Can Data-Informed Management and Structured Pedagogy Improve Learning? Evidence from public schools in Rwanda

Daniel Rodriguez-Segura
Vice President, M&E
NewGlobe

Timothy Sullivan
Chief Academic Officer
NewGlobe

Priscilla Lu
Senior Data Analyst
NewGlobe

Tito Nezehose
Director of M&E
RwandaEQUIP

Marlee Mullane
Research Fellow
NewGlobe

Abstract

Despite substantial investments in educational systems in Sub-Saharan Africa, low- and middle-income countries face persistently low learning outcomes. Gray-Lobe et al. (2022) evaluated a successful whole-school educational model in a private school network in Kenya, which achieved very large learning gains. However, it remains uncertain whether this model can be effectively adapted to public settings. This study rigorously assesses the RwandaEQUIP program, a similar model applied at scale to public schools in Rwanda. After just 17 weeks of instruction, the RwandaEQUIP program demonstrated notable improvements in numeracy and literacy. Pupils in the program displayed faster growth in both English and Kinyarwanda. Teacher English proficiency and credentials did not significantly impact learning gains, likely due to the highly structured pedagogical support provided. Furthermore, suggestive evidence indicates that the program achieved higher teacher attendance and increased instructional delivery, potentially reducing fiscal burdens associated with teacher absenteeism or off-task activities.

I. Introduction

Learning outcomes in Sub-Saharan Africa are incredibly low: 9 out of 10 children cannot read with comprehension by the end of primary school.[1] Foundational literacy skills lead to positive economic returns at individual and national levels, and they have also been found to be correlated with increased participation in the labour market, improved health, and intergenerational mobility.[2] However, the current state of education in low- and middle-income countries (LMICs) is not adequately equipping many students to fully reap the benefits of education. Large amounts of financial and human resources are currently being poured into educational systems in the region, and yet, these investments from already constrained budgets have yielded relatively low returns in terms of learning outcomes. For example, Rwanda, the country where this study takes place, allocates 5% of the nation's GDP towards education annually and has a Primary net pupil enrolment rate of 95%. Despite this, as of 2017, one in two Primary 3 pupils were still unable to read at a comprehensive level.[3]

This phenomenon of high attendance and low learning outcomes in public schools has been documented in most LMICs around the world, and it is labelled by the World Bank as the 'learning crisis'. Poor instructional practices, gaps in teacher content knowledge, heterogeneous access to quality schools and teachers, and a lack of appropriate governance and accountability structures, are typically identified as the key enablers of this crisis.[4]

Significant amounts of policy and research efforts have gone into finding interventions and educational approaches that could help LMICs exit out of the learning crisis. Yet, despite the considerable body of research and interventions conducted in various sub-Saharan African education systems on different point solutions[5], there exists a relative lack of scholarly investigation and information regarding comprehensive, whole school interventions that tackle several enablers of the learning crisis at once.

Among the few studies that examine whole-school interventions in LMICs, the results are very promising. For example, Gray-Lobe et al. (2022), conducted an experimental evaluation of a whole-school educational model in Kenya which relies heavily on data-informed stakeholder and school management, and structured pedagogy. They found that this model achieved extraordinarily large learning gains, and results were among the 99th percentile of all impact evaluations in similar settings. However, their study was conducted within a private school network — potentially reducing the external validity of these results within a public school setting. As such, the current literature has a relative gap in terms of whether the model studied in Gray-Lobe et al. (2022) can be successfully adapted to a public setting as well. This study seeks to fill this critical knowledge gap and contribute to the existing literature in order to advance our understanding of effective educational practices within the country and its peers.

This study presents an impact evaluation of the RwandaEQUIP program, an intervention which uses a similar model to that studied in Gray-Lobe et al. (2022), but applied at-scale to public schools across Rwanda. In particular, we investigated whether (1) primary schools pupils in RwandaEQUIP schools make larger gains in foundational literacy and numeracy relative to their peers in non-RwandaEQUIP schools, (2) what portions of the performance distribution saw the largest gains, and (3) how the RwandaEQUIP program impact rates of

[1] World Bank. 2018. *Learning to Realize Education's Promise*. Washington D. C., United States: International Bank for Reconstruction and Development. doi:10.1596/978-1-4648-1096-1.
[2] UNESCO. 2022. Spotlight on Basic Education. Paris, France: UNESCO.
[3] Ibid.
[4] The World Bank. 2022. "Learning in Crisis". World Bank.
[5] Masino and Niño-Zarazùa, 2015; Evans and Popova, 2016; Ganimian and Murinane, 2016.

effective practices among teachers relative to quality inputs such as English fluency and level of qualification. In order to answer these questions, we use a matched difference-in-difference quasi-experimental set-up with 60 schools representative of the RwandaEQUIP cohort of schools, along with a rich battery of learning assessments targeting foundational numeracy and literacy in English and Kinyarwanda.

