



# **Mobile Learning Lab Project Evaluation report – Sierra Leone**

**DECEMBER 2018**

***60 million girls* Foundation**

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## Executive summary

The poor quality of education in much of the developing world has created a learning crisis for children. To address educational quality, the **60 million girls Foundation** designed a Mobile Learning Lab (MLL) to provide up-to-date, high-quality learning materials for children in remote villages that have limited (if any) access to the Internet or electricity. This paper summarizes the need for new ways of thinking about the delivery of quality education and looks at the design of the MLL based on the structure and outcomes from our 2013-2017 pilot tests and our 2017-2018 evaluation project in the Koinadugu district of Sierra Leone. The paper also considers whether this evaluation project met its objectives to deliver educational materials in a way that is interesting for students, harnesses their intrinsic motivation to learn, increases their self-confidence and results in superior learning outcomes, as measured by learning assessments at the start and at the end of the project compared to a control group.

## Conclusions

Grade 4, 5 and 6 students in rural northern Sierra Leone saw significant increases in math and literacy outcomes compared to control groups following access to the MLL for even as little as two hours per week over 16 weeks. Beyond the improvement in cognitive skills, there was considerable evidence of an increase in intrinsic motivation and self-confidence of all students, girls and boys, as noted in high levels of attendance, more engaged learning in the classroom, more enthusiasm and classroom participation by students who had access to the MLL, as well as strong peer learning while using the MLL that spilled over into community activities. The students' enthusiasm for learning based on interests and needs was also noted by parents in the five communities. The strong engagement of the community, from the start of the evaluation project and parents' perception of the positive impact of the MLL, contributed, in our opinion, to the fact that all five treatment communities relaunched the MLL program – with no financial assistance and minimal technical support – once the evaluation program was completed.

The strong finding on the negative impact of discipline on children's learning and non-cognitive skill acquisition was equally important to note. Students participating in the MLL were more than twice as likely as those in the control group to cite discipline as a negative aspect of classroom learning.

The non-cognitive skills we examined (intrinsic motivation, self-confidence and level of aspiration) are crucial to ensuring that students develop a positive attitude towards learning so that they are more likely to stay in school in the medium and long term. This is particularly significant for young girls as they shift from elementary to secondary school. It is at this transition point that girls face a greater number of obstacles such as child marriage, early childbirth and HIV/AIDS, which limit their life choices and often mean the end of their education.

Another clear takeaway is that the children enjoyed the MLL. Access to the tablets attracted students to the MLL and then the great depth and range of content and the many delivery models (video, text, games, interaction) kept them engaged and interested over the longer term – up to eight months of weekly use in this evaluation project with an attendance rate of 90%. The choice of content and the delivery model that best suited the students' way of learning were thus customized by the students themselves. It would be possible to further customize this model for children with visual handicaps (possibly using larger fonts, a large amount of video content) and hearing impairments (use of captions already available on several

literacy videos, text and written material) as well as adding content and/or tools specific for various learning disabilities.

Further, the low operating cost per student (\$0.06/student hour) shows that the MLL can be a cost-effective way to improve learning outcomes in communities with large class sizes and a limited number of trained teachers, textbooks and teaching aids. The MLL is a model that can have an immediate impact on students and does not require significant investments of money and time in teacher training or other supervision activities to launch the program and to be effective.

With scale and broad partnerships, costs will continue to come down and service support will improve.

We also believe that it is possible to turn the MLL into a community-driven and/or micro-enterprise sustainable model.

Our evaluation project results are in line with research carried out on KA Lite in Liberia and Guatemala, as well as research on the use of Feed the Monster in Ethiopia, South Africa, the US and the Azraq refugee camp for Syrian children where use in a self-directed environment showed the greatest improvement in test scores.

Children are at ease using a tablet and understand how such a tool can help them get the information they need. The MLL is an introduction to the use of technology to help support their requirements.

