments and their associated indicators would best result in the greatest learning outcomes is difficult. The following report attempts to demystify this process through an in depth analysis of investment inputs as well as the indicators that measure the outcome of these inputs.

The overall objective of this report is to answer the following question: how do we most efficiently measure and direct educational investments in low-resource environments in order to achieve meaningful learning outcomes? Through a review of existing literature, this report will aim to address and provide recommendations for the following questions:

1) What is the best approach per dollar invested to drive improved learning outcomes for children in schools in low-resource settings?
2) Which numeracy/literacy tools (apps) have driven the strongest improvements in learning outcomes for children?
3) Which indicators of school quality have the strongest links to improving learning outcomes for children?

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[2] "Education Transforms Lives." UNESCO, June 28, 2019. https://en.unesco.org/themes/education.
[3] Ibid.
[4] "Goal 4 .:. Sustainable Development Knowledge Platform." United Nations. United Nations, 2019. https://sustainabledevelopment.un.org/sdg4.
[5] Ibid.
[6] World Development Report: Learning to Realise Education's Promise (World Bank, 2018), https://www.worldbank.org/en/publication/wdr2018)

1. Investment for Improved Learning Outcomes

1.1. Background

This section of the report seeks to analyse cost-effective solutions to improve learning outcomes in children enrolled in school. In order to properly address these questions, the interventions analysed have been divided in five distinct categories: school leadership training, teacher training, parent education/engagement, learning tools, and financial incentives. Using this conceptual framework, we analysed various interventions falling under each category. A complete list of all interventions evaluated can be found in Appendix 1. However, the EduFinance program currently benefits children enrolled in school in over 22 countries. Given the diversity of experiences and challenges faced by educators in these regions, prescribing a one-size-fits-all approach might prove to be counter-productive.

Instead, this report recommends an <u>iterative approach</u> aimed at identifying the specific needs of the educational setting and prescribing coherent and effective measures to address them. This recommendation is based on the notions layed out through the Problem-Driven Iterative Adaptation (PDIA) to governance issues.[7] This approach favours context-driven solutions in lieu of 'best practice' spearheaded by international actors. It was first utilised to address institution-building and governance challenges in a way that allows the solutions set in place to retain legitimacy and remain sustainable overtime.

The mechanism utilized in the PDIA could be used to identify the 'best approach per dollar invested' in each specific context in which EduFinance operates. Crucially, the PDIA approach seeks to bring local solutions to local issues, which would allow Opportunity International to harness the knowledge of direct beneficiaries of the EduFinance programs, while also providing them with an opportunity to articulate and prioritise the issues that they deem as the most pressing.

Alongside best practices from the PDIA approach, this report will also outline some of the benefits of investing in specific inputs along the five areas of the conceptual framework, identifying the best inputs per dollar spent for each. However, identifying the real needs of the beneficiaries is paramount to maximizing the impact per dollar spent and ultimately improving learning outcomes for children in low-resource settings.

1.2. Research Question

This section of the report seeks to answer the following question: What is the best approach per dollar invested to drive improved learning outcomes for children in schools in low resource settings?

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[7] Matt Andrews et al., Building Capability by Delivering Results: Putting Problem-Driven Iterative Adaptation (PDIA) Principles into Practice (OECD, 2015), https://www.oecd.org/dac/accountable-effective-institutions/Governance Notebook 2.3 Andrews et al.pdf)

1.3. Analysis

An assessment of 38 potential investment areas based on the impact on learning outcomes, as well as average return on investment, was done to determine which approach per dollar invested would result in the highest learning outcomes. With a consideration of the World Development Report framework, the following are a list of interventions determined to be the best options for achieving learning outcomes from EduFinance's five activity areas. An assessment of all 38 potential investment areas can be found in Appendix 1 and 2.

School Leadership Training

Investment in leadership training have generally shown great benefits to learning outcomes[8], due to its impact on nearly every aspect of a schooling system including, but not limited to, school culture, school management, and teaching and learning. If effective, leadership training has been found to both directly and indirectly improve teaching quality in schools, improve governance and accountability structures, and ensure the effective use of resources that best aid teaching and learning practices.[9] When leadership is ineffective, it can mean that school leaders are not providing instructional advice to teachers and may not be prioritizing learning. A lack of adequate governance practices often results in a lack of meaningful autonomy and community engagement, which further affects learning.[10] Improved school leadership and management capabilities results in the better allocation of resources, the increased motivation and retainment of teachers particularly important in low-resource settings, as well as improved community engagement - all of which directly or indirectly affects learning outcomes.[11] According to the World Development Report, a study of eight countries found that a 1.00 standard deviation increase in an index of management capacity is associated with a 0.23–0.43 standard deviation increase in student outcomes. School leadership training can occur in a variety of forms. **This report finds that *School Leadership and Professional Development* programs have the greatest impact on learning outcomes and the highest returns on investment.**

School Leadership and Professional Development

Studies show that schools with better management capabilities have better test scores, with these results being found regardless of region and type of education system.[12] Better management is synonymous with effective leadership, which often refers to having school principals and headteachers that are actively involved in school development planning, assisting teachers with lesson planning and goal setting, who prioritize learning among their students above all else, and are able to manage and utilize resources effectively with student needs in mind.[13] Strong management practices also have the ability to motivate and retain teachers, as well as create a school environment that promotes

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[8] World Development Report: Learning to Realise Education's Promise (World Bank, 2018), https://www.worldbank.org/en/publication/wdr2018
[9] Ibid.
[10] Ibid.
[11] Bruns, Barbara, Deon Filmer, and Harry Anthony Patrinos. 2011. "Making Schools Work: New Evidence on Accountability Reforms. Human Development Perspectives Series." Washington, DC: World Bank.
[12] Bloom, Nicholas, Renata Lemos, Raffaella Sadun, and John Van Reenen, "Does Management Matter in Schools?" Economic Journal 125, no. 584 (2015): 647–74.
[13] EFA Global Monitoring Report Team. "Investing in Teachers Is Investing in Learning: A Prerequisite for the Transformative Power of Education." Global Education Monitoring Report, July 2015. https://en.unesco.org/gem-report/investing-teachers-investing-learning-prerequisite-transformative-power-education.

attendance among both teachers and students and promotes a desire to learn.[14] One study shows that student learning improved significantly when training was provided to principals in the following sets of skills: how to give feedback of teachers on lesson plans; how to support teachers in student assessment and evaluation; and how to give feedback on teacher performance.[15] As mentioned, leadership does not necessarily directly affect learning outcomes, however it does have an effect on the quality of teacher-learner interactions which does directly affect learning outcomes. As such, Professional Development programs are often varied in subject and content depending on the needs of the participants. Professional Development trainings are found to be the most effective when they include the following best practices: 1) treatment of leadership development as a continuum with pre-service and in-service training, 2) the provision of consistent and cumulative training overtime, and 3) the provision of a variety of workshops and sessions that are tailored to the needs of the specific community.[16] Training can occur in multiple ways including the use of cluster meetings and one-on-one mentorship. The cost of these programs are varied depending on the needs of the community, however the outcomes and impact on learning are generally very positive when these best practices are followed.

Teacher Training

According to the World Bank, one of the most fundamental elements of learning is effective teaching through well-equipped and motivated teachers.[17] In many education systems, particularly those serving poorer communities, teachers often do not have the skills and training necessary to adequately foster learning, and there is often little or inconsistent professional development training as well as limited mechanisms to mentor and encourage teachers themselves.[18] Teacher training that does occur in low- and middle-income countries is low quality, and often goes unevaluated making it ineffective. Much of this is linked to limited resources, as well as inadequacies in school leadership and management capabilities.[19] All teachers require continued support to enable them to improve their teaching practices, foster motivation, and help them adapt to change. Teachers that receive pre-service and in-service training, are generally found to teach better then those who do not.[20] Interventions and investments that focus on improved teaching practices and methods of learning, particularly with regards to supplemental instruction to children falling behind in grade level competencies, have been shown to be effective in improving learning outcomes. This often goes hand-in-hand with efforts to improve school governance and teacher accountability.[21] Therefore, ongoing training plays a key role in improving learning outcomes by providing teachers with additional knowledge and resources on how to support struggling learners.[22] Teacher training can occur in a

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[14] Ibid.
[15] Fryer, Roland G, "Management and Student Achievement: Evidence from a Randomized Field Experiment." NBER Working Paper 23437, National Bureau of Economic Research, Cambridge, MA.
[16] Pont, Beatriz, Deborah Nusche, and Hunter Moorman. "Improving School Leadership: Policy and Practice." OECD Report, 2008. https://www.oecd.org/education/school/44374889.pdf
[17] World Development Report: Learning to Realise Education's Promise (World Bank, 2018)
[18] Tandon, Prateek, and Tsuyoshi Fukao. 2015. Educating the Next Generation: Improving Teacher Quality in Cambodia. Directions in Development: Human Development Series. Washington, DC: World Bank.
[19] World Development Report: Learning to Realise Education's Promise (World Bank, 2018).
[20] EFA, "Investing in Teachers
[21] Glewwe, P., and K. Muralidharan. "Improving Education Outcomes in Developing Countries." Handbook of the Economics of Education, 2016, 653–743. https://doi.org/10.1016/b978-0-444-63459-7.00010-5.
[22] EFA, "Investing in Teachers".

variety of forms. **This report finds that *Teacher Mentorship Training* and *Teacher Knowledge Training* have the greatest impact on learning outcomes and the highest returns on investment.**

Teacher Mentorship Training

There are many studies to suggest the benefit of mentorship programs for teachers, during both pre-service and in-service training. For example, a pre-service teacher mentoring project undertaken in Kenya found that collaborative mentoring can enhance teacher development, and is an important resource in the teaching/learning process.[23] By working with experienced teachers, teacher trainees are able to learn new teaching methods and gain guidance on essential skills such as lesson planning and delivery. Ideally, mentorship would be incorporated into existing training mechanisms not requiring significant additional cost.

Teacher Knowledge Training

One of the greatest barriers to achieving learning outcomes, is a teachers own limited knowledge on the subject matter being taught. It is found that many teacher education programs focus on teaching methods and pedagogical theory, but they lack the resources to upgrade weak subject knowledge. A study in Uganda found that the curriculum for initial primary teacher education devotes 262 hours of instructional time to teaching methods and only 120 hours to math, english, and science, and most of that time is spent learning subject-specific teaching methods with an assumption that trainees have previous subject knowledge.[24] Limited subject knowledge would limit a teacher's ability to adequately convey concepts to students. Therefore more knowledge training is necessary depending on the ability of the teacher. This type of training would be more effective when incorporated into preservice training.

Parent Education/Engagement

Parent and community accountability and engagement efforts can have indirect but positive benefits on learning outcomes as they can encourage parents to become more engaged and aware of their children's learning and education. Research shows that when parents are more engaged, children will in turn also become more engaged, and school leadership and teachers more motivated as they are held accountable by the community.[25] In low-income settings, it can often be the case that parents themselves have not received much of an education and are therefore unable, or feel they are unable, to contribute and engage with their children's schools. As such, improved parent education can bridge a link between home and school allowing for an improved learning environment for students, indirectly helping to improve learning outcomes.[26] Increasing engagement in ways that promote community oversight of service delivery and accountability mechanisms for school management and teachers can improve outcomes, with studies showing that this is most impactful on issues that parents can easily

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[23] Ochanji, Moses, Nicholas Twoli, M Bwire, and John Maundu. "Teacher Mentoring for Effective Teacher Training and Development The Case of a Developing Country, Kenya." Teacher Education and Practice. 30, no.1 (2017).
[24] EFA, "Investing in Teachers".
[25] Westhorp, Gill, Bill Walker, Patricia Rogers, Nathan Overbeeke, Daniel Ball, and Graham Brice. "Enhancing Community Accountability, Empowerment and Education Outcomes in Low and Middle-Income Countries: A Realist Review," May 2014. https://assets.publishing.service.gov.uk/media/57a089f140f0b652dd0004a2/Community-accountability-2014-Westhorp-report.pdf.
[26] Ibid.

observe such as teacher absenteeism (if that is an issue).[27] Studies show that community engagement efforts can help to: 1) connect community leadership with school leadership improving accountability mechanisms; 2) regulate the supply of teachers and provide motivation for retainment; 3) enforce autonomy and decision-making capability of school leadership; 4) increase the capability of the community leadership; and, 5) improve school facilities and procedures, as well as a number of other benefits.[28]

In 2014, researchers at the University of London published a comprehensive analysis of 30 studies across multiple countries that assess the outcomes of initiatives geared towards increased parent and community participation in schooling.[29] This document appears to be an excellent consolidation of research from around the world, and could be a great resource when trying to determine the best practices for parent education/engagement methods.[30] A number of interventions highlighted in the report were designed specifically to address problems with accountability. Most, if not all, use monitoring of some sort at the local level. Interventions include community score cards, text-book monitoring, monitoring of teacher attendance and so on. One example: community score cards involve a staged intervention, typically engaging a whole community in reaching agreements about reforms required for a given public service, such as a school. The methodology reflects a fairly well-tested, facility-focused approach to citizen participation. It uses multiple small groups to develop scorecards, a social audit process to gather data, and a community gathering to discuss the findings from both and agree on an action plan. However it should be noted that interventions and their results are extremely context dependent.