We find that after only the first 17 weeks of instruction, the RwandaEQUIP programme raised learning outcomes by approximately 0.4 standard deviations in numeracy and literacy across all assessments. Even though the programme enforced the national policy of English-medium instruction more strictly than comparison schools, pupils in the RwandaEQUIP programme displayed faster growth in both English and Kinyarwanda, likely due to a large quality differential in the instructional support available to teachers in both types of schools. We find that neither teachers' English levels nor credentials moderate learning gains, likely due to the highly structured nature of the pedagogical support provided to them. Finally, we find suggestive evidence that the programme achieved higher teacher attendance and more delivery of instruction during the time allotted for it — implying a reduction in the fiscal burden posed by behaviours like teacher absenteeism or off-task activities.

II. Context and Implementation of the RwandaEQUIP Programme

Current State of Rwanda Education. The country of Rwanda has made remarkable social and economic progress. From 1975 to 2018, net enrolment in primary school rose from 51% to 95%, with the population of children under 14 years old increasing from 2.1 million to 5.4 million within the same timeframe.[6] This impressive improvement has occurred in tandem with increased education spending by the government. In 2021, the government allocated 3.8% of the national GDP towards the sector, which is higher than the sub-Saharan African average of 3.4.[7] Despite significant investments in teacher professional development, programme design, and technology integration to strengthen teaching and learning across the country, learning outcomes in Rwandan public schools have stagnated at levels far below international standards. USAID's 2019 assessment revealed in Primary 3, 20% of pupils struggled to read even a single word in Kinyarwanda, while a concerning 50% displayed insufficient reading proficiency for effective comprehension. This suggests that regardless of academic advancement, half of the pupils remain at a level of reading proficiency that hinders their comprehension of written texts. These findings align with the baseline results from this study, where the average primary 3 pupil, assessed through the EGRA assessment before RwandaEQUIP implementation, did not reach the fluency threshold necessary for comprehension. Hence, the majority of children in Rwanda attend school, but are not learning the fundamental literacy and numeracy skills necessary for their education.

There are many potential causes as to why learning outcomes are so low in a country with such a high primary enrolment rate. For one, chronic and widespread teacher absenteeism has effectively raised actual student to teacher ratios to a level at which teachers are unable to cater to their students' needs, given the lack of teacher support systems.[8] Furthermore, in combination with the teacher shortage, school infrastructure that is not prepared to serve so many pupils per school, and a policy preference for smaller class sizes make it so that the vast majority of schools in the country utilise a double-shift model, where students go to school for only half a day, while teachers stay throughout and instruct two groups of students. A double-shift model does effectively reduce the average student to teacher ratio, although this effectively cuts students' instruction time in half. Beyond only instructing

[6] World Bank. 2023. "World Development Indicators | DataBank." World Bank DataBank. .
[7] The World Bank. 2021. "Government expenditure on education| Data." World Bank Data.
[8] UNICEF, *Time to Teach*, p8.

students for half of the day, a lack of structure and training has left educators unable to effectively utilise materials such as textbooks.

A report published by the World Bank on effective approaches to improve global education found that structured pedagogy and targeted instruction suitable for pupil learning levels both yield high returns for relatively low cost.[9] The World Bank also stressed the importance of teacher accountability through data collection, effective training, and guidance when implementing educational interventions in low- and middle- income countries.[10] These recommendations, along with those of highly respected researchers in the field of international education, form a foundation of research which supports and bodes well for the RwandaEQUIP programme.

RwandaEQUIP Programme Launched in January 2022, the RwandaEQUIP program aims to enhance learning outcomes and align with the government's policy of English medium instruction in primary grades in public schools across Rwanda. . The program centred around five pillars: scientifically-based learning materials, a technology-enabled instructional model, data-driven training, 360-degree support teams, and technology-driven monitoring and reporting. Implemented in 100 schools across 13 districts, RwandaEQUIP sought to improve foundational literacy and numeracy, enhance exam performance, and train teachers in creating learning-centric classrooms. The program incorporated digitised teacher guides composed of: lesson objectives, pedagogical procedures, independent practice opportunities, and mechanisms for assessing learning. Continuous evaluation of instructional materials was conducted through digital data collection, daily lesson observations, and professional development programs. RwandaEQUIP ensured comprehensive support by addressing operational factors and performance indicators through its support teams, assessing school conditions, teacher assignments, tablet availability, lesson delivery, and classroom attendance.