## **Recommendations**

- 1) In new project funding, partners should provide any new content developed with *60 million girls'* funds as open source material to add to the RACHEL.
- 2) In future implementation of the MLL, after 4 weeks of self-directed use, have a coordinator take about 30 minutes to review with the students the full list of content on the RACHEL. In this way, the students can adjust their usage to find content that is most helpful to them, and to understand the depth of content available. The sessions would remain self-directed after that one intervention.
- 3) Pre-configure the tablets before use in an MLL to prevent situations such as accidental locking, and ensure full access to the content with the appropriate drivers for the latest programs.
- 4) After week 2 or 3, have the MLL coordinator explain to students how to close web pages and tabs to minimize drain on batteries.

## **Background: Access without quality has led to a learning crisis**

Research from the UNESCO Institute of Statistics (UIS) shows that 617 million children and adolescents do not meet minimum proficiency levels in literacy and mathematics. Over two-thirds of these children live in Central/Southern Asia and sub-Saharan Africa – two of the world's poorest regions. In low-income

countries, poor quality learning has meant that 90% of children aged 6-14 do not meet minimum proficiency standards in reading and 87% do not meet minimum proficiency standards in mathematics.<sup>1</sup>

The learning crisis has important consequences for global poverty reduction efforts and for the success of the 2030 Agenda for Sustainable Development. Without even the most basic skill set, these uneducated children will be hard-pressed to find jobs as adults that will allow them to increase wages in the formal employment sector, adapt to new technologies that can improve agricultural output, for example, or make informed decisions regarding their health and that of their family.

There are several reasons for the learning crisis in low-income countries, and our intervention focuses on three of them: the lack of trained teachers, overcrowded classrooms and limited access to educational materials. Rapid improvements in access to primary level education following the introduction of the Millennium Development Goals (MDGs) in 2000, combined with substantial population growth in sub-Saharan Africa, meant that there were not enough teachers to keep up with demand. The UIS reports that an additional 69 million teachers are needed by 2030 to meet the needs of the world's children.<sup>2</sup>

Meanwhile, any solution has to consider the fact that remote locations limit children's access to quality textbooks, reading materials and other educational tools. This is further confounded by limited (if any) access to electricity and Internet connectivity, as well as teachers' poor to non-existent computer skills.

## **The Mobile Learning Lab Approach**

The Mobile Learning Lab (MLL) is designed to overcome these obstacles to quality education. It is a tool that can be used in a variety of learning applications where access to the Internet and electricity are either limited or unavailable. The MLL provides offline educational resources to allow children or adults to learn, explore and discover without books or online resources.

### **There are many possible configurations, but all have three basic components**

#### **A: RACHEL**

The RACHEL (Remote Area Community Hotspot for Education and Learning) was developed by World Possible and is a portable plug-and-play server that stores educational websites and makes the content available over a local offline wireless connection. This simple-to-operate device (charge the battery and turn it on) provides instant access to offline versions of the world's best free educational websites, including Khan Academy, Wikipedia and dozens of other resources. Visit [www.worldpossible.org](http://www.worldpossible.org) to view a complete list of standard content in English, French and Spanish, as well as local language content.

#### **B: User Device**

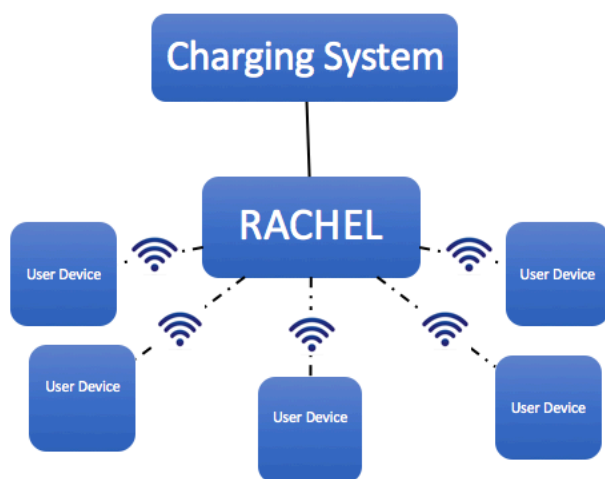
To access content on the RACHEL, each user requires a device with Wi-Fi capability, a video card and sound card with associated drivers. This can be a laptop computer, tablet, or smartphone and does not require any installation of software, other than web browser capability to access the information on the RACHEL.