From an investment perspective, more research is required to determine if parent education and community engagement is the best approach per dollar invested to drive learning outcomes. There is clear evidence that increased parent and community engagement are a way through which to keep school management and teachers accountable, directly impacting learning.[31] However the methods currently used to increase parent education and community engagement are varied with inconsistent success rates, and are highly dependent on the social structure and governance mechanisms of a given community. Any plans for intervention at the community level must take into account the specific context and conditions of the community, and would need to be a long-term iterative process.[32]

Learning Tools

Learning tools are an essential albeit broad input within the context of a school setting. Research has shown inconclusive assessments about the efficacy of investments in certain inputs, with some claiming their benefits and others their inadequacies in improving learning outcomes, depending on the specific context. Without adequate teacher training and leadership mechanisms in place, inputs such as textbooks and furniture often fail to reach the classroom and are therefore ineffective at improving learning outcomes. This further points to the need for a PDIA approach to need-assessment,

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[27] Bruns, "Making Schools Work"
[28] Westhorp, "Enhancing Community Accountability".
[29] Ibid.
[30] Ibid.
[31] Pradhan, Menno, Daniel Suryadarma, Amanda Beatty, Maisy Wong, Arya Gaduh, Armida Alisjahbana, and Rima Prama Artha. "Improving Educational Quality through Enhancing Community Participation: Results from a Randomized Field Experiment in Indonesia." American Economic Journal: Applied Economics 6, no.2 (2014): 105–26.
[32] Westhorp, "Enhancing Community Accountability".

in order to ascertain the optimal portfolio of interventions to be put in place in each specific location and maximise the impact per dollar invested. Even so, because of the foundational role some learning tools play towards improving learning outcomes, this report puts forward the following recommendation. **This report finds that *Textbooks* and *Laptops* have the greatest impact on learning outcomes and the highest returns on investment.**

Textbooks

Among the most cost-effective learning tools, textbooks are also the most used educational inputs worldwide. The effectiveness of these inputs broadly depends on three factors: 1) how closely allied to the school curriculum the tools are; 2) how they have been distributed/used by the teachers; and, 3) whether they cater to the pre-existing learning abilities of the pupils. An intervention carried out in Sierra Leone found that, after distributing textbooks with no other mechanism in place, a majority of the textbooks were locked away in cupboards during follow-up inspections.[33] Similarly, Benevot argues that the value of textbooks towards improving learning outcomes in children is rather susceptible to the content of the textbooks.[34] It is, in fact, important to keep in mind that the content of textbooks can be politicised in a way that can be detrimental to improving learning outcomes in children. In a similar vein, familiar cultural references can be conducive to learning and the degree to which the textbook caters to the abilities of the pupils plays a significant role in determining their effectiveness.[35] This point to the need to pair the distribution of textbooks with other measures to ensure that the tools are utilised effectively by the teachers, but also to select learning material that are conducive to learning and appropriate to the pupils' abilities.

Laptops

Similarly to textbooks, laptops can be a useful resource to improving learning outcomes. In this case, however, the cost of this input will be determined by the typology of the laptop selected as well as the number of individual laptops distributed within a school. Laptops represent a good example of technologies who have been found to be conducive to learning but that, similarly to other inputs, can fall into disuse if the distribution programs are not paired up with strong governance and appropriate teacher training to maximise the utility of this resource. For example, the One Laptop Per Child' initiative's rolling out was delayed by several years in Brazil. When the laptops were finally distributed and allocated to different classrooms, a survey found that more than 40% of the teachers whose classroom partook in the program never or rarely used this resource as part of their core class activities.[36] This points to the fact that a needs assessment is necessary in order to determine the gaps to be addressed in each school.

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[33] Shwetlena Sabarwal, David K. Evans, and Anastasia Marshak, 2014. "The Permanent Input Hypothesis: The Case of Textbooks and (No) Student Learning in Sierra Leone." Policy Research Working Paper 7021, World Bank, Washington, DC

[34] Benavot, Aaron. "Improving the Provision of Quality Education: Perspectives from Textbook Research." Journal of International Cooperation in Education. 14, 2: (2011): 1-16. https://pdfs.semanticscholar.org/6660/187bbb2cc20c3eac46b123716ab9632c14d2.pdf.

[35] Ibid.

[36] Lena Lavinas, and Alinne Veiga, 2013. "Brazil's One Laptop Per Child Program: Impact Evaluation and Implementation Assessment," Cadernos de Pesquisa 43 (149).

Incentives

The efficacy of incentives is highly dependent on what those financial incentives are geared towards. It is found that if incentives are geared towards the measured improvement of teacher qualification and skills, then there is a direct improvement in learning outcomes. If the incentives are financial in nature and geared towards school infrastructure inputs, there is no real indication of success. And if it is geared towards leadership training, there are indirect improvements in learning outcomes.[37]

For context, looking at incentives entails considering situations in which teachers and pupils have little incentive to perform well beyond their intrinsic motivation to do so. Additionally, the typologies of financial incentives are extremely varied. In fact, the incentive can either be provided based on inputs, such as school attendance, or based on outputs, such as learning outcomes. Similarly, the incentives can either be available to all those who reach a certain goal or they can be distributed to teachers on a competitive basis. Lastly, the incentives can be financial or nonfinancial in nature. **This report finds that *Conditional Cash Transfers* and *School Feeding Programs* have the greatest impact on learning outcomes and the highest returns on investment.**

Conditional Cash Transfers

Conditional cash transfers have o been widely used as a tool to incentivising school enrollment and attendance. Parker and Todd reviewed the effectiveness of the first large-scale conditional cash transfer program, Progresa (now called Oportunidades).[38] Oportunidades started in Mexico in 1997 as a poverty alleviation program. Through Oportunidades, selected families would receive two types of conditional transfers, one contingent upon a family member seeking preventative care, and the other tied to educational attainment. The educational component of the transfer was used to foster school enrollment and attendance and, in fact, it was shown to have a significantly positive impact on enrollment rates.[39] The caveat, however, is that, given Oportunidades' success, conditional cash transfers have been used in various different contexts, with mixed results. Ladhani and Sitter suggest that the efficacy of conditional cash transfers should be more rigorously evaluated in the contexts in which this social program is used, without giving the achievement of positive outcomes for granted without conducting rigorous evaluations.[40]

School Feeding Programs

School feeding programs feature prominently as one of the most widespread solutions to incentive enrollment, attendance, and improved learning outcomes in low-resource environments. Jomaa, McDonnell and Probart conducted an analytical review of school feeding programs in low-resource settings in developing countries.[41] In doing so, they found that such programs have positive effects on both enrollment and attendance. Similarly, Biswas et al. found that mid-day meals had a

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[37] "Improving Education Outcomes in Developing Countries."

[38] Parker, Susan W., and Petra E. Todd. "Conditional Cash Transfers: The Case of Progresa/Oportunidades." Journal of Economic Literature. 55, 3 (2017): 866-915. https://www.aeaweb.org/articles?id=10.1257/jel.20151233.

[39] Ibid.

[40] Ladhani, Sheliza, and Kathlen C. Sitter. "Conditional Cash Transfers: A Critical Review." Development Policy Review, 38, 1 (2018). https://onlinelibrary.wiley.com/doi/full/10.1111/dpr.12416.

[41] Jomaa, Lamis H., Elaine McDonnell, and Claudia Probart. "School Feeding Programs in Developing Countries: Impacts on Children's Health and Educational Outcomes." Nutrition Reviews, 69, 2 (2011): 83-98. https://academic.oup.com/nutritionreviews/article/69/2/83/1909764.

positive impact on attendance and enrollment in Eastern Western, and Southern zones in India.[42] However, evidence pointing towards a connection between the school feeding programs and the achievement of improved learning outcomes was mixed, with the highest improvement seen in low-resource environments.

1.4. Recommendations

Overall the research conducted (as described above and as found in Appendix 1 and 2) suggests that all areas of investment are interconnected and therefore, investments should be made holistically given the specific context and needs of the individual school and community. The strengths and limitations of all individual institutions will vary widely, and as a result their needs will also vary. Investment recommendations should reflect this diversity of need and should be tailored accordingly. Therefore, an iterative approach utilizing the PDIA is recommended. The recommended approach will allow individual schools, and community leaders to determine what their needs are and where best to invest their money. This allows for a decentralised investment policy that does not require any given institute to invest money into an area that may not be beneficial for them. As such, the simplified two-step process is as follows:

1) Consistent self-monitoring and evaluation procedures should be established and should take place at the individual school and community level to determine their strengths and limitations and the effect that these have on learning outcomes.

   ● This should involve improved mechanisms for measurement and evaluation that focus on learning, and take into consideration the best indicators that relate to learning outcomes (more on this in part 3).

2) Depending on the evaluation, determine the best investment option for the given school/community. This would take into account the country context, leadership accountability and trustworthiness, as well as where investments have already been made and where investments need to be made in the future.

   ● For example, if a school is found to already have strong leadership and management mechanisms but limited community engagement, and if the social structure of that community allows for it, then investments might be made to improve community engagement.

   ● It should be noted that a number of these investment areas are highly interrelated and therefore investing in one will have an impact on another area, and this impact must be monitored to mitigate any potential unforeseen negative consequences.

However if specific recommendations are to be made, depending on the context and with the PDIA in mind, investments in the following areas will result is improved learning outcomes as well as ensuring a relatively high return on investment:

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[42] Biswas, Puja, and Amit Kundu. "Gender Parity Index in Primary School in Rural India: An Analysis." Turkish Economic Review. 6,2 (2019). http://www.kspjournals.org/index.php/TER/article/view/1867.

Investment Area	Activity	Impact
School Leadership Training	School Leadership and Professional Development	Improved governance and accountability structures, teaching quality, resource management, community engagement, learning environment, all positively impacting learning outcomes.
Teacher Training	Teacher Mentorship Training	By working with experienced teachers, teacher trainees are able to learn new teaching methods and gain guidance on essential skills such as lesson planning and delivery, improving the teacher-learning interaction.
	Teacher Knowledge Training	Improved subject knowledge increases teachers ability to adequately convey concepts to students, improving learning outcomes.
Parent Education/ Engagement	*no specific recommendation can be made as this is highly context dependant*	Increased parent engagement leads to increased student engagement, as well as school management and teacher motivation and accountability, positively impacting learning outcomes.
Learning Tools	Textbooks	Textbooks that have content conducive to learning, and are used and distributed effectively are linked to improved learning outcomes.
	Laptops	Depending on knowledge and infrastructure capacity, laptops can be an additional teaching resource with the ability to improve learning outcomes.
Incentives	Conditional Cash Transfers	Contribute towards higher enrollment, attendendance, and improved learning outcomes by off-setting the opportunity cost of quitting school.
	School Feeding Programs	Provides an added incentive to be enrolled and attend classes in low-resource environments. Nutrition linked to improved learning outcomes.

2.0 Improving Learning Outcomes Through Numeracy and Literacy Tools

2.1 Background

Over the last decade there have been rapid advancements in information and communication technologies (ICT), enabling innovators to leverage education technology (ed-tech) to transform learning. Innovators have produced countless technological resources purposed for bettering learning outcomes universally. In terms of technological resources, ed-tech often materializes through computer-assisted learning (CAL) and mobile-learning applications that cater to the individual needs of the student.[43] Ed-tech offers the potential to open doors and creates opportunities for children and youth through expanding access to quality education, facilitating communication between teachers, students, and families, and reducing other barriers across a wide range of educational contexts.[44] What is more, it can aid learning outcomes by providing immediate feedback, while also providing teachers with regular and rapid data that can be used to help struggling students.[45] In particular, in the area of numeracy skills, studies show ed-tech programs exhibit promise in improving learning outcomes.[46] With this knowledge, this section of the report seeks to identify mobile applications that improve learning outcomes for children and youth.

2.2 Research Question

This section of the report seeks to answer the following question: *which numeracy or literacy tools have driven the strongest improvements for learning outcomes for children*?

Here, the focus is on mobile-learning applications. This report identifies two apps that have driven the strongest improvements in learning outcomes for children. The recommended apps that answer this question are *onebillion*, and *Khan Academy*. The conceptual model for this section divides the applications into two categories: literacy tools and numeracy tools. As such, the recommended applications fall into one of these categories which serves the purpose of improving learning outcomes. The analysis of these applications also stems from five established criteria to measure the apps. The best apps must meet criteria 1-4, while criterion 5 is not a requirement, but is preferred. The data for these applications reveal improvements in test scores, as well as an impact in a variety of children—boys, girls, and students with special educational needs and disabilities (SEND)—in a diverse of low-resource environments. All apps that were assessed can be seen in *table 1*. The applications, the depths of their test design, and their results, are discussed below.

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[43] Maya Escueta et al, "Education Technology: An Evidence-Based Review," National Bureau of Economic Research (2017): 23.
[44] Ibid, 2.
[45] Ibid, 24.
[46] Ibid.

Table 1

Compilation of Apps Assessed			
Application	Assessed by a Third Party? (Y/N)	Robustness of Assessment (Weak/Satisfactory/Strong)	Recommended (Y/N)
ABA English	<u>Y</u>	Weak	N
onebillion	Y	Strong	Y
Duolingo	Y	Satisfactory	N
Khan Academy	Y	Strong	Y
Raspberry Pi for Learning (Pi4L)	N	N/A	N
Jumpido	N	N/A	N
Open Learning Exchange	N	N/A	N
ClassDojo	Y	Weak	N
Reading Eggs and Mathseeds	Y	Weak	N
The iMlango Project	N	N/A	N
Snapplify	N	N/A	N
Youtube Teach	N	N/A	N
Flow Free	N	N/A	N
Quick Maths	N	N/A	N
Dragon Box	N	N/A	N
Hungry Caterpillar Play School	N	N/A	N
Quick Math Junior	N	N/A	N
PBS Kids Games	Y	Weak	N
Elmo Loves 123s	N	N/A	N
Todo Math	Y	Weak	N

Criteria and Qualification of Selected Apps

Five criteria derived from the research were established as a barometer for the effectiveness of these apps. These criteria include the following:

1. **Retainability**: does this application aid in long-term improvements?
2. **Style of teaching staff**: how are these apps used in the classroom? Understanding that the success of these apps is heavily contingent on the methods used to teach, it is important that they are integrated in cohesion with traditional teaching for a more holistic and impactful outcome?
3. **Ability to scale**: realistically, can this app be applied to various environments or age groups, and achieve relatively comparable results?
4. **Cost**: how much does the application cost?
5. **Other complementary benefits**: overall, does use of the app have positive spillover effects. Did the application increase student attendance? Did it give the teacher more time to interact with students who were struggling? Did it increase community engagement? Does it provide a specific cost advantage in comparison to other apps?

2.3 Analysis

Onebillion

Onebillion is a developer that created a suite of math applications (eight, to be exact) called *onecourse. Onecourse* is designed for children aged 3-6, and it functions as a literacy tool.[47] Although there are eight applications, the suite of apps are simply iterations derived from the two original apps, 'Math 3-5' and 'Math 4-6', offered specifically for schools, home, and in the Chichewa language, the native tongue in parts of Malawi, Zambia, and Mozambique. Therefore, despite there being eight apps from the company, they are all listed here under the *onebillion* umbrella. The apps are available to be downloaded in Apple and Google app stores.

With respect to **retainability**, use of *onebillion's* math applications showed clear immediate and sustained learning benefits for the development of early mathematical skills.[48] An intervention located in the United Kingdom in 2017 for students aged 4-7 was assessed through four studies—three of which are relevant to the research in this report—which consist of control and treatment groups performing tests before (pre-test) and after (post-test) the intervention. The app showed significant and immediate results, sustained gains following the intervention, and a particular effect on low achievers.[49] *Figure 1* presents the results from study 1, demonstrating an increase in mean test scores from 13.39 to 24.34.