III. Data

Sample Selection. 30 treatment schools and 30 comparison schools were selected from the broader pool of the 299 Rwandan schools included in the school census conducted by programme officials. The treatment schools were part of the 100 schools that joined RwandaEQUIP, and the comparison schools were part of 199 schools that did not. In selecting which particular schools would comprise the set of 60 schools for this study, the goal was to find a subset of 30 comparison schools which was as similar as possible to the 30 treatment schools at baseline, and that, ideally, the 60 selected schools also resembled the broader set of 100 RwandaEQUIP schools as much as possible so that estimated effects of the programme would be generalizable to all 100 RwandaEQUIP schools. In order to find a set of schools that allowed us to track the progress of the overall programme, a “propensity score matching” statistical method was utilised. Then, within each of the five provinces, pairs of schools were created with similar characteristics, as proxied by their likelihood of being selected into the RwandaEQUIP subset. Stratifying by province, a "nearest neighbour" approach was used to find pairs of treatment and comparison schools within the common support area of propensity scores. Finally, balance tests were performed to ensure covariate balance among the selected schools, and the 60 resulting schools were used in a difference-in-difference model to evaluate the effect of the programme on learning outcomes.

[9] Global Education Evidence Advisory Panel. 2023. Cost Effective Approaches to Improve Global Learning. Washington D.C., United States: The World Bank.
[10] The World Bank. 2022. “Learning in Crisis”. World Bank.

Measured Outcomes: Early Literacy in English and Numeracy. First, we used the Early Grade Reading Assessment and Early Grade Mathematics Assessment (EGRA/EGMA) to measure the foundational literacy and numeracy skills of pupils. These tools were developed by the Research Triangle Institute (RTI) in conjunction with USAID and have been used by education ministries and multilateral agencies around the world. The EGRA component of baseline focuses on writing and reading skills in the English language. The EGMA component captures skills in numeration and operations, the metric system, and geometric figures (shapes), in conformity with guidelines from the national mathematics curriculum. The EGRA and EGMA were administered in Pre-Primary through Primary 2. Second, Rwanda's Local Early Grade Reading Assessment (LEGRA) was used to measure foundational literacy skills in Kinyarwanda. This assessment was developed jointly between the Rwanda Education Board (REB) and USAID, and has been administered in Rwandan schools on more than 2 million pupils between Primary 1 and Primary 3. Therefore, this assessment is particularly valuable to measure literacy in an contextually-appropriate manner. Third, an adapted-version of the Learning Achievement in Rwandan Schools (LARS) was used for literacy and mathematics in Primary 3 and Primary 6. These assessments were developed particularly for the Rwandan context, and they have been externally validated.[11] External research has also relied on this instrument as a measure of learning, which supports its status as an additional point of reference for the tracking of pupil achievement.[12]

Teaching Practices. Beyond learning outcomes, intermediate outcomes were also measured to understand what happened in classrooms and schools which might have led to improved learning. In particular, we were interested in understanding how teacher instruction and attendance may have been shaped by RwandaEQUIP, and how management practices evolved as a result of the programme. To measure teaching practices, we used an adapted version of TEACH, a tool originally developed by the World Bank, and a teacher questionnaire developed by RwandaEQUIP. These instruments allowed us to collect information on teaching and learning processes, including the use of materials, instructional content, pupil-teacher interaction, and the time spent on task and assessment techniques. Finally, the RwandaEQUIP technological platform allows for the collection of longitudinal metrics on teacher attendance and lesson completion for the treatment group.

IV. Empirical Approach

We used a difference-in-differences model to estimate the impact of the RwandaEQUIP programme on literacy and numeracy outcomes in P1-P6 pupils. The study compares pupils' outcomes in 30 treatment and 30 control schools before and after the program, which took place from February to June of 2022. In particular, for any given outcome Y, for student i, in school s, at time t, we ran the following linear regression:

$$Y_{ist}=\beta_0 + \beta_1(\text{Treatment})_s + \beta_2(\text{Post})_{is} + \beta_3(\text{Post x Treatment})_{ist} + \varepsilon_{ist}$$

Where the parameter of interest is β_3 — the causal effect of the RwandaEQUIP programme. Put differently, β_3 represents how much additional growth in the outcome Y pupils in RwandaEQUIP schools experienced, relative to their counterparts in other schools. Due to the the fact that comparison and treatment schools were fully balanced on covariates at baseline, it is reasonable to infer that they were following a similar trajectory and would have yielded similar endline results in the absence of RwandaEQUIP — in other words, the parallel trends assumption of the difference-in-differences method is likely to be true, and

[11] AlphaPlus. 2017. “Case Study - Support for the Learning Achievement in Rwandan Schools Project (LARS).” AlphaPlus.

[12] AlphaPlus, *Rwandan Learning Case Study*, 2017; NESA, *Learning Achievement in Rwandan Schools*; USAID SOMA UMENYE, *Equating Study*, 2021.

consequently, any disparities observed in learning outcomes can be attributed to the implemented intervention.

V. Results

Foundational literacy and numeracy outcomes We found that pupils in RwandaEQUIP schools performed significantly better than their counterparts in foundational literacy and numeracy. By the end of the first school year, RwandaEQUIP pupils were reading 11.5 cwpm, compared to 7 cwpm for comparison pupils. This treatment effect, 4.8 cwpm in only 17 weeks, is 72% higher than where treatment pupils would have been without the programme. These remarkable gains are also observed in other sub-skills: 115% in reading unfamiliar words (a measure of decoding abilities), 107% in reading familiar words (a measure of both decoding skills and pupils' repository of "sight words"), and 150% in reading comprehension (the ultimate goal of "literacy"). RwandaEQUIP pupils also experienced significant learning gains in Kinyarwanda. Their growth rate was twice that of pupils in comparison schools — approximately 9.2 words per minute faster across Primary 1 through Primary 3. Higher rates of improvement were seen for non-readers — those reading 0 correct words per minute. At the end of Primary 1, comparison schools had twice as many non-readers as RwandaEQUIP schools.. During the programme's first 17 weeks, the share of Primary 1 non-readers in Kinyarwanda decreased by 30% more than the number of non-readers in comparison schools. In English, the number of non-readers in RwandaEQUIP Primary 1 decreased by 53 percentage points in RwandaEQUIP schools, compared to a 24 percentage points decrease in comparison schools.

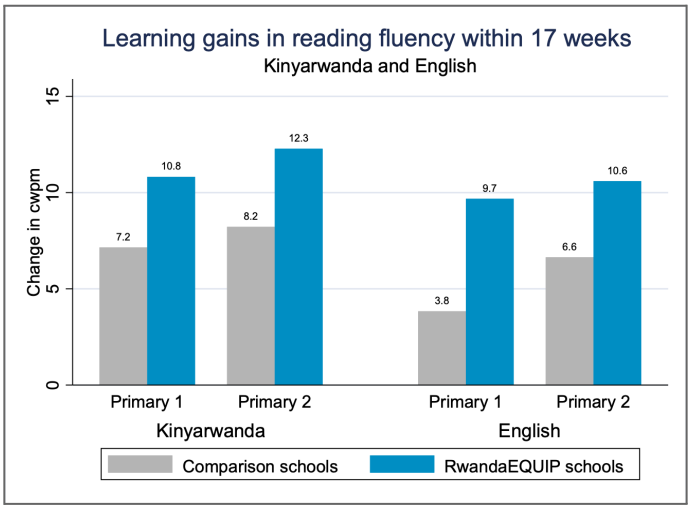

Table 1: Regression results for early English literacy outcomes (EGRA)