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[47] Onebillion, https://onebillion.org/about/the-goal/ (accessed February 16, 2020)
[48] Laura A. Outhwaite, Anthea Gulliford, and Nicola J. Pitchford, "Closing the gap: Efficacy of a tablet intervention to support the development of early mathematical skills in UK primary school children," Computers and Education (2017): 44.
[49] Ibid, 43.

Study 1: Group mean performance in curriculum knowledge and maths concepts at pre-test, immediate post-test and delayed post-test and percentage (%) gains following the 6-week intervention period with the maths apps.

Measure	Year	Mean (SD)				
		Pre-test	Immediate Post-test	% gain	Delayed Post-test	% gain
Curriculum knowledge	EYFS	13.39 (9.64)	24.34 (11.88)	21.9	27.17 (10.50)	27.6
	Key Stage 1	20.91 (12.52)				
Maths concepts	EYFS	10.67 (7.24)	12.89 (6.92)	4.6	15.48 (5.20)	10.0
	Key Stage 1	17.27 (8.15)				

Figure 1: Laura A. Outhwaite, Anthea Gulliford, and Nicola J. Pitchford, "Closing the gap: Efficacy of a tablet intervention to support the development of early mathematical skills in UK primary school children

A similar effect can be seen in studies 2 and 3 as illustrated in *figure 2*, demonstrating increases in the mean and standard deviation from the pre-test to post-test periods.

		Year	Mean (SD)		
			Pre-test	Post-test	% gain
Study 2	New curriculum knowledge	EYFS	27.17 (10.87)	39.11 (6.72)	23.9
	Composite maths concepts	EYFS	14.22 (4.46)	19.27 (5.19)	5.1
Study 3	New curriculum knowledge	Key Stage 1	29.41 (7.30)	40.37 (4.52)	21.9
	Composite maths concepts	Key Stage 1	16.22 (2.70)	20.08 (3.53)	3.9

Figure 2: Laura A. Outhwaite, Anthea Gulliford, and Nicola J. Pitchford, "Closing the gap: Efficacy of a tablet intervention to support the development of early mathematical skills in UK primary school children"

Standard Assessment Time of test		Group		
		Maths tablet	Non-maths tablet	Normal practice
S1 (n = 44)		n = 22	NA	n = 20
MC	Pre	2.0 (1.7) 0–5		3.4 (4.3) 0–13
	Post	5.1 (4.6) 0–17		4.5 (4.3) 0–13
	% Gain	6.5		2.3
CK	Pre	2.4 (2.7) 0–12		2.7 (1.7) 0–6
	Post	7.7 (6.3) 0–24		5.9 (5.3) 0–20
	% Gain	10.6		6.4
S2 (n = 110)		n = 38	n = 35	n = 37
MC	Pre	8.6 (6.5) 0–20	10.1 (5.7) 0–21	8.4 (6.3) 0–19
	Post	14.6 (6.6) 0–24	12.5 (7.3) 0–23	10.5 (6.5) 0–19
	% Gain	12.5	5.0	4.4
CK	Pre	6.4 (6.3) 0–24	8.3 (8.1) 0–28	5.5 (5.3) 0–21
	Post	20.7 (10.3) 0–37	15.1 (8.5) 2–31	10.8 (7.4) 0–26
	% Gain	28.6	13.6	10.6
CKG	Post	23.8 (9.1) 7–41.5	17.4 (10.3) 0–36	20.7 (8.4) 4–39
S3 (n = 131)		n = 44	n = 44	n = 43
MC	Pre	14.9 (5.7) 0–23	15.4 (5.6) 0–22	14.9 (5.2) 0–22
	Post	19.5 (5.2) 5–27	19.3 (5.1) 4–26	18.6 (6.0) 0–26
	% Gain	9.6	8.1	7.7
CK	Pre	13.5 (9.3) 0–34	14.8 (10.1) 1–37	11.0 (10.3) 0–33
	Post	35.2 (7.0) 19–46	24.9 (8.0) 3–36	23.4 (6.9) 7–36
	% Gain	43.4	20.2	24.8
CKG	Post	33.5 (7.3) 19–47.5	20.0 (6.7) 7–36	27.2 (8.1) 10–43

Figure 3: Nicola J. Pitchford, "Development of early mathematical skills with a tablet intervention: a randomized control trial in Malawi"

Furthermore, researchers conducted a randomized control trial (RCT) in Malawi on a sample of 283 children, dividing students into three groups: maths tablet intervention (using *onebillion*), non-maths tablet control, and standard face-to-face practice.[50] An analysis of pre-test and post-test results conveyed significant effects of the maths tablet intervention, making strong gains over time.[51] Looking at *figure 3*, what can be seen is a comparative analysis between the three groups. Looking at the pre-test and post-test scores over the intervention period, the chart demonstrates the greatest improvements were by the maths tablet group in the areas of mathematical concepts (depicted as MC in the chart), curriculum knowledge (depicted as CK on the chart), and curriculum knowledge generalization (depicted as CKG on the chart).

In terms of the **style of the teaching staff**, the use of applications did not substitute traditional learning; *onebillion's* applications were used as complementary tools to teachers for 30-60 minutes a

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[50] Nicola J. Pitchford, "Development of early mathematical skills with a tablet intervention: a randomized control trial in Malawi," Frontiers in Psychology (2015): 1.
[51] Ibid.

day depending on the assigned treatment group to aid in learning mathematics.[52] Related to the research in the first section on learning tools, this is important because adequate leadership mechanisms must be in place for learning outcomes to be impacted. With respect to the **ability to scale**, *onebillion* math apps are available in over 50 languages at no extra charge, making it readily accessible to a multitude of low-resourced communities and nations. *onebillion's* applications have been used in the following countries: Malawi, the United Kingdom, Kenya, South Africa, Uganda, India, Ethiopia, Brazil, and Cambodia. Being that their applications have been used in both developed and developing nations with similar results, this indicates that *onebillion's* applications are highly scalable.

In terms of **cost**, 75 percent of *onebillion* math apps are free, with costs associated with in-app purchases for accessing certain features. With respect to the applications that are not free, these apps are specifically for the school environment, offering tailored curriculums. These apps are 'Maths age 3-5, for schools' with a cost of $31.99, and 'Maths 4-6, for schools' with a cost of $54.99. With respect to any **other complementary benefits**, *onebillion's* math apps aid in reducing knowledge gaps in classes. The company's applications demonstrate a significant link between early maths ability and short-term memory, as children with weaker memory's exhibited larger learning gains, suggesting that children with poor memory skills can obtain foundational mathematical knowledge.[53] As such, *onebillion's* math apps can be used by all children, while also reducing strains on the teacher.[54] The applications also aid balancing out gender discrepancies in early age performance in mathematics; research from an intervention in Malawi indicated that girls learned just as well as boys when using the interactive math apps.[55] Furthermore, the applications also promote learning in SEND children by promoting high levels of engagement and creating an inclusive environment.[56]

Khan Academy

Khan Academy is a not-for-profit organization that provides free education.[57] Their apps are available to be downloaded in Apple and Google app stores. There are two apps under the Khan Academy umbrella: *Khan Academy*, and *Khan Academy Kids*. The apps provide personalized, interactive learning that allow students to learn at their own pace by bridging knowledge gaps, and accelerating their understanding to improve learning outcomes.[58] Overall, the *Khan Academy* functions as a numeracy tool. The original app, *Khan Academy*, is for children aged 4-18. The app aids in all mathematical subjects, ranging from age groups of early childhood education (ECE) to university.[59] With respect to *Khan Academy Kids*, the app provides content for children aged 2-7.[60]

In terms of **retainability**, *Khan Academy* conducted an RCT on ninth grade students in Sri Lanka through a study of the app's numeracy video tutorials in a blended learning environment.[61] On average,

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[52] Ibid, 47; Nicola J. Pitchford, Antonie Chigeda, and Paula J. Hubber. "Interactive apps prevent gender discrepancies in early-grade mathematics in a low-income countries in sub-Sahara Africa," Developmental Science (2019): 8.

[53] Outhwaite, Gulliford, and Pitchford, "Closing," Computers and Education (2017): 57.

[54] Ibid, 58.

[55] Pitchford, Chigeda, and Hubber. "Interactive," Developmental Science (2019): 12.

[56] Nicola J Pitchford, Elizabeth Kamchedzera, Paula J Hubber, and Antonie L Chigeda. "Interactive Apps Promote Learning of Basic Mathematics in Children with Special Education Needs and Disabilities," Frontiers in Psychology (2018): 1.

[57] Khan Academy, https://www.khanacademy.org/about (accessed February 13, 2020).

[58] Ibid.

[59] Ibid.

[60] Ibid.

[61] Ibid.

Khan Academy resulted in increasing students' raw and scaled test scores by 3.15 and 3.77 percentage points respectively, indicating that the app would help Sri Lankan students in mathematics.[62] These results can be seen in *figure 4*, as a calculated average between ATE (average treatment effects).

Period	Post Test-1			Post Test-2		
Outcome	Raw (1)	Std (2)	Scaled (3)	Raw (4)	Std (5)	Scaled (6)
Robustness Check-1[a]						
ATE	2.72 **	0.14 **	2.34 ***	0.43	0.03	0.49
	(1.15)	(0.07)	(0.87)	(1.13)	(0.08)	(0.75)
ATT	1.72	0. 06	1.29	0.09	0.01	0.08
	(1.36)	(0.08)	(0.99)	(1.37)	(0.09)	(0.88)
Obs	744	744	744	719	719	719
Robustness Check-2[b]						
ATE	5.01 **	0.27 *	3.96 ***	1.97	0.12	2.24 *
	(2.43)	(0.15)	(1.49)	(1.96)	(0.14)	(1.31)
ATT	2.47	0.10	2.20	4.11 **	0.26 *	3.85 ***
	(2.70)	(0.16)	(1.66)	(2.03)	(0.14)	(1.38)
Obs	164	164	164	167	167	167

Figure 4: Bilesha Weeraratne and Brian Chin, "Can Khan Academy e-learning video tutorials improve mathematics achievement in Sri Lanka"

Additionally, in the study there were two post-tests: the first was after five months, and the second was after seven months. Looking to the post test after seven months, the researchers found that on average randomly selected students from the treatment group experienced 4.11 percentage point increases in their raw test scores.[63] As such, *Khan Academy* also has significant long-term impacts as the increase was found to be statistically significant.[64] Similarly, an RCT was conducted in El Salvador to assess *Khan Academy's* impact on numeracy skills among students in grade 3-6.[65] Here, they found that *Khan Academy* consistently outperforms the more traditional approach to teaching math.[66] For this RCT, 118 schools were assigned to one of three interventions; 80 classes were assigned to a control group, 39 to version 1, and 39 to version 2. This assessment measured the impact of the app to the equivalent in school years, that is, how many years in school it would take to achieve the same results the app produced. Their findings indicate that there were gains in math ability equivalent to 0.19-0.47 school years through the integration of *Khan Academy.*[67]

In terms of the **style of the teaching staff**, *Khan Academy* was used as a teaching tool complementary to traditional classroom teaching (2-3 days KA and the rest 2-3 days traditional teaching). In El Salvador, they ran an hour of class each afternoon after the school day.[68] Related to the research in section one on learning tools, this is important because adequate leadership mechanisms must be in place for learning outcomes to be impacted. With respect to the **ability to scale**, the research indicates interventions were done in Sri Lanka and in Morazán, El Salvador. In both contexts' improvements were seen to math test scores for children in grades 3-6, as well as students in ninth grade. Language is also a factor that impacts scalability. *Khan Academy* is available in English, Spanish, French, Brazilian, and Portuguese, and is also being translated into 36 other languages. The

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[62] Weeraratne and Chin, "Can," (2018): 93.
[63] Ibid, 101.
[64] Ibid.
[65] Konstantin et al, Expanding school time and the value of Computer-Assisted Learning. (El Salvador, Consciente, 2019), 1.
[66] Ibid.
[67] Ibid, 13.
[68] Konstantin et al, "Expanding" (El Salvador, Consciente, 2019), 1.

variety of languages ensures the app is able to function in a variety of contexts rather simply. The **cost** for *Khan Academy* renders it a cost-effective application as it is free of charge, also feeding back in its ability to scale, being accessible to many. Finally, with respect to **other complementary benefits**, the intervention for *Khan Academy* in El Salvador implemented the app in a specific style which also entails cost-effectiveness; in particular, the teachers and supervisors were used. Teachers were qualified professionals who were able to teach classes. When the application was implemented alongside teachers, the cost was approximately 53 USD per beneficiary; this combination yielded the highest benefits and largest improvements for children.[69] When *Khan Academy* was implemented alongside supervisors—less educated individuals who simply monitored students—the cost was 44 USD. This is less than the cost of teachers alone, which is 45 USD.[70]

2.4 Recommendations

Taken as a whole, *onebillion* and *Khan Academy* effectively meet all five criteria. They demonstrate the effects from the apps are retainable beyond the test period, conveying sustained improvements in the long-term. *Khan Academy* learnings was retained long-term after five months and seven months while, *onebillion* showed immediate and sustained improvements. The apps also were implemented in cohesion with the teaching staff as the physical presence of the teacher is necessary to drive the strongest improvements. In terms of scalability, the apps can feasibly be scaled, as the apps have been used in varied contexts and have demonstrated similar results in improved learning outcomes. Together, these apps have been used across different regions, some of which align with target areas of EduFinance. *onebillion's* applications have been used in Malawi, the United Kingdom, Kenya, South Africa, Uganda, India, Ethiopia, Brazil, and Cambodia. As such, the company's applications can be scaled to countries targeted in EduFinance's global outreach efforts. Countries in which both *onebillion* and EduFinance operate include India, Kenya, Uganda, Ethiopia, and Malawi. Nonetheless, *onebillion's* scalability is promising considering its application and success in diverse contexts. *Khan Academy* was used in areas characterized by poverty; this means that these are also low-income areas that face barriers in accessing education and bettering learning outcomes, as indicated by the high rate of failure in mathematics in Sri Lanka, and an illiteracy rate of more than 20 percent in Morazán.[71] EduFinance has targeted low-income countries with analogous challenges in the Americas and Asia. Contexts between existing target areas and where the apps were tested differ; nonetheless, considering Khan Academy was tested in countries located in Asia and the America's, these applications may be scalable to the following countries targeted by EduFinance: Ecuador, Peru, Honduras, India, Pakistan, and Nepal. The applications are also affordable and reduce the associated costs of learning for low-income countries and communities as they are free to download, with *onebillion* having in app purchases and other versions with an associated cost for schools. Lastly, the apps have other complementary benefits that aid the learning environment, specifically the apps are simple to use thereby freeing up teacher time as there is less attention demanded on behalf of the student. *Khan Academy* may also reduce teacher costs as professionally trained teachers may not be required to drive learning improvements; supervisors can be used instead simply as class monitors.