	All		Nursery 3		Primary 1		Primary 2	
	Comparison schools at midline mean/SD	Treatment effect	Comparison schools at midline mean/SD	Treatment effect	Comparison schools at midline mean/SD	Treatment effect	Comparison schools at midline mean/SD	Treatment effect
All outcomes (standardised across rounds)	-0.17	0.39***	-0.12	0.37***	-0.22	0.46***	-0.16	0.36***
	(0.85)	(0.11)	(0.87)	(0.14)	(0.80)	(0.14)	(0.88)	(0.13)
Print orientation (%)	0.59	0.12**	0.45	0.18**	0.59	0.08	0.71	0.12*
	(0.39)	(0.05)	(0.39)	(0.08)	(0.39)	(0.07)	(0.35)	(0.07)
Listening comprehension (%)	0.35	0.16**	0.36	0.21***	0.32	0.15*	0.38	0.11
	(0.36)	(0.07)	(0.35)	(0.07)	(0.36)	(0.08)	(0.35)	(0.08)
Initial sound identification (%)	0.35	0.14**	0.25	0.06	0.32	0.19**	0.46	0.15
	(0.35)	(0.07)	(0.28)	(0.07)	(0.34)	(0.08)	(0.37)	(0.1)
Phonemic awareness (%)	0.22	0.16***	0.15	0.07	0.17	0.24***	0.32	0.16*
	(0.27)	(0.05)	(0.21)	(0.05)	(0.24)	(0.07)	(0.31)	(0.08)
Oral vocabulary (%)	0.36	0.1***	0.28	0.11***	0.36	0.11**	0.42	0.1**
	(0.2)	(0.03)	(0.19)	(0.04)	(0.2)	(0.05)	(0.19)	(0.04)
Letter names (#)	7.19	4.42	3.16	2.91	6.81	7.3*	11.21	2.80
	(12.28)	(3.17)	(8.25)	(2.67)	(11.67)	(3.91)	(14.47)	(4.06)
Non-familiar words (#)	4.40	4.71**	-	-	-	7.3*	4.40	4.71**
	(7.23)	(2.01)	-	-	-	(3.91)	(7.23)	(2.01)
Familiar words (#)	4.23	4.35**	-	-	2.44	4.2**	5.99	4.39**
	(7.03)	(1.66)	-	-	(5.64)	(1.74)	(7.78)	(1.93)
Reading fluency (cwpm)	6.99	4.81*	-	-	4.28	5.78**	9.43	4.06
	(10.75)	(2.5)	-	-	(10.47)	(2.77)	(10.42)	(2.71)
Reading comprehension (%)	0.06	0.09***	0.00	0	0.04	0.12***	0.12	0.13**
	(0.16)	(0.03)	(0)	(0)	(0.13)	(0.04)	(0.22)	(0.06)
Proficiency	0.29	0.18**	0.29	0.27***	0.23	0.25**	0.36	0.05
	(0.46)	(0.07)	(0.45)	(0.08)	(0.42)	(0.1)	(0.48)	(0.09)

Notes: The statistical significance of differences across sub-samples is denoted with the following key: * p<0.10, ** p<0.05, *** p<0.01.

Table 2: Regression results for Kinyarwanda literacy outcomes(LEGRA)

	All		Primary 1		Primary 2		Primary 3	
	Comparison schools at midline mean/SD	Treatment effect	Comparison schools at midline mean/SD	Treatment effect	Comparison schools at midline mean/SD	Treatment effect	Comparison schools at midline mean/SD	Treatment effect
All outcomes (standardised across rounds)	-0.07	0.33***	-0.04	0.34**	-0.05	0.24*	-0.12	0.44***
	(0.96)	(0.11)	(0.98)	(0.17)	(0.96)	(0.13)	(0.94)	(0.14)
Understanding words (%)	0.80	0.07	0.79	0.10	0.82	0.04	-	-
	(0.26)	(0.06)	(0.27)	(0.07)	(0.24)	(0.06)	-	-
Writing (%)	0.66	0.07	0.68	0.11	0.64	0.04	-	-
	(0.34)	(0.06)	(0.34)	(0.07)	(0.33)	(0.06)	-	-
Reading fluency (cwpm)	23.62	8.92**	11.04	3.30	21.11	3.94	38.94	19.61**
	(23.87)	(3.69)	(11.28)	(2.82)	(17.49)	(3.39)	(29.69)	(7.62)
Reading comprehension (%)	0.60	0.12**	0.61	0.14*	0.49	0.16**	0.70	0.06
	(0.34)	(0.06)	(0.36)	(0.07)	(0.35)	(0.08)	(0.29)	(0.07)
General language (%)	0.59	0.19***	-	-	-	-	0.59	0.19***
	(0.28)	(0.05)	-	-	-	-	(0.28)	(0.05)
Proficiency (%)	0.33	0.21***	0.42	0.25***	0.24	0.19**	0.34	0.21**
	(0.47)	(0.07)	(0.49)	(0.08)	(0.43)	(0.08)	(0.47)	(0.09)

Notes: The statistical significance of differences across sub-samples is denoted with the following key: * p<0.10, ** p<0.05, *** p<0.01.

Interestingly, while the program decreased the share of zero-word English and Kinyarwanda readers by 30% and 10% respectively in Primary 1, it did not decrease the share of non-readers in Primary 2 (or P3 in Kinyarwanda). However, in Primary 2 and 3, the program was effective in reducing the share of the relatively higher performing group (pupils who read at 20-30 cwpm) by 10% for EGRA and by 20% and 35% for LEGRA Grade 2 and Grade 3 respectively.

In early numeracy, we observe that the RwandaEQUIP programme had similarly large effects across the board. For instance, after only 17 weeks of the programme, Primary 1 pupils in RwandaEQUIP experienced an almost five-fold acceleration in their expected progress in numeracy, and were better at solving simple addition and subtraction problems than Primary 2 pupils in comparison schools. This pattern is observed across other skills as well, as pupils were 85% better at solving simple subtraction problems, 27% better at solving simple multiplication problems, and 43% better at solving division problems than they would have been had they not joined the programme.