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[69] Ibid.
[70] Ibid.
[71] Ibid, 1.

Beyond this, *onebillion* and *Khan Academy* are interactive apps that independently study, give the student control (enabling them to go at their own pace), and provide consistent, real-time feedback.

The ability of these applications to meet these criteria has led to the recommendation of *onebillion* and *Khan Academy* as literacy and numeracy tools that most strongly improve learning outcomes.

3. Linking Improved Learning Outcomes to Indicator Refinement

3.1 Background

Measuring the outputs of an educational system is a key component in determining the efficacy of inputs, while simultaneously providing a point of reference for the shaping of future interventions. Furthermore, parsing out specific indicators which are *more* effective at determining improvements to learning outcomes can increase the potential value of a measurement framework. This measurement structure can be operationalized in the educational environment as it attaches weight to specific areas within Pathways to Excellence (P2E) and, as such, can be used as a reference for school leaders to focus investments and school improvements more effectively. While the learning outcome objectives - and thus requisite conditions to improvements of such - can vary greatly between individual schools, educators and educational professionals should move towards the adoption of indicators which meet a globally accepted degree of quality. As such, comparing the internally-designed educational indicators within P2E to those established by UNESCO, a key organization in the pursuit of high-quality education, can be an effective baseline to ensure the validity and robustness of said measurements. According to UNESCO, three broad principles exist in the pursuit of quality education: relevance, equity in access and outcome, and the maintenance of individual rights.

3.2 Research Question

The underlying question asked in this approach is as follows: *Which indicators of school quality have the strongest links to improving learning outcomes for children?*

Aligning indicators - A Conceptual Model for the Measurement of Educational Outputs

UNESCO groups educational indicators into four primary categories: context, input, process, and output.[72] "*Context*" provides information on the contextual factors which impact the learning of a student, including student characteristics, the socio-economic conditions revolving around the student, cultural aspects (taboos, etc.), impressions on the teaching profession and surrounding community. "*Input*" information on the distribution and implementation of resources related to the facilitation of learning. It also measures the quantity of financial, material or human resources involved, ensuring that they are delivered to the intended areas. "*Process*" provides information on how activities are delivered within the learning environment. This can reveal whether the objectives of the education system are being attained and to what degree. This includes the development and implementation of teaching standards, school "climate" and leadership within the school. Finally, "*Output*" provides information on the overall performance of the educational system in terms of subject knowledge, competency in comprehension, the degree of grade repetition, progression and completion.

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[72] UNESCO. 2019. "Quality and Learnin*g Indicators." Learning Portal. UNESCO's International Institute for Educational Planning. November 14, 2019. https://learningportal.iiep.unesco.org/en/issue-briefs/monitor-learning/quality-and-learning-indicators.

Of these four categories, **"Output indicators provide the most important data for understanding whether educational quality and learning outcomes are improving as intended."[73]**

For the sake of this report, the 30 P2E indicators, in addition to the 12 P2E Early Childhood Education (ECE) indicators will be distributed into the relevant categories as outlined by UNESCO. This will allow for the indicator pool to be constrained, enabling a more detailed analysis to be conducted. Those falling into the *output* category will be set aside to undergo increased scrutiny, as research shows that these are the most effective at measuring impact on learning outcomes. Those falling into the other three categories will be compared to baseline indicators (as established by Sustainable Development Goal 4, "Quality Education") as a means to ensure robustness and adherence to principles of sustainable and equitable education. From this point, the *output* indicators will undergo further analysis in an attempt to elicit information on the correlation which may exist between these specific indicators and overall learning outcomes. Data will be gathered on national examinations pre- and post-implementation of targeted intervention as well as data on international assessment of individual schools, if available.

Lastly, interpretations of these indicators, specifically the means in which they measure and contribute to improved learning outcomes, is a crucial step in both encouraging their adoption and further refining our understanding of the mechanisms which underlie educational systems. Furthermore, this understanding can facilitate a diffusion of educational standards, improving wider regional educational systems, their educators and environments, further improving learning outcomes.

3.3 Analysis

Categorical Distribution

It was found that virtually all of the P2E indicators could fall into more than one of the UNESCO indicator categories. The results are contained in Appendix 3 and ECE results in Appendix 4. The characteristics of each individual indicator as outlined in the P2E self-assessment were analyzed to determine which category it belonged; the highest rated level (Level 5) was prioritized as it described the ideal conditions for an educational institution.[74] Seven P2E and four ECE P2E indicators met the conditions to fit into the Output category. Notably, all of these indicators also fell into additional categories. As such, each area is at least partially represented in the final selection.

Output Indicators:

Pupil Engagement

External Assessment of School

Child-Centered Teaching and Learning Strategies*

Special Educational Needs and Disabilities (SEND)

Assessment of Pupil Performance

Lesson Planning and Delivery

School Development Plan

Curriculum*

Learning Materials*

Teaching*

Assessment of Pupil Progress*

(ECE denoted by *)

[73] Jaap Scheerens.; Luyten, H.; van Ravens, J. 2011. 'Measuring educational quality by means of indicators'. In: J. Scheerens; H. Luyten; J. van Ravens (Eds) Perspectives on educational quality: Illustrative outcomes on primary and secondary schooling in the Netherlands (pp. 35–50). Dordrecht: Springer Netherlands.
[74] Opportunity International. 2017. "Pathways to Excellence: The Guide for School Development Planning." Oxford: Opportunity International.

Comparative Framework - Linking to SDG4

SDG4 Global Indicators provide a meaningful reference point for indicator robustness. As these indicators are designed to elicit information on processes related to the reaching of SDG4 targets, they can be considered ideal. While P2E indicators are localized, SDG4 indicators are the baseline for indicator reach - i.e. P2E indicators should, at the bare minimum, align with SDG4 indicators. Eleven thematic indicators have been created as key measurements of global SDG4 objective attainment (outlined in Appendix 5).[75] These were categorized into the aforementioned UNESCO indicator groupings and reduced to keywords so as to be useful as a comparative, qualitative metric. This distribution can be seen in Appendix 6.

SDG4 Keywords	
Student Assessment	Literacy-Numeracy Attainment
Early Childhood Development	Inclusive Curriculum
Early Childhood Education	Comprehensive Curriculum
Continuing Education	WASH Facilities
Attendance	School Infrastructure,
ICT (Training and Access)	Financial Aid,
Accessibility	Teacher Training/Development
Inclusion	

26 out of 42 P2E indicators, when distributed within this framework, met baseline conditions to align with SDG4 principles (Fig. 1). However, many of these are related to the management or central ethos/image of schools, rather than addressing the quality or delivery of educational programs itself and as such, can be considered extraneous to the scope of SDG4 indicators. Adjusted for this, 26 out of 35 P2E Indicators are represented (Fig. 2).
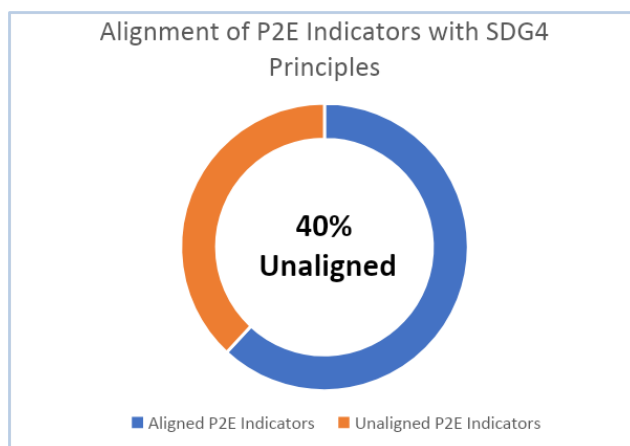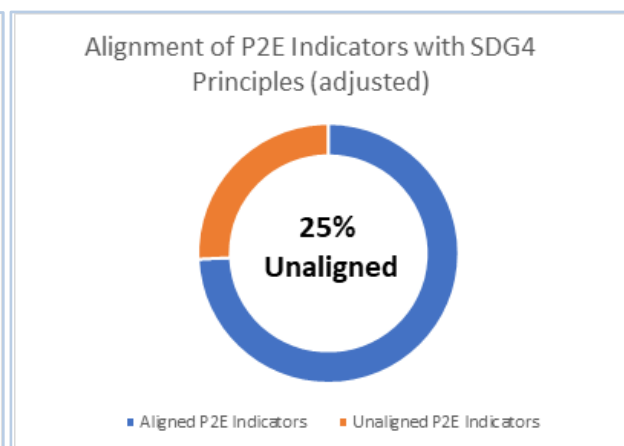

Figure 1

Figure 2

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[75] UNESCO. 2019a. "SDG 4 Data Digest - How to Produce and Use the Global and Thematic Education Indicators." Montreal, QC: UNESCO Institute for Statistics.

This lack of representation can be explained by the private nature of P2E-subject institutions, which have a mandate focused on the improvement of education delivery, rather than expansion. Despite this, school environment indicators could be developed with a focus on maximising reach within the respective catchment area of individual institutions, particularly to disenfranchised or disparate populations.

Output Indicator Analysis

A quantitative analysis of Output indicators falls outside of the scope of this report, due to a combination of unwieldiness such a process would be and the reliance on contextual information required to formulate such a framework. Furthermore, forming a central, weighted ranking of Output indicators was ultimately found to be inadvisable due to the inability to be inclusive of contextual considerations in such a framework. In contrast, highlighting the importance of output indicators and then allowing school operators to, in conjunction with key community members, determine a ranking of importance is ideal.

> All keywords are represented except for Attendance, Financial Aid and Accessibility. This omission has implications for the P2E program:
>
> **Attendance:** Ensuring that the proportion of children in community attending school is increased is not a priority.
>
> **Financial Aid:** Providing financial aid to families which cannot afford tuition is not a priority.
>
> **Accessibility:** Ensuring access to children from disenfranchised groups is not a priority.

Interpretations

As indicator scores are improved, this is a reflection of some tangible gains in the subject institution. As such, highlighting those indicators which provide measurements leading to enhanced learning outcomes is ultimately an exercise in understanding the underlying mechanisms of said indicators. While it has been established that Output indicators have a strong relationship with the attainment of improved learning outcomes - in addition to those which directly complement them - interpreting the mechanical functions which are being measured is an integral component of forming an educational framework conducive to student development. Appendix 7 contains a detailed analysis of the individual output indicators; beginning with a conceptual description (i.e. what is the goal of the indicator?) and followed by an interpretation which provides a linkage between attainment goals and the functions of said indicator. The table below summarizes these findings.

Indicator	Interpretation
Pupil Engagement	*High "Pupil Engagement" scores imply that students are being provided with both a support network but also the motivation to attend and perform in a school environment.*
External Assessment of School	*Higher "External Assessment" scores are a reflection of a cohesive educational ecosystem.*

Child-Centered Teaching and Learning Strategies	*Higher "Child-Centered Teaching and Learning Strategies" scores are indicative of an environment inclusive of different learning styles, and are thus equipped with the tools and facilities to motivate children to excel in their studies.*
Special Educational Needs and Disabilities (SEND)	*High "Special Educational Needs and Disabilities (SEND)" scores reflect a school environment equipped with the tools, knowledge and awareness to instruct and guide special needs students in a meaningful manner.*
Assessment of Pupil Performance	*High "Assessment of Pupil Performance" scores reflect a school environment which is competent in both delivering and developing regular, meaningful student assessments.*
Lesson Planning and Delivery	*High "Lesson Planning and Delivery" scores reflect a supportive educational environment where instructors are capable of and encouraged to develop their skills in planning and reflecting on their lesson delivery.*
School Development Plan	*High "School Development Plan" scores are indicative of an educational ecosystem well equipped to identify areas of concern, develop and implement solutions while maintaining considerations such as resource availability and wider social considerations.*
Curriculum (ECE)	*High "Curriculum" scores indicate that a school has implemented an ECE-specific curriculum which supports young children in their academic and personal development.*
Learning Materials (ECE)	*High "Learning Materials" scores reflect an educational ecosystem prepared to both instruct younger children, and continually refine teaching methods.*
Teaching (ECE)	*Refer to "Child-Centered Teaching and Learning Strategies"*
Assessment of Pupil Progress (ECE)	*Refer to "Assessment of Pupil Performance"*

3.4 Recommendations

Based on these findings, the following recommendations can be made related to the use, design and implementation of P2E Indicators:

1. **Highlight *Output* Indicators as Most Likely to Drive Improved Learning Outcomes**

Indicators which are directly concerned with student performance and attainment are the most effective at predicting and driving improved learning outcomes for children. *Output* indicators fall into this classification area, as they are direct measures of success.

Other system level or management indicators should compliment the attainment goals of the individual institution and there should be a clear linkage to this end result.

2. **Incorporate a *Context-Specific* Indicator Ranking Exercise into the P2E Self-Assessment Process**

The value of indicators as measurements of success is largely derived from their comprehensive applicability - i.e. an indicator possessing a strong link to improved learning outcomes will typically express this linkage in a ubiquitous manner. However, the needs of individual institutions are varied and can only be determined through internal consultation and assessment. As such, any weighted ordering should be established as an aspect of this self-assessment process.

3. **Formulate Indicators Related to the Equitable Enrollment**

While the goal of school operators is to provide high quality education to their student body, increasing enrollment in their catchment area - particularly to disadvantaged populations - should be considered. Forming indicators which measure the existence and quality of inclusive enrollment programs can assist in shaping this behaviour and can further align participating institutions with SDG4 principles.

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Appendices

Appendix 1: Intervention Assessments

Activity	Findings
School Leadership Training	
School Leadership and Professional Development (SLPD)	Studies show that schools with better management capabilities have better test scores, with these results being found regardless of region and type of education system.[76] Better management is synonymous with effective leadership, which often refers to having school principals and headteachers that are actively involved in assisting teachers with lesson planning and goal setting, who prioritize learning among their students above all else, and are able to manage and utilize resources effectively with student needs in mind.[77] One study shows that student learning improved significantly when training was provided to principals in the following sets of skills: how to give feedback of teachers on lesson plans; how to support teachers in student assessment and evaluation; and how to give feedback on teacher performance.[78] Professional Development programs are often varied in subject and content depending on the needs of the participants. Professional Development trainings are found to be the most effective when they include the following best practices: 1) treatment of leadership development as a continuum with pre-service and in-service training, 2) the provision of consistent and cumulative training overtime, and 3) the provision of a variety of workshops and sessions that are tailored to the needs of the specific community.[79] The cost of these programs are varied depending on the needs of the community, however the outcomes and impact on learning are generally very positive when these best practices are followed.
Cluster Leadership Meetings	A report from the Catholic Relief Services outlines some strategies for capacity-building cluster programs based on the success of programs that they implemented in India. According to this report, the characteristics of a good cluster program include: 1) the opportunity for peer learning and support, 2) inclusion of schools of varied capacity that complement each other, 3) ability to share resources among schools, and 4) programs where local resources and skills are identified and integrated into programming. The benefits of such a program have been clear, as it provides the opportunity for teachers, principles, and school managers to develop their skills in a sustainable way, encourages community building, and inculcates healthy competition and accountability among schools.[80] Another example, focusing on the training of principles suggests participants learn more effectively and gain more from training when given the opportunity to engage in discussion groups with their peers in which they are able to form commitments and build a "web of accountability".[81] The costs of such programs are relatively low in comparison to others, as they are able to target multiple schools in one program, and they usually aim to utilize skills and resources already available among the group of participating schools .
One-on-one Leadership training	A study of mentors and mentees among school leaders in England found the mentorship component of formal development programs to be the most beneficial part of the program, as it provided a non-threatening structure for dialogue and allowed participants with the ability to reflect on their leadership practices with experienced mentors.[82] While the benefits of mentorship are clear, the feasibility and cost-effectiveness within low-resource and potentially isolated communities brings into question whether this is the most effective training option. Rather than a stand alone program it may be most effective when incorporated as an element of general professional development activities.
School Development Planning	A study done in Nigeria found that School development planning promotes school improvement in several ways including: 1) supporting systematic self-evaluation that allows the school community to identify priorities, progress, and prepare for the future, 2) directs school efforts for quality education and schooling, 3) supports professional development for school staff, 4) mobilizes and optimizes school and community resources through planning, and 5)

[76] Bloom, Nicholas, Renata Lemos, Raffaella Sadun, and John Van Reenen, "Does Management Matter in Schools?" *Economic Journal* 125, no. 584 (2015): 647–74.

[77] EFA Global Monitoring Report Team. "Investing in Teachers Is Investing in Learning: A Prerequisite for the Transformative Power of Education." Global Education Monitoring Report, July 2015. https://en.unesco.org/gem-report/investing-teachers-investing-learning-prerequisite-transformative-power-education..

[78] Fryer, Roland G, "Management and Student Achievement: Evidence from a Randomized Field Experiment." NBER Working Paper 23437, National Bureau of Economic Research, Cambridge, MA.

[79] Pont, Beatriz, Deborah Nusche, and Hunter Moorman. "Improving School Leadership: Policy and Practice." OECD Report, 2008. https://www.oecd.org/education/school/44374889.pdf

[80] Catholic Relief Services. "How to Use the Cluster Approach for Capacity Building in Schools - India." 2009. https://www.crs.org/sites/default/files/tools-research/how-to-guide-cluster-approah-capacity-building-schools.pdf

[81] Pont, "Improving School Leadership".

[82] Ibid.

	supporting change and innovation within the schools system.[83] School development planning is an essential part of the functionality and growth of any institution and leaders of all levels of schooling should be developing plans in some capacity already. Training for school leaders specifically focused on the creation of school development plans is an investment area that would have a direct impact on all factors affecting learning outcomes, such as the management of the learning environment, teacher development, teaching resources, parent engagement, and most importantly student engagement.[84] Guidelines for planning already exist, and interventions could be relatively inexpensive if self-evaluation mechanisms are already in place.
Digital Resources	Refer to Learning Tools sections below
Pathways to Excellence	
School Culture	
Behaviour Management	Research suggests that the aim of classroom management is to establish a quiet and calm environment in the classroom so that the students can take part in meaningful learning, and classroom management contributes to a students social and moral development.[85] In many cases, classroom management often focuses on student behaviour and discipline. However studies show that classroom management is now more about understanding the class as a social system. Several factors and conditions influence classroom management: "the self-understanding of teachers and their mindfulness, the multicultural classroom, behaviour management, lack of knowledge on classroom management, knowledge of physical and social context, rules, relations and commitment, person-centred versus teacher-centred classroom management, and classroom management in connection with motivation and learning."[86] The study states that classroom management is as much about managing learning processes when an activity is taking place as it is about creating peace and quiet so students feel motivated and engaged allowing them to achieve learning outcomes. Training and interventions geared towards behaviour management can be incorporated into leadership and teacher training at the same costs.
Parent and Community Engagement	Refer to Parent Education/Engagement section below
Child Protection	Save the Children developed programming and policy to highlight the importance and connection between education and child protection. According to STC, Education and Child Protection are deeply interconnected. Education is a pivotal right for the development of girls and boys and child protection is a condition to guarantee their well-being. Education requires an appropriate and inclusive environment to protect all children and youth regardless of race, sex, and/or ethnicity. The provision of quality and relevant education that promotes child protection means empowering children and youth to build their own holistic life plans as a way to concretely pursue their goals and reach their potential. The document outlines a number of existing programs and highlights how these efforts improve attendance and enrollment.[87]
Pupil engagement and (might include learner profile)	Research with primary school-aged children shows that pupils who like their teachers and classmates, and whose teachers have high expectations for them, tend to be more motivated to put sustained effort into their schoolwork and are more likely to attend school regularly, come to class prepared, and complete their homework. These engaged pupils, who feel like they belong and are comfortable in the school, tend to show better academic performance than less engaged peers. Among older students, strong feelings of attachment to the school and involvement in school life are associated with greater self-esteem and lower levels of antisocial behaviour, as well as superior academic performance. Disengagement from school is a gradual process. Poor relationships with peers and negative experiences in school have been associated with lower engagement several years later. Such disengagement is seen as the beginning of a progression that sometimes culminates in early school leaving. Early school leaving, in turn, is strongly associated with a host of further social, health-related, and economic costs. Study done in the UK.[88]
Staff engagement	One way to motivate teachers is to offer an attractive career path. Teachers in many parts of the world are underpaid, and so highly qualified individuals are not attracted to this work. Additionally, if promotion criteria included the recognition of teacher efforts to improve learning outcomes among disadvantaged learners, this will provide necessary

[83] Ugochukwu Kysburn Agi, "School Development Planning: A Strategic Tool for Secondary School Improvement in Rivers State, Nigeria," *Journal of the International Society for Teacher Education* 21, no. 1 (2017): 88 - 99.
[84] Ibid
[85] Postholm, May Britt. "Classroom Management: What Does Research Tell Us?" *European Educational Research Journal* 12, no. 3 (2013): 389–402. https://doi.org/10.2304/eerj.2013.12.3.389.
[86] Ibid.
[87] Save the Children Canada, "Education and Child Protection". https://www.savethechildren.ca/wp-content/uploads/2016/03/education_child_protection.pdf
[88] Aidan Clerkin and Ann-Marie Creaven, "Chapter 3: Pupil engagement". In E. Eivers & A. Clerkin (Eds.). (2013). National Schools, international contexts: Beyond the PIRLS and TIMSS test results. Dublin: Educational Research Centre.

	incentives for good teachers to work in deprived areas to improve education quality and equity.[89]
Inclusion	A number of Asian Pacific countries have ratified the UN Conventions on the Rights of People with Disabilities and have identified an urgent need to include children with special educational needs in regular school programs. Successful implementation of such a policy reform requires significant changes in the way education is provided to all students, but most importantly depends upon how adequately the teachers and related professionals are prepared to implement the reform. This paper reviews research from 13 Asian Pacific countries, undertaken in the last five years, to address two questions. First it reports on the issues, challenges, and proposals related to inclusive education in these countries. Second the review reports on how each region has progressed towards implementing the Millennium Development Goals with particular emphasis on how teacher education has or has not responded to this. The review concludes that a lack of well thought out policy, few resources, and limited understanding of inclusion seems widespread in the Asia-Pacific region. As yet special education and related service expertise and teacher education for inclusion, is not in place to support teachers to work inclusively. However the benefits of inclusive programming on attendance and enrollment are undeniable.[90]
School Management	
Clean and Safe Environment for Learning	It is well documented that a welcoming and safe learning environment has a significant impact on indicators like attendance and enrollment, particularly for girls. However the impact of school infrastructure on academic performance varies depending on context. For example, in Latin America, a study conducted across 15 countries and 3000 primary schools, found that the availability of basic infrastructure and services (water, electricity, sewage), didactic facilities (sport installations, labs, libraries), as well as the number of books in the library and computers in the school do have an effect on the achievement of primary education students in Latin America, but their relative impact varies significantly from country to country.[91] Another study done in Pakistan found that a favourable classroom physical environment had a significant positive effect on the academic achievement scores of secondary school students.[92] In general, the impact of the school environment on learning outcomes is generally positive however very dependent on context. Costs will vary based on the type of infrastructure improvement that is required, and the returns on investment are inconclusive.
Teacher Recruitment	The perception of teaching as a low status profession can adversely impact recruitment and retention. Improving the status of teaching is not only associated with better motivation and job satisfaction, it can also increase teacher retention and performance as well as student learning.Strong leadership and management skills and effective governance structures also lead to increased teacher recruitment and retention.[93]
School Governance	According to the World Development Report poor management and governance often undermine schooling quality. Although effective school leadership does not raise student learning directly, it does so indirectly by improving teaching quality and ensuring effective use of resources. "Across eight countries that have been studied, a 1.00 standard deviation increase in an index of management capacity—based on the adoption of 20 management practices—is associated with a 0.23–0.43 standard deviation increase in student outcomes. But school management capacity tends to be lowest in those countries with the lowest income levels, and management capacity is low in schools. School governance—particularly the decision-making autonomy of schools, along with the oversight provided by parents and communities—serves as the framework for seeking local solutions and being accountable for them. In many settings, schools lack any meaningful autonomy, and community engagement fails to affect what happens in classrooms.[94]
Financial business management and marketing	Refer to the Financial Incentives/Loans section below.
Teacher and lesson oversight/ Teacher development and standards	Lack of professional support is considered a major constraint to teacher job satisfaction. 'A focus on supervision, including observing and helping teachers, holds the greatest potential for improving teaching and learning'. In particular, 'supervision helps teachers feel valued, makes them visible and noticed and helps improve their teaching skills'.Teacher support can take several forms 'from externally imposed formal inspection of schools and teachers, to regular on---going monitoring of teacher performance by external supervisors or head teachers, to mentoring of individual teachers by

[89] EFA Global Monitoring Report Team. "Investing in Teachers Is Investing in Learning: A Prerequisite for the Transformative Power of Education." Global Education Monitoring Report, July 2015.

[90] "Reforming Teacher Education for Inclusion in Developing Countries in the Asia-Pacific Region" Umesh Sharmaa, Chris Forlinb, Joanne Deppelera, and Yang Guang-xue

[91] Murillo, F. Javier, and Marcela Román. "School Infrastructure and Resources Do Matter: Analysis of the Incidence of School Resources on the Performance of Latin American Students." *School Effectiveness and School Improvement* 22, no. 1 (2011): 29–50. https://doi.org/10.1080/09243453.2010.543538.

[92] Suleman, Qaiser, Hassan Danial Aslam, and Dr. Ishtiaq Hussain. "Effects of Classroom Physical Environment on the Academic Achievement Scores of Secondary School Students in Kohat Division, Pakistan." *International Journal of Learning and Development* 4, no. 1 (2014): 71. https://doi.org/10.5296/ijld.v4i1.5174.

[93] EFA, "Investing in Teachers".

[94] *World Development Report: Learning to Realise Education's Promise* (World Bank, 2018), https://www.worldbank.org/en/publication/wdr2018

	their own colleagues within their own classrooms'.[95]
Teaching and Learning	
Teaching and Learning Resources	Additional teaching and learning resources play a key role in improving learning outcomes. One type of resource includes systems of instructional support such as those found in Ethiopia through cluster supervisors, in Kenya through teachers' advisory center tutors, and Malawi through primary education advisors.[96] Evaluations of these systems found that these programs had a significant impact on student outcomes because it gave them the opportunity to spend more time with instructors in smaller and more focused group settings.[97] The provision of additional teaching support can be costly especially in contexts where the availability of teachers is already limited. Additional teaching support is not the only type of teaching and learning resource, this would also include *Learning Tools* which will be discussed below.
Lesson Planning and Delivery	Lesson planning can impact the effectiveness of how students are taught. An analysis of teacher guides from 13 countries and 19 projects was used to assess the benefits of pre-structured and scripted lesson plans. The impact results of the programs that use teacher guides show significant positive impacts on learning outcomes, associated with approximately an additional half year of learning, showing that structured teachers' guides contribute to improved learning outcomes.[98] Additionally, the study found that teachers make a variety of changes in their classroom instruction from how the guides are written, showing that the utilization of structured teachers' guides do not create robotic teachers unable to use their own professional skills to teach children, but are rather provide helpful guides that ensure students receive all the right information based on the curriculum[99], positively impacting learning outcomes. If learning guides are already available in a given region, implementation should not be too costly, however training for teachers on how to use guides may be necessary.
Assessment of Learning	The literature generally suggests that increased use of 'assessment for learning' strategies leads to higher quality education, and is especially successful when teachers and instructors take the time to develop assessment strategies within their classroom that are not only dependant on external tests and examinations, as these external assessments can place pressure on schools to improve the results achieved by their students rather than focusing on student learning in general.[100] Studies show that interventions that train teachers on the use of better methods of evaluation for their students have been effective, as improved methods that focus on student learning rather than results allow teachers to identify the students that are falling behind and may require supplemental instruction. If done consistently and student needs are monitored and taken into consideration, students feel more engaged and motivated, increasing attendance and decreasing dropout rates.[101] Assessment of Learning can be incorporated into *School Development Planning* initiatives as well as teacher training.
Child Centred Teaching and Learning	Studies suggest that only a small fraction of learners are able to keep up with the set curriculum due to a multitude of different environmental factors which may limit learning. As such teachers are often only equipped to focus on students who are able to keep up with the set curriculum, further marginalizing the learning process of those who are not able to do so. When teachers are given the training and the resources to teach to the level of all students with a focus on learning improvements rather than test scores, research shows the benefit this has on learning outcomes.[102]
School curriculum	Curriculum is an essential component of the education system as it guides school leaders and teachers on what students should be taught at any given level, and should direct the learning of students, essential to achieving learning outcomes. However, a curriculum that does not put the student first can be of significant disadvantage to a student's ability to achieve learning outcomes. Studies done in South Asia and Africa, show that a majority of students spend years of instruction with very little progress gained on basic skills.[103] The data from these studies suggest that the pace of curriculum moves faster than the pace of learning, which decreases learning outcomes. However, when the pace of instruction slows down, students are actually able to learn faster and achieve greater learning outcomes.[104] Curriculum is often set at the national level, however, improved teaching methods can help to offset the negative impact of poorly planned curriculum, which can be integrated into generation school leadership and teacher training.