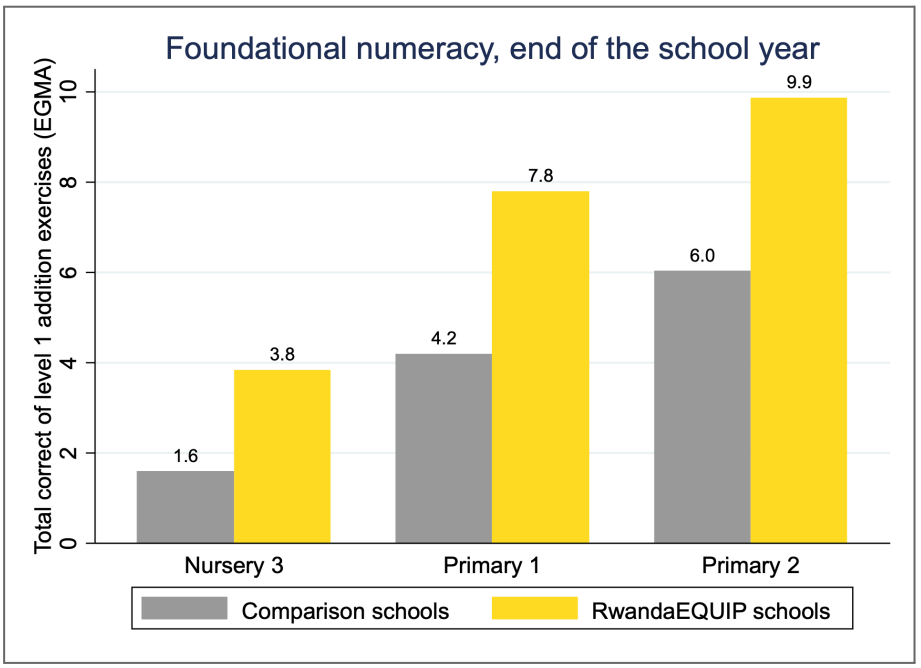

Table 3: Regression results for numeracy outcomes (EGMA)

	All		Nursery 3		Primary 1		Primary 2	
	Comparison schools at midline mean/SD	Treatment effect	Comparison schools at midline mean/SD	Treatment effect	Comparison schools at midline mean/SD	Treatment effect	Comparison schools at midline mean/SD	Treatment effect
All outcomes (standardised across rounds)	-0.22	0.39***	-0.26	0.46***	-0.19	0.34***	-0.22	0.42***
	(0.83)	(0.10)	(0.82)	(0.12)	(0.83)	(0.12)	(0.85)	(0.12)
Counting circles (%)	0.79	0.07*	0.67	0.16***	0.90	-0.01	-	-
	(0.26)	(0.04)	(0.28)	(0.05)	(0.18)	(0.04)	-	-
Number identification (%)	0.33	0.22***	0.21	0.23***	0.31	0.24***	0.45	0.24***
	(0.29)	(0.04)	(0.25)	(0.06)	(0.27)	(0.06)	(0.29)	(0.06)
Number discrimination (%)	0.14	0.02	0.09	0.03	0.14	0.02	0.17	0.02
	(0.08)	(0.01)	(0.08)	(0.02)	(0.08)	(0.02)	(0.08)	(0.02)
Missing number identification (%)	0.20	0.07**	0.12	0.08**	0.19	0.09**	0.25	0.06*
	(0.17)	(0.03)	(0.14)	(0.04)	(0.15)	(0.04)	(0.18)	(0.03)
Word problems (%)	0.24	0.09*	0.13	0.12**	0.26	0.04	0.30	0.11*
	(0.28)	(0.05)	(0.21)	(0.05)	(0.28)	(0.06)	(0.31)	(0.07)
Addition - L1 (%)	0.23	0.19***	0.16	0.22***	0.21	0.19***	0.30	0.19***
	(0.2)	(0.04)	(0.2)	(0.05)	(0.18)	(0.05)	(0.19)	(0.05)
Addition - L1 (#)	4.10	3.13***	1.58	2.21***	4.19	3.87***	6.02	3.74***
	(3.78)	(0.74)	(2.03)	(0.52)	(3.58)	(1.06)	(3.87)	(1.01)
Addition - L2 (%)	0.11	0.06	0.00	0	0.12	0.08	0.18	0.11*
	(0.22)	(0.04)	(0)	(0)	(0.23)	(0.06)	(0.26)	(0.07)
Addition - L2 (#)	1.35	1.13***	-	-	1.11	0.88**	1.56	1.23***
	(1.39)	(0.3)	-	-	(1.34)	(0.35)	(1.39)	(0.4)
Subtraction - L1 (%)	0.19	0.17***	0.13	0.14**	0.17	0.2***	0.26	0.2***
	(0.19)	(0.04)	(0.2)	(0.05)	(0.17)	(0.05)	(0.19)	(0.05)
Subtraction - L1 (#)	3.42	3.06***	1.27	1.4**	3.37	4***	5.19	4.02***
	(3.6)	(0.71)	(1.99)	(0.53)	(3.35)	(0.94)	(3.85)	(0.98)
Subtraction - L2 (%)	0.09	0.06*	0.00	0	0.10	0.1*	0.16	0.10
	(0.2)	(0.04)	(0)	(0)	(0.19)	(0.05)	(0.24)	(0.06)
Subtraction - L2 (#)	1.22	1.13***	-	-	0.98	1**	1.41	1.09**
	(1.27)	(0.35)	-	-	(1.18)	(0.45)	(1.32)	(0.45)
Multiplication (%)	0.33	0.09	-	-	-	-	0.33	0.09
	(0.27)	(0.08)	-	-	-	-	(0.27)	(0.08)
Division (%)	0.28	0.12	-	-	-	-	0.28	0.12
	(0.26)	(0.09)	-	-	-	-	(0.26)	(0.09)
Shape recognition (%)	0.28	0.01	0.24	0.04	0.16	-0.01	0.43	0.03
	(0.2)	(0.03)	(0.14)	(0.03)	(0.12)	(0.04)	(0.22)	(0.05)
Proficiency (%)	0.03	0.1***	0.00	0	0.02	0.14***	0.07	0.16***
	(0.18)	(0.03)	(0)	(0)	(0.14)	(0.04)	(0.25)	(0.06)