[95] EFA, "Investing in Teachers".
[96] EFA, "Investing in Teachers".
[97] Ibid.
[98] Piper, Benjamin, Yasmin Sitabkhan, Jessica Mejia, and Kellie Betts. "Effectiveness of Teachers' Guides in the Global South: Scripting, Learning Outcomes, and Classroom Utilization," November 2018. https://doi.org/10.3768/rtipress.2018.op.0053.1805.
[99] Ibid.
[100] Dylan Wiliam, Clare Lee, Christine Harrison, and Paul Black. "Teachers Developing Assessment for Learning: Impact on Student Achievement." *Assessment in Education: Principles, Policy & Practice* 11, no. 1 (2004): 49–65. https://doi.org/10.1080/0969594042000208994.
[101] EFA, "Investing in Teachers".
[102] EFA Global Monitoring Report Team, July 2015.
[103] Pritchett, Lant, and Amanda Beatty. "The Negative Consequences of Overambitious Curricula in Developing Countries." *SSRN Electronic Journal*, 2012. https://doi.org/10.2139/ssrn.2235869.
[104] Ibid.

Teacher Training	
Cluster teacher meetings	Cluster teacher training shows the same benefits as discussed above with regard to *Cluster Leadership Training*. The same principles apply, and the benefits of such a program have been clear, as it provides the opportunity for teachers, principles, and school managers to develop their skills in a sustainable way, encourages community building, provide for resource sharing, and inculcates healthy competition and accountability among schools.[105] The costs of such programs are relatively low in comparison to others, as they are able to target multiple teachers in one program, and they usually aim to utilize skills and resources already available among the group of participating teachers.
Digital Resources	As the world becomes more and more technologically connected, digital resources do present a number of benefits and opportunities for teacher development. There are a number of case studies and pilot projects that have been very successful, including UNESCO projects in Pakistan and Nigeria that used mobile phones to deliver pedagogical content to early-grade and primary school teachers. Participants were given a free Nokia mobile and a SIM card with six months of free internet connectivity and credits for text messaging and phone calls, which teachers used to interact with each other and ask questions. Evaluations suggested that these projects had successfully used technology to support hard-to reach teachers to access materials that created positive changes and improved learner outcomes.[106] There are a number of successful case studies like this one. However, the greatest challenges to the use of digital resources are cost and technological literacy, and these challenges exist in all cases. The use of digital resources for teacher training has significant potential, however many barriers to implementation remain.
Teacher Mentor Training	There are many studies to suggest the benefit of mentorship programs for teachers, during both pre-service and in-service training. For example, a preservice teacher mentoring project undertaken in Kenya found that collaborative mentoring has the capacity to enhance teacher development, and that it is an important resource in the teaching/learning process.[107] By working with experienced teachers, teacher trainees are able to learn new teaching methods and gain guidance on essential skills such as lesson planning and delivery. Ideally, mentorship would be incorporated into existing training mechanisms not requiring significant additional cost.
Teacher Knowledge Training	One of the greatest barriers to achieving learning outcomes, is a teachers own limited knowledge on the subject matter being taught. It is found that many teacher education programs focus on teaching methods and pedagogical theory, but they lack the resources to upgrade weak subject knowledge. One study in Uganda found that the curriculum for initial primary teacher education devotes 262 hours of instructional time to teaching methods and only 120 hours to math, english, and science, and most of that time is spent learning subject-specific teaching methods with an assumption that trainees have previous subject knowledge.[108] Limited subject knowledge would limit a teacher's ability to adequately convey concepts to students. Therefore more knowledge training is necessary depending on the ability of the teacher. This type of training would be more effective when incorporated into preservice training.
Parent Education/ Engagement	
Specific-accountability Interventions	There are a small number of interventions that have been designed specifically to address short-route accountability or to address very specific problems with accountability and which operate at the local level. Most, if not all, use monitoring of some sort at the local level. Interventions include community score cards, text-book monitoring, monitoring of teacher attendance and so on. One example: community score cards involve a staged intervention, typically engaging a whole community in reaching agreement about reforms required for a given public service, such as a school. The methodology reflects a fairly well-tested, facility-focused approach to citizen participation. It uses multiple small groups to develop scorecards, a social audit process to gather data, and a community gathering to discuss the findings from both and agree on an action plan[109].
Decentralisation and School-based Management	A study done in Burundi, Senegal, Malawi, and Uganda explored the role of parents and teachers in improving the learning of students.[110] It found that teachers, Parent Teacher Associations (PTAs) and School Management Committee (SMC) members play a key role in both encouraging and dissuading parental involvement. Most teachers are keen to engage with parents but are wary of encouraging them to monitor teaching and learning as this gives parents "too much

[105] Catholic Relief Services, "How to Use Cluster Approach".

[106] McAleavy, Tony, Alex Hall-Chen, Sarah Horrocks, and Anna Riggall. "Technology supported professional development for teachers: lessons from developing countries." *Education Development Trust*, (2018).

[107] Ochanji, Moses, Nicholas Twoli, M Bwire, and John Maundu. "Teacher Mentoring for Effective Teacher Training and Development The Case of a Developing Country, Kenya." Teacher Education and Practice. 30, no.1 (2017).

[108] EFA, "Investing in Teachers".

[109] Ibid.

[110] Marphatia, Akanksha A., Karen Edge, Elise Legault, and David Archer. "Politics of Participation: Parental Support for Children's Learning and School Governance in Burundi, Malawi, Senegal and Uganda." *Human Rights Documents Online*, (2010). https://doi.org/10.1163/2210-7975_hrd-0153-0055.

	power over them".[111] Local power dynamics, which may make school governing bodies appear inaccessible to parents, often do not encourage participation either. The study found that many parents are given the impression that school governance is a technical matter that is best left to those who understand it – and that teaching and learning are the "business of schools and teachers" and should not be interfered with. This intimidates parents who opt out of participating and end up playing less meaningful roles. Many community leaders and headteachers as well as education administrators often see parents as part of the problem rather than as part of the solution.[112] Therefore, it is not surprising that parents do not feel encouraged to be more involved in schools, despite the benefits.
Learning Tools	
Tablets	This article critically reviews the literature reporting use of tablets by primary and secondary school children across the curriculum, with a particular emphasis on learning outcomes. Among the 12 studies rated as 'high' for methodological trustworthiness, nine report positive learning outcomes and three no difference in learning outcomes; none report negative learning outcomes. There appears little doubt that tablets (and other mobile technologies) can viably support children so they are able to complete a variety of learning tasks. Schools ought not to assume that teaching staff are ready to operate tablets from the outset (Melhuish & Falloon, 2010) but should actively create adequate opportunities for professional development. They, however, also note how a lack of relevant training, a shortage of technical support and the absence of a tablet policy can prevent staff from using tablets on a regular basis..[113] However, they also point out that tablets proved to be most effective in contexts in which teachers are trained on how to make the most out of this resource.[114] Therefore, the use of technological inputs is more likely to result in the improvement of learning outcomes when teachers' and educators are provided with training on how to make the best use out of this resource.
Computers	Laptops represent a good example of technologies who have been found to be conducive to learning but that, similarly to other inputs, can fall into disuse if the distribution programs are not paired up with strong governance and appropriate teacher training to maximise the utility of this resource. Additionally, the effectiveness and cost of this intervention will also vary depending on the type, quality, and number of laptops provided to the school, as well as the ultimate locus of accountability (teachers, principals). Lavinas and Veiga studied the distribution of laptops to primary schools in Brazil. The One Laptop Per Child' initiative's rolling out was delayed by several years because of issues with administration and local governance. When the laptops were finally distributed and allocated to different classrooms, a survey found that more than 40% of the teachers whose classroom partook in the program never or rarely used this resource as part of their core class activities.[115] A different study identifies the critical success factors that influence the acceptance of e-learning systems in developing countries. The authors identify six dimensions which impact the ability of computers to lead to positive learning outcomes. The dimensions are: 1) learners' characteristics (i.e. computer self-efficacy, internet self-efficacy, and attitude toward e-learning); 2) instructors' characteristics (i.e. timely response, self-efficacy, technology control, focus on interaction, attitude toward students, interaction fairness); 3) institution and service quality (i.e. computer training, program flexibility) ; 4) infrastructure and system quality (i.e. internet access quality, reliability, ease of use, system functionality, system interactivity, system response); 5) course and information quality (i.e. course quality, relevant content, course flexibility); and, 6) extrinsic motivation (i.e. perceived usefulness, clear direction). Therefore, the effectiveness of computers as learning tools is highly dependent on the context.[116]
Textbooks	The provision of textbooks is an example of a learning tool that can improve learning outcomes. An intervention carried out in Sierra Leone found that, after distributing textbooks with no other mechanism in place, a majority of the textbooks were locked away in cupboards during follow-up inspections.[117] Similarly, Benevot argues that the value of textbooks towards improving learning outcomes in children is rather susceptible to the content of the textbooks.[118] It is, in fact, important to keep in mind that the content of textbooks can be politicised in a way that can be detrimental to improving learning outcomes in children. In a similar vein, familiar cultural references can be conducive to learning. As such, while it is true that textbooks have the potential to meaningfully contribute to learning outcomes, it is essential to provide

[111] Ibid.

[112] Ibid.

[113] Hablert, B, L. Major, and S. Hennessy. "Tablet use in schools: a critical review of the evidence for learning outcomes." Journal of Computer Assisted Learning. 32, 2 (2015). https://onlinelibrary.wiley.com/doi/full/10.1111/jcal.12123?casa_token=FWIHiihpM3oAAAAA%3Aw55WnAn2fDLUupWBVPqktbs G6xlLl7ZOesNk6kUmu7zBkC5fyJ1vN2BBA8WXhAs_Ug6entO_Lipg8Q.

[114] Ibid.

[115] Lena Lavinas, and Alinne Veiga, 2013. "Brazil's One Laptop Per Child Program: Impact Evaluation and Implementation Assessment," *Cadernos de Pesquisa* 43 (149).

[116] Bhuasiria, Wannasiri, Oudone Xaymoungkhounb, Hangjung Zo, Jae Jeung Rho, and Andrew Ciganek. "Critical success factors for e-learning in developing countries: A comparative analysis between ICT experts and faculty." Computers & Education. 58, 2 (2012): 843-855. https://www.sciencedirect.com/science/article/abs/pii/S0360131511002545.

[117] Shwetlena Sabarwal, David K. Evans, and Anastasia Marshak, 2014. "The Permanent Input Hypothesis: The Case of Textbooks and (No) Student Learning in Sierra Leone." Policy Research Working Paper 7021, World Bank, Washington, DC

[118] Benavot, Aaron. "Improving the Provision of Quality Educaiton: Perspectives from Textbook Research." Journal of International Cooperation in Education. 14, 2: (2011): 1-16. https://pdfs.semanticscholar.org/6660/187bbb2cc20c3eac46b123716ab9632c14d2.pdf.

	them in the context of a comprehensive intervention that also entails the training of teachers, as discussed in the previous sections.
Interactive Whiteboards	The use of interactive whiteboards (IWB) potentially comes with a number of benefits. Through being linked to a computer with Internet access, it is an unrestricted portal for interaction with an infinitely wide range of secondary digital resources. This offers teachers tremendous ease and flexibility in sourcing materials to stimulate dialogue. In addition, IWB use can support community knowledge building through text and object construction within its proprietary software environments, aided by its specialized tools for direct manipulation of digital objects. However, most of the evidence comes from the use of this tool in Western countries. Even so, the tool is not linked to higher attendance or enrollment, but it is linked to slightly increased learning outcomes when teachers are trained and committed to using the tool.[119]
Incentives	
School Improvement	With regards to the features of the environment, it is important to also mention some of the physical features of the schools that could contribute to improvements in enrollment, attendance, and learning outcomes. For example, Birdthistle et al. found that having separate washroom facilities improved enrollment and attendance rate of girls in primary and secondary school.[120] Therefore, when considering the elements of the education system that could lead to improved enrollment and attendance rates, and better learning outcomes, it is also important to keep in mind the physical features of the environment.
Merit-based Scholarships	Scholarship programs are an example of financial incentive that can be used to improve attendance, enrollment, and learning outcomes. However, once again, the evidence to corroborate this hypothesis is mixed. Before delving into the efficacy of this tool, it is important to make a distinction between types of scholarship programs that focus on student achievement, merit-based scholarships, and programs that seek to target students from particularly resource strapped households, need-based scholarships. In their review of financial incentives to improve educational outcomes, Glewwe et al. found that merit-based scholarships in primary and post-primary contexts did not significantly improve learning outcomes in children.[121] Need-based scholarships, on the other hand, have been shown to have a stronger link in improving attendance and enrollment and, in some cases, learning outcomes. Banerjee et al, studied the Female Stipend Program in Bangladesh, a need-based scholarship program with some conditionalities, such as minimum required attendance rate.[122] They found that, by "raising the return to schooling," the program was successful in encouraging female students to remain in school longer, thus having positive effects on both attendance and enrollment.[123] The study also looked at a version of the program which provided scholarships conditional on the pupil's achievement. In that case, the program was correlated with positive learning outcomes contingent upon the student's "perceived probability of winning the award."[124]
Conditional Cash Transfers	In addition to scholarship programs, conditional cash transfers have also been widely used as a tool to incentivising school enrollment and attendance. Parker and Todd reviewed the effectiveness of the first large-scale conditional cash transfer program, Progresa (now called Oportunidades).[125] Oportunidades started in Mexico in 1997 as a poverty alleviation program. Through Oportunidades, selected families would receive two types of conditional transfers, one contingent upon a family member seeking preventative care, and the other tied to educational attainment. The educational component of the transfer was used to foster school enrollment and attendance and, in fact, it was shown to have a significantly positive impact on enrollment rates.[126] The caveat, however, is that, given Oportunidades' success, conditional cash transfers have been used in various different contexts, with mixed results. Ladhani and Sitter suggest that the efficacy of conditional cash transfers should be more rigorously evaluated in the contexts in which this social program is used, without giving the achievement of positive outcomes for granted without conducting rigorous evaluations.[127]

[119] Hennessy, S. "The Role of Digital Artefacts on the Interactive Whiteboard in Supporting Classroom Dialogue." Journal of Computer Assisted Learning. April, 2011. https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2729.2011.00416.x?casa_token=sLnaxZ-6qkkAAAAA%3ALwDkTLod_7sxMsMSurxVmyBZ_EOGVCmCNucoduaMEzAgpyQSBtK6A9RRxmpMym2VYl62PNxImwfJuQ.

[120] (Birdthistle, Dickson, Freeman, and Javidi 2011)

[121] Glewwe, Paul W., Eric A. Hanushek, Sarah D. Humpage, and Renato Ravina. "School Resources and Educational Outcomes in Developing Countries: A Review of the Literature from 1990 to 2010." *The National Bureau of Economic Research*.

[122] Banerjee, Abhijit, Paul Glewwe, Shawn Powers, and Melanie Wasserman. "Expanding Access and Increasing Student Learning in Post-Primary Education in Developing Countries: A Review of the Evidence." *J-PAL Post-Primary Education Initiative Review Paper*. 2013. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.571.1914&rep=rep1&type=pdf.

[123] Ibid.

[124] Ibid.

[125] Parker, Susan W., and Petra E. Todd. "Conditional Cash Transfers: The Case of Progresa/Oportunidades." *Journal of Economic Literature*. 55, 3 (2017): 866-915. https://www.aeaweb.org/articles?id=10.1257/jel.20151233.

[126] Ibid.

[127] Ladhani, Sheliza, and Kathlen C. Sitter. "Conditional Cash Transfers: A Critical Review." *Development Policy Review*, 38, 1 (2018). https://onlinelibrary.wiley.com/doi/full/10.1111/dpr.12416.

Teacher-Pupil Ratio	In terms of features of the environment, this report has looked at the level of preparation of teachers as well as their training, and the connection to enrollment, attendance, and improved learning outcomes. However, the pupil-teacher ratio also influences these metrics. Biswas et al. discuss how a low pupil-teacher ratio had a positive effect on the enrollment rate of girls in primary school in Eastern. Wstern, and Southern India.[128] In addition to this, Duflo, Dupas, and Kremer found that hiring more local teachers helped improve learning outcomes in primary schools in Kenya.[129] However, the same research also noted how this intervention was most effective when paired with targeting instruction to students' initial achievement level, so as to tailor the content and the teaching abilities of the pupil.[130]
School Feeding Programs	Among non-financial incentives, school feeding programs feature prominently as one of the most widespread solutions to incentive enrollment, attendance, and improved learning outcomes in low-resource environments. Jomaa, McDonnell and Probart conducted an analytical review of school feeding programs in low-resource settings in developing countries.[131] In doing so, they found that such programs have positive effects on both enrollment and attendance. Similarly, Biswas et al found that mid-day meals had a positive impact on attendance and enrollment in Eastern Western, and Southern zones in India.[132] However, evidence pointing towards a connection between the school feeding programs and the achievement of improved learning outcomes was mixed.

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[128]Biswas, Puja, and Amit Kundu. "Gender Parity Index in Primary School in Rural India: An Analysis." Turkish Economic Review. 6,2 (2019). http://www.kspjournals.org/index.php/TER/article/view/1867.
[129] Duflo, Ester, Pascaline Dupas, and Michael Kremer. "Peer Effects, Pupil-Teacher Ratios, and Teacher Incentives: Evidence from a Randomized Evaluation in Kenya." J-PAL. 2001. https://www.povertyactionlab.org/evaluation/peer-effects-pupil-teacher-ratios-and-teacher-incentives-kenya.
[130] Ibid.
[131] Jomaa, Lamis H., Elaine McDonnell, and Claudia Probart. "School Feeding Programs in Developing Countries: Impacts on Children's Health and Educational Outcomes." *Nutrition Reviews,* 69, 2 (2011): 83-98. https://academic.oup.com/nutritionreviews/article/69/2/83/1909764.
[132] Biswas, Puja, and Amit Kundu. "Gender Parity Index in Primary School in Rural India: An Analysis." Turkish Economic Review. 6,2 (2019). http://www.kspjournals.org/index.php/TER/article/view/1867.

Education Finance
School Investments that Work

OPPORTUNITY
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What is the best approach per dollar invested to drive improved learning outcomes for children in schools in low resource settings?

Area	Activities	Done by OI	Impact		Cost and Return	
			Attendance	Enrollment	Average Cost of	Average
School Leadership Training					Per child, per year	
			Note: Many of these activities		Note: In many of the below cases,	
	School Leadership and Professional Development (SLPD)	Yes	+++	+++	$0.4	$$/$$$
	Cluster Leadership Meetings	Yes	++	++	$1.1	$/$$
	One-on-one Leadership training	No	++	++	$1.1	$/$$
	School Development Planning	Yes	+++	+++	$1.1	$$$
	Digital Resources	Yes	+	+	$0.2	N/A
	Pathways to Excellence	Yes			$0.2	
	School Culture					
	Behaviour Management		++	+	$$$	$
	Parent and Community Engagement		+++	+++	$$$	$$$
	Child Protection		+++	+++	$$	$$$
	Pupil engagement and (might include learner profile)		++	+	$	$$
	Staff engagement		++	+	$$	$
	Inclusion		+++	+++	$$$	$$$
	School Management					
	Clean and Safe Environment for Learning		+++	++	$$/$$$	$$
	Teacher Recruitment		+	+	$$$	$$
	School Governance		++	+++	$$	$$
	Financial business management and marketing					
	Teacher and lesson oversight/ Teacher development and standards		++	+	$	$$
	Teaching and Learning					
	Teaching and Learning Resources		++	+	$$	$$
	Lesson Planning and Delivery		+			
	Assessment of Learning		retention	retention		
	Child Centred Teaching and Learning		+++	++		
	School curriculum		+++	++	$$	$$$
Teacher Training						
	Cluster teacher meetings		+		$1.1	$
	Digital Resources		+		$0.2	
	Teacher Mentor Training		+		$1.1	$$
	Teacher Knowledge Training		++	++	Dependent on when the training	
	Distance Learning		+	+	$	$
Parent Education/Engagement						
			well and	well and	Costs vary drastically depending	
Learning Tools						
	Tablets	No	+	+	$$	$/$$
		No	+	+	$$	$/$$
	Computers	No	++	+	$$	$/$$
			++	+	$$	$/$$
	Textbooks	No	+	++	$	$/$$
			+	++	$	$/$$
	Interactive Whiteboards	No	+	+	$$	$
Incentives						
	School Fee Loans	Yes				
	School Improvement	Yes				
	Toilets/ washrooms	Yes	+++	++	$$	$$$
	Classrooms	Yes				
	Etc..					
	Merit-based Scholarships		+	+	$	$
	Need-based Scholarships					
	Hiring more teachers?					
	School Feeding Programs					

Appendix 3: P2E[133]

Pathways to Excellence Indicator Distribution			
Context	**Input**	**Process**	**Output**
School Culture*	School Development Plan*	Teacher and Lesson Oversight*	Pupil Engagement*
Parent Engagement	Teacher and Learning Resources	Clean and Safe Environment*	External Assessment of School*
School in the Community	Teacher and Lesson Oversight*	School Culture*	Child-Centered Teaching and Learning Strategies*
Staff Environment and Engagement	Teacher Recruitment	Pupil Engagement*	Special Educational Needs and Disabilities (SEND)*
Clean and Safe Environment*	Teacher Retention	Teacher Development and Standards*	Assessment of Pupil Performance*
School Administration and Marketing	Teacher Development and Standards*	External Assessment of School*	Lesson Planning and Delivery*
School Governance*	Financial and Business Management of School	Behaviour Management	School Development Plan*
Gender, Racial and Religious Inclusivity*	School Governance*	Child-Centered Teaching and Learning Strategies*	
Special Educational Needs and Disabilities (SEND)*	Gender, Racial and Religious Inclusivity*	Special Educational Needs and Disabilities (SEND)*	
Information and Communications Technology (ICT)*	Broad and Balanced Curriculum*	Assessment of Pupil Performance*	
Learner Profile	Information and Communications Technology (ICT)*	Lesson Planning and Delivery*	
Pastoral Care	Extra-Curricular Activities*	Broad and Balanced Curriculum*	
Personal, Social and Health Education (PSHE)*	Personal, Social and Health Education (PSHE)*	Information and Communications Technology (ICT)*	
Child Protection*	Child Protection*	Extra-Curricular Activities*	
Careers Counselling*	Careers Counselling*	Careers Counselling*	

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[133] Opportunity International, "Pathways to Excellence: The Guide for School Development Planning," 2017.

Appendix 4: ECE P2E[134]

Early Childhood Education - Pathways to Excellence Indicator Distribution			
Context	**Input**	**Process**	**Output**
Health, Nutrition and Child Safety: Nutrition* Classroom Relationships* Professional Development* Family Engagement and Support Community Outreach and Collaboration*	Health, Nutrition and Child Safety: Nutrition* Health, Nutrition and Child Safety: Health* Professional Development* Assessment of Pupil Progress* Leadership and Management	Physical Learning Environment Health, Nutrition and Child Safety: Health* Classroom Relationships* Curriculum* Learning Materials* Teaching* Community Outreach and Collaboration*	Curriculum* Learning Materials* Teaching* Assessment of Pupil Progress*

Appendix 5: SDG4 Keyword Development

Indicator Descriptions and Keyword Development

The following is a brief description of the eleven aforementioned indicators, alongside the methodology used for collecting related data. Each indicator is accompanied by a keyword or keywords which capture the underlying goal of the respective indicator. These keywords can be used to reflect the overarching goals of the indicators and thus, provide a useful means for comparison to ensure that P2E indicators are both following suit and adequately representative.

1. *Proportion of children and young people (a) in Grade 2 or 3; (b) at the end of primary education; and (c) at the end of lower secondary education achieving at least a minimum proficiency level in (i) reading and (ii) mathematics, by sex.*

a.   **Reasoning**: This indicator is intended to reflect the number of children at different educational stages meeting minimal proficiency levels, as measured through learning assessments.

b.   **Methodology**: Utilising national assessment results, or through cross-national initiatives to determine both minimum proficiency level and proportion meeting said level.

c.   **Keyword**: Student Assessment

2. *Proportion of children under 5 years of age who are developmentally on track in health, learning and psychosocial wellbeing, by sex.*

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[134] Opportunity International. 2018. "Pathways to Excellence: Early Childhood Education." Oxford: Opportunity International.

a.   **Reasoning**: This indicator reflects the quality, availability, and accessibility of both care and educational programs, leading up to the beginning of school. This is particularly vital to ECE.

b.   **Methodology**: Household surveys are utilised to measure the proportion of children aged 36 - 59 months which meet the minimum standards in at least three of the following four areas: Literacy-numeracy, Physical, Social-Emotional and Learning.

c.   **Keyword**: Early Childhood Development

   2. *Participation rate in organized learning (one year before the official primary entry age), by sex*

a.   **Reasoning**: This indicator measures the availability and accessibility of ECE programs (those before official entry into an educational system).

b.   **Methodology**: Enrollment data is collected through official reporting methods and household surveys (where informal ECE programs are more common).

c.   **Keyword**: Early Childhood Education

   2. *Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex.*

a.   **Reasoning**: This indicator measures the proportion of a particular population which is engaged in some sort of educational program or training (formal or informal).

b.   **Methodology**: Household surveys and administrative input.

c.   **Keywords**: Attendance, Continuing Education

   2. *Proportion of youth/adults with ICT skills, by type of skill.*

a.   **Reasoning**: This indicator reveals the degree of, and accessibility to, ICT training and knowledge.

b.   **Methodology**: In school assessments and household surveys.

c.   **Keywords**: ICT Training/Access

   2. *Parity indices (female/male, rural/ urban, bottom/top wealth quintiles and others such as disability status, indigenous peoples and the conflict-affected, as data become available) for all education indicators on this list that can be disaggregated.*

a.   **Reasoning:** This indicator can elicit information on the existence and severity of disadvantaged groups within an area.

b.   **Methodology**: External assessment.

c.   **Keywords**: Accessibility, Inclusion, Representation

   2. *Proportion of population in a given age group achieving at least a fixed level of proficiency in functional: (a) literacy and (b) numeracy skills, by sex.*

a.   **Reasoning**: Provides information on the proportion of a population which has achieved a minimum level of literacy and numeracy proficiency (fixed or functional), as defined through national, regional and international learning assessments. Displays effectiveness and access to minimum literacy and numeracy training.

b.   **Methodology**: In-school assessments and household surveys.

c.   **Keywords:** Student Assessment, Literacy-Numeracy Attainment

   2. *Extent to which: (i) global citizenship education and (ii) education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in: (a) national education policies (b) curricula (c) teacher education and (d) student assessments.*

a.   **Reasoning**: Indicator provides information on the degree to which sustainable development and global citizenship (gender equality, human rights, etc.) is included in the curriculum.

b.   **Methodology**: Teacher and student assessment and curriculum analysis.

c.   **Keywords**: Comprehensive Curriculum, Inclusive Curriculum

   2. *Proportion of schools with access to: (a) electricity; (b) the Internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) adapted infrastructure and materials for students with disabilities; (e) basic drinking water; (f) single-sex basic sanitation facilities; and (g) basic handwashing facilities (as per the WASH indicator definitions).*

a.   **Reasoning**: Indicator measures the proportion of schools which have access to requisite learning tools and resources; accessible physical infrastructure and learning materials; and basic sanitary facilities. Reflects degree in which students of different physical and mental realities can participate, as well as access to modern educational tools and requisite WASH facilities.

b.   **Methodology**: External assessments.

c.   **Keywords**: Accessibility, WASH, School Facilities

   2. *Volume of official development assistance flows for scholarships by sector and type of study.*

a.   **Reasoning**: Proportion of ODA which is directed towards scholarships and bursaries.

b.   **Methodology**: Collected through OECD.

c.   **Keywords**: Financial Aid, ODA

   2. *Proportion of teachers in: (a) pre-primary education; (b) primary education; (c) lower secondary education; and (d) upper secondary education who have received at least the minimum organized teacher training (e.g. pedagogical training) preservice or in-service required for teaching at the relevant level in a given country, by sex.*

a.   **Reasoning**: Indicator reflects the degree of educators which have been provided with organized teacher training.