Notes: The statistical significance of differences across sub-samples is denoted with the following key: * p<0.10, ** p<0.05, *** p<0.01.

Class size and single vs. double shift models We did not find evidence that class size moderates learning gains. Although small correlations were observed between class size and some outcomes, these are likely to be statistical noise and that there is no real difference in program effectiveness between the smaller and the larger classes through additional analysis. Single shift schools were also not found to produce significant differences in learning gains when compared with double shift schools. In summary, the effective student to teacher ratio did not impact student learning outcomes, but the increased instructional time coming out of the change to single-shift in certain schools did.

Teacher qualification levels and instructional practices. Schools with average higher teacher qualifications levels did not experience significant larger gains.. Schools with more shares of more qualified teachers (post-secondary education) did not experience larger gains either . In sum, the RwandaEQUIP programme worked as well in schools with lower teacher qualification levels as it did in schools with more qualified teachers. Over the course of the study, rates of teacher absenteeism decreased by half in treatment schools from baseline to midline. Total instruction time per pupil also increased as a result.

VI. Discussion and Recommendations

The implementation of the RwandaEQUIP programme significantly accelerated pupils' learning — producing over a year's worth of progress in its first 17 weeks in certain sub-skills, as demonstrated by RwandaEQUIP Primary 1 pupils who surpassed the English

fluency, and numeracy levels of comparison school Primary 2 pupils. The success of the program among primary level students can be attributed to a select number of systems and practices:

1. **Implementing highly structured pedagogy through lesson plans, learning materials, and ongoing teacher training and support increases learning outcomes.** Providing a structured, supportive system for teachers facilitated greater learning gains among pupils. The structured pedagogy that was created and implemented as a part of this study (which included lesson plans, learning materials, and ongoing support and training for teachers) was developed specifically targeting the median pupil learning level, based on data points taken from the baseline report from this study. Prioritising foundational literacy and numeracy ensures that pupils have the necessary skills in order to progress further in their education, which leads to lower dropout rates and
2. **Utilising data-informed management of education professionals improved teacher attendance and lesson delivery.** Data was collected throughout the study through teacher input via tablets and regular tests administered by trained RwandaEQUIP employees. The tablets were also used by teachers in order to access lesson plans and materials, mark attendance, and communicate with support teams.
3. **Centering curriculum on foundational literacy and numeracy skills.** Primary 1 and 2 pupils benefited more than any other subgroups within the study. This is likely due to the increasing heterogeneity in learning levels within Primary 3-6. Due to the cumulative nature of educational curriculum, pupils who were unable to master foundational skills in earlier years will be less able to benefit from standardised instruction. Further research is required to see how whole-school educational inputs can benefit upper level pupils in the short term, and if a programme such as RwandaEQUIP has long-term positive effects on pupils who are enrolled in the program at a young age. We hypothesise that pupils will continue to experience accelerated learning gains proportional to the amount of instruction received from the program.
4. **Increased, high-quality instructional time made a significant difference.** Pupils in single-shift schools did not perform meaningfully better than their peers in double-shift schools. Instruction time also increased overall due to higher rates of teacher attendance. This dramatic decrease in teacher absenteeism was likely due to increased accountability measures and oversight in the form of daily data collection on tablets. Through these tablets, the program was also able to track and confirm that teachers within the RwandaEQUIP programme were more likely to deliver lessons than their counterparts, increasing instructional time through their rate of active instruction, increased attendance, and the change to a single-shift model. Notwithstanding the elevated student-to-teacher ratios that would ensue from adopting a single-shift model, the conclusions drawn from this study indicate that the single-shift approach, when combined with increased rates of attendance, and high-quality lesson delivery, proves more efficacious than the double-shift model due to its provision of twice the total instruction time per pupil.
5. **Standardising and enforcing English as the language of instruction by also providing high-quality structured support in Kinyarwanda. T**he RwandaEQUIP programme more strictly enforced the Government of Rwanda's policy of English as the medium of instruction than their counterparts, and yet pupils were still shown to have augmented learning gains in Kinyarwanda and English relative to pupils in the comparison group.These results suggest gains achieved in English did not come at the expense of progress in Kinyarwanda due to the increased quality of Kinyarwanda lessons.

The results from this study are promising, and have implications for similar results in other low- and middle income countries. More research is needed regarding the core components of the program in various contexts and time frames. If practices such as the ones here in this study can be implemented on a larger scale across the country of Rwanda, millions of students could receive a higher quality of education and enjoy the benefits thereof.

VII. References

AlphaPlus. 2017. “Case Study - Support for the Learning Achievement in Rwandan Schools Project (LARS).” AlphaPlus. https://www.alphaplus.co.uk/wp-content/uploads/2021/04/Case-Study-LARS.pdf.

Evans, David K., and Anna Popova. 2016. “What Really Works to Improve Learning in Developing Countries? An Analysis of Divergent Findings in Systematic Reviews.” *The World Bank Research Observer* 31, no. 2 (August): 242-270. https://doi.org/10.1093/wbro/lkw004.

Ganimian, Alejandro, and Richard J. Murinane. 2016. “Improving Education in Developing Countries: Lessons From Rigorous Impact Evaluations.” *Review of Educational Research* 86 (3): 719-755. https://doi.org/10.3102/0034654315627499.

Global Education Evidence Advisory Panel. 2023. *Cost Effective Approaches to Improve Global Learning*. Washington D.C., United States: The World Bank. https://documents1.worldbank.org/curated/en/099420106132331608/pdf/IDU0977f73d7022b1047770980c0c5a14598eef8.pdf.

Masino, Serena, and Miguel Niño-Zarazùa. 2015. “What works to improve the quality of student learning in developing countries?” *International Journal of Educational Development* 48 (December): 53-65.

National Examination and School Inspection Authority. 2022. “LEARNING ACHIEVEMENT IN RWANDAN SCHOOLS.” NESA. https://www.nesa.gov.rw/index.php?eID=dumpFile&t=f&f=51692&token=75eaa3203eddfe6c7bc44095ac30fd00c6455388.

UNESCO. 2022. *Spotlight on Basic Education Completion and Foundational Learning in Rwanda*. Paris, France: United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000383301/PDF/383301eng.pdf.multi.

USAID Soma Umenye. 2021. “Equating Study: LARS IV, EGRA 2018, LEGRA 2021.” Equating Study: LARS IV, EGRA 2018, LEGRA 2021. https://pdf.usaid.gov/pdf_docs/PA00Z2QZ.pdf.

World Bank. 2018. *Learning to Realize Education's Promise*. Washington D. C., United States: International Bank for Reconstruction and Development. doi:10.1596/978-1-4648-1096-1.

The World Bank. 2021. “Government expenditure on education, total (% of GDP) | Data.” World Bank Data. https://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS?most_recent_value_desc=true.

The World Bank. 2022. “Learning in Crisis: Prioritizing education & effective policies to recover lost learning.” World Bank. https://www.worldbank.org/en/news/immersive-story/2022/09/16/learning-in-crisis-prioritizing-education-effective-policies-to-recover-lost-learning.

World Bank. 2023. “World Development Indicators | DataBank.” World Bank DataBank. https://databank.worldbank.org/source/world-development-indicators.