b.   **Methodology**: Teacher records, in-school assessments and surveys

c.   **Keywords**: Teacher Training/Development

Appendix 6: P2E Indicator SDG4 Distribution

Distribution of P2E/P2E-ECE (specified by +) indicators to SDG4 Global Indicator keywords							
Student Assessment	**Early Childhood Development**	**Early Childhood Education**	**Continuing Education**	**Attendance**	**ICT**	**Accessibility**	**Inclusion**
School Governance

External Assessment of School

Assessment of Pupil Performance*

Broad and Balanced Curriculum*

Assessment of Pupil Progress+* | Classroom Relationships+

Teaching+ | Teaching+

Assessment of Pupil Progress+* | School in the Community

Careers Counselling | | Broad and Balanced Curriculum*

Information and Communication Technology (ICT) | | Gender, Racial and Religious Inclusivity

Special Educational Needs and Disabilities (SEND)*

Pastoral Care |
| **Literacy-Numeracy Attainment** | **Inclusive Curriculum** | **Comprehensive Curriculum** | **WASH Facilities** | **School Infrastructure** | **Financial Aid** | | **Teacher Training** |
| Assessment of Pupil Performance*

Curriculum+ | Child-Centered Teaching and Learning Strategies*

Special Educational Needs and Disabilities (SEND)*

Broad and Balanced Curriculum*

Personal, Social and Health Education (PSHE)* | School Development Plan*

Lesson Planning and Delivery*

Broad and Balanced Curriculum*

Personal, Social and Health Education (PSHE)* | Clean and Safe Environment Conducive to Learning*

Physical Learning Environment+

Health, Nutrition and Child Safety: Health+ | School Development Plan*

Clean and Safe Environment Conducive to Learning*

Special Educational Needs and Disabilities (SEND)* | | | Teaching and Learning Resources

Teacher Recruitment

Teacher Development and Standards

Lesson Planning and Delivery*

Child-Centered Teaching and Learning Strategies*

Learning Materials+

Professional Development+ |

Appendix 7: Output Indicator Assessment

Output Indicators		
Indicator Name	**Concept**	**Interpretation**
Pupil Engagement	This indicator is concerned with the magnitude of engagement individual students have with their learning environment, peers, and instructors. Since engagement rates are directly correlated to student performance and retention, this is a crucial measurement to establish within an educational system.	A high score indicates that students are not just adequately engaged with their personal schooling, but understand the importance of a cohesive, supportive educational ecosystem. This is expressed through active engagement with their peers, teachers and subject matter. Furthermore, research shows that teacher engagement in particular is a crucial component of expanding student engagement; when a genuine interest in the behaviour and performance of students is displayed by instructors, students are more motivated to perform and actively participate within the learning environment.[135] Additionally, providing students with platforms to engage with one another - either in the classroom or outside - reinforces the social, collaborative component of the learning process, while also further integrating education/academics into the norm framework of the community.[136]
External Assessment of School	This indicator is concerned with the implementation of, and preparation for, external examinations within a school environment, as well as the effective employment of data produced through them. External assessments are not only a key tool in evaluating the quality of educational provisioning within a single institution, but the data derived is often aggregated to understand regional or national	High scores in this area indicate that an education centre is effectively aligning its teaching, curricula, and logistical standards and, as such, equipping students with the tools to best perform on these examinations. This score also indicates that schools are not only participating, but actualizing the information resulting from assessments. Ensuring that schools are participating in not only large-scale, nationally-mandated

[135] Krista R. Muis, John Ranellucci, Gregory Trevors, and Melissa C. Duffy. 2015. "The Effects of Technology-Mediated Immediate Feedback on Kindergarten Students' Attitudes, Emotions, Engagement and Learning Outcomes during Literacy Skills Development." Learning and Instruction 38 (August): 1–13. https://doi.org/10.1016/j.learninstruc.2015.02.001.

[136] Gavin Northey, Rahul Govind, Tania Bucic, Mathew Chylinski, Rebecca Dolan, and Patrick van Esch. 2017. "The Effect of 'Here and Now' Learning on Student Engagement and Academic Achievement." British Journal of Educational Technology 49 (2): 321–33. https://doi.org/10.1111/bjet.12589.

	educational trends. As this data is essential in identifying areas of concern, it is a crucial input to the improvement of education quality and thus, overall learning outcomes.	assessments, but also regional, international and organizational ones is not only complimentary, but a crucial aspect in the formation of an analytical framework which can better direct system-level investment schema and improvements.[137] It should be noted however that these large-scale assessments, while important in understanding the complete educational system, are less effective as instruments for individual interventions.[138]
Child-Centered Teaching and Learning Strategies	This indicator is concerned with the pedagogical methods employed by teachers, as well as associated structural and practical tools employed to ensure that a varied approach, which accounts for different learning styles and needs, is employed. As such, having instructors and classrooms properly equipped to engage in child-centred teaching is an essential component of improving learning outcomes.	High scores in this area are indicative of learning environments which are inclusive of teaching tools which meet the needs of different learning styles. This implies that teachers not only possess the ability to employ a multitude of teaching tools and approaches, but actively employ them in their lessons. Continued integration into an education system is directly determined by a student's ability to internalize and engage with classroom content and the instructor.[139] Ensuring the deployment of varied teaching approaches is a means to account for this variance in individual student learning styles and thus maximise attendance, engagement and retainment of information - all essential components of increased learning outcomes and positive perceptions of education.[140] Furthermore, the expansion of teaching methods to be inclusive of non-traditional techniques can invigorate the learning environment and while providing

[137] UNESCO, "SDG 4 Data Digest", 2019.

[138] Thomas R. Guskey. 2016. "How Classroom Assessments Improve Learning." In On Formative Assessment: Readings from Educational Leadership (EL Essentials), 3–14. Alexandria, VA: ASCD. Thomas R. Guskey. 2016. "How Classroom Assessments Improve Learning." In On Formative Assessment: Readings from Educational Leadership (EL Essentials), 3–14. Alexandria, VA: ASCD.

[139] Mark R. Young, Bruce R. Klemz, and J. William Murphy. 2003. "Enhancing Learning Outcomes: The Effects of Instructional Technology, Learning Styles, Instructional Methods, and Student Behavior." Journal of Marketing Education 25 (2): 130–42. https://doi.org/10.1177/0273475303254004.

[140] Cristina Tulbure. 2011. "Do Different Learning Styles Require Differentiated Teaching Strategies?" Procedia - Social and Behavioral Sciences 11: 155–59. https://doi.org/10.1016/j.sbspro.2011.01.052.

		increased opportunity to innovate within the classroom.[141] [142]
Special Educational Needs and Disabilities (SEND)	This indicator looks to the existence of a policy framework within an educational institution which addresses the identification, inclusion, and monitoring of children with special needs and disabilities within said institution. It further addresses the need for training and assessment of education providers in the area of special needs students. Ensuring that children of all capacities are able to receive an education is not only important in improving their individual learning outcomes, but also in promoting wider inclusion into their respective communities.	High scores in this area implies the existence of a robust, meaningful framework for special needs children and associated training, outreach and evaluative standards. Educational institutions and individual educators which are responsive to children with special needs is a direct input into an increase in both student performance and parental satisfaction.[143] Accomplishing this however, requires aware and confident instructors, a supportive school administration, and robust assessment parameters.[144]
Assessment of Pupil Performance	This indicator is concerned with the existence of robust and consistently applied student assessment tools, practices, and policies. Regular and meaningful assessment of student performance is directly related to improvements to learning outcomes and long-term attainment in educational performance.	High scores in this area imply that the school is able to formulate assessment tools and standards which adequately test a student's performance and knowledge, while providing educators with useful information to guide and structure future interventions. As such, higher attainment in this area also reflects an instructor body which possesses the knowledge to design and implement such assessment tools. An aspect of this efficacy is the ability for an instructor to deliver assessments in a manner which is conducive to students' continued learning. An instructor's role as an assessor is an outward expression of classroom power

[141] Myrto-Foteini Mavilidi, Anthony D. Okely, Paul Chandler, and Fred Paas. 2017. "Effects of Integrating Physical Activities Into a Science Lesson on Preschool Children's Learning and Enjoyment." Applied Cognitive Psychology 31 (3): 281–90. https://doi.org/10.1002/acp.3325.

[142] Karen L. Bierman, Robert L. Nix, Brenda S. Heinrichs, Celene E. Domitrovich, Scott D. Gest, Janet A. Welsh, and Sukhdeep Gill. 2013. "Effects of Head Start REDI on Children's Outcomes 1 Year Later in Different Kindergarten Contexts." Child Development 85 (1): 140–59. https://doi.org/10.1111/cdev.12117.

[143] Deborah P. Waber, Ellen C. Boiselle, Jonathan M. Girard, Joseph L. Amaral, and Peter W. Forbes. 2016. "Ascertaining Educational Outcomes after Assessment in Children with Learning Disorders." The Clinical Neuropsychologist 31 (1): 219–32. https://doi.org/10.1080/13854046.2016.1244289.

[144] Wendy Peia Oakes, Liane E. Schellman, Kathleen Lynne Lane, Eric Alan Common, Lisa Powers, Tricia Diebold, and Taryn Gaskill. 2018. "Improving Educators' Knowledge, Confidence, and Usefulness of Functional Assessment-Based Interventions: Outcomes of Professional Learning." Education and Treatment of Children 41 (4): 533–65. https://doi.org/10.1353/etc.2018.0028.

		dynamics and as such, must be conducted in a manner which is constructive and non-hostile. This is not only a determining factor in the way a student will view the current schooling environment, but can be decisive in shaping their feelings towards education in the future.[145] Regular student assessment has been shown to directly contribute to the retention and understanding of tested knowledge areas - a key point behind the usage of "test-enhancement learning".[146]
Lesson Planning and Delivery	This indicator reflects the ability of instructors within an educational institution to consistently integrate effective teaching methodologies into their lesson planning, as well as the degree of support instructors receive in this area. Effective lesson planning is an important aspect of maintaining student engagement, knowledge attainment and pupil retention - key contributors to overall improvement to learning outcomes.	High scores in this area are reflective of lesson planning which is varied and the product of reflection, refinement and the incorporation of proven techniques. Instructors engaged in this level of lesson planning will have the support of their peers and school operators, while also possessing the training to continuously assess the effectiveness of their lessons. A component of this is being able to determine the "right" way to structure a lesson. Instructors must possess the expertise and support networks to construct lessons in a way which will achieve long-term educational objectives, such as retainment. Otherwise, educators run the risk of implanting motivations or behaviours which may negatively impact the performance of students and their continued mentality towards education.[147] Lessons which enrich the learning capacity of students are also the product of shared learning networks, and the transference of techniques and understanding to and between educators. Encouraging these

[145] "Formative Assessment and Learning: Where Psychological Theory Meets Educational Practice." 1998. In Investigating Formative Assessment: Teaching, Learning and Assessment in the Classroom, 83–105. Philadelphia, PA: Open University Press.

[146] Peter Cantillon. 2008. "Do Not Adjust Your Set: The Benefits and Challenges of Test-Enhanced Learning." Medical Education 42 (10): 954–56. https://doi.org/10.1111/j.1365-2923.2008.03164.x.

[147] Lisbeth Ku, Helga Dittmar, and Robin Banerjee. 2014. "To Have or to Learn? The Effects of Materialism on British and Chinese Children's Learning." Journal of Personality and Social Psychology 106 (5): 803–21. https://doi.org/10.1037/a0036038.

		networks within an institutional environment can be an effective means in improving the quality and delivery of lesson planning.[148]
School Development Plan	This indicator is a measurement of the ability of a school ecosystem to effectively establish a development plan. This is the product of an effective consultation process, a robust self-assessment capacity, and the ability to manage the resource-outcome balance. A development plan is an important aspect of improving the policies, infrastructure, and resources of a school ecosystem, which directly contribute to the quality of education provided and, thus, the improvement of learning outcomes.	High scores in this area imply a comprehensive consultation process - inclusive of not just school operators, but community members, parents, government officials, relevant experts and key instructors - the ability to connect long-term objectives to short-term activities, and a mindset focused on meaningful, attainable outcomes. Establishing a development plan is typically the beginning of a causal sequence to improving other areas of concern within an education environment; both being the product of and impetus for sequential improvements. Elements to the formation of an effective development plan include considerable and periodic evaluation of goals and methods; the inclusion of an entity external to the school environment to supplement the views of those directly involved; and, a robust evaluative methodology to assist in the assessment of progress.[149]
ECE Output Indicators		
Curriculum	This indicator seeks to verify the presence of an ECE-specific curriculum within an educational institution. The development and implementation of a curriculum which is considerate of the unique needs of younger children is crucial in ensuring the improvement of learning outcomes.	A high score in this area indicates that a school possesses an adequate ECE-centric curriculum, which is inclusive of the educational, behavioural, physical, familial and socio-emotional dimensions of a child's development, while also ensuring that the physical infrastructure and policy standards exist to facilitate a healthy learning environment.
Learning Materials	This indicator is concerned with the teaching tools and materials (TLMs) employed by teachers when	Higher scores in this area are indicative of an educational environment possessing a large,

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[148] Ian Clark. 2012. "Formative Assessment: Assessment Is for Self-Regulated Learning." Educational Psychology Review 24 (2): 205–49. https://doi.org/10.1007/s10648-011-9191-6.

[149] Barbara MacGilchrist, and Peter Mortimore. 1997. "The Impact of School Development Plans in Primary Schools∗." School Effectiveness and School Improvement 8 (2): 198–218. https://doi.org/10.1080/0924345970080202.

	instructing in an early childhood environment. This is derived through independent research and collaborative efforts with other educators. The consistent application of creative and engaging TLMs are the key means to improve learning outcomes and instill a drive to learn in young children.	diverse and effective TLM toolset for the early childhood age group. This can include novel teaching tools,[150] as well as accompanying methodological suites.[151]
Teaching	Refer to "Child-Centered Teaching and Learning Strategies"	
Assessment of Pupil Progress	Refer to "Assessment of Pupil Performance"	

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[150] Linda Chmiliar. 2017. "Improving Learning Outcomes: The IPad and Preschool Children with Disabilities." Frontiers in Psychology 8 (May). https://doi.org/10.3389/fpsyg.2017.00660.

[151] Bierman et al., "Effects of Head Start", 2013.