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<sup>1</sup> UIS Fact Sheet 46, September 2017, p. 15, table 2

<sup>2</sup> UIS Fact Sheet 39, October 2016, p. 1

## Configuration diagram



## Pros and cons of the user device options

Device	Pro	Con
<b>Laptop</b>	Robust, versatile and has a large screen	Uses more power and not easily transportable; cost is high
<b>Android tablet</b>	<ul style="list-style-type: none"> <li>• Durable and good viewing with 7" screen and screen protection prevents damage</li> <li>• Uses less power than laptops/desktops</li> <li>• Easier to transport</li> <li>• Easier to store</li> <li>• Low cost to purchase</li> </ul>	
<b>Smartphone</b>	<ul style="list-style-type: none"> <li>• With Wi-Fi and large screen can access content efficiently</li> <li>• Uses less power than options above</li> <li>• Lowest cost to purchase</li> </ul>	Small viewing screen

**Optional equipment:** Headphones are very useful to allow users to view videos or other learning systems that contain audio content without disturbing others. Any headphone with audio jacks that can be plugged into the device can be used.

## C: Charging System

If electricity is not available to charge the RACHEL and user devices, alternate forms of charging are needed. This requires either a solar charging system or a diesel/gas generator. The charging system should be able to charge all of the user devices and the RACHEL, as needed, within a time frame that works for the scheduled use of the MLL.

We used the BBOXX solar charging system, which consisted of 3 solar panels, 3 rechargeable batteries and 3 charging discs. When the BBOXX batteries are completely drained, it takes up to 5 hours to fully charge again during the dry season. During the rainy season, it depends on the strength of the sunrays and the weather, but typically takes much longer.

When the tablets are completely discharged, it takes up to 3 hours connected to the BBOXX discs for them to fully charge again. The BBOXX system we used can charge 27 tablets at once. Continually charging for 6 hours will complete drain/discharge the BBOXX; therefore, 54 tablets can be fully recharged within one day.

When the BBOXX is disconnected from the solar panel for a week, it will completely drain/discharge, even without connecting any device.

### **Depending on the application and number of users, the MLL can be set up in various ways**

#### **Configuration for the evaluation project**

1. **RACHEL Server (1)** with standard English content available at:  
<https://store.worldpossible.org/collections/frontpage/products/rachel-plus>
2. **Tablets (30)**: Samsung 7" tablets with protective anti-scratch coating on the screens and 15 headphones
3. **Charging System (3)**: BBOXX Home Solar system to provide enough power to charge all 30 tablets and the RACHEL each night

This charging system requires the following:

- 3 x BBOXX home charging system
- 3 x 50W solar panels
- 3 x USB phone charging hub
- 3 x multiple phone charging hub

Available from: [sales@BBOXX.co.uk](mailto:sales@BBOXX.co.uk)

#### **Cost breakdown in CAD\$ (2017)**

1. RACHEL Server (1): \$650
2. Tablets (30) and headphones (30): \$3,660
3. BBOXX solar systems (3): \$855
4. Transportation: \$1,500

**Total cost: \$6,665**

#### **Operational costs**

- Replacement of 2 tablets/year and 3 batteries every two years: \$275/year
- Stipend MLL coordinator: \$1,200 annually for 20 hours/week supervision at MLL
- 1 MLL = 24,000 student hours per year
- 30 students at 4 hours/day x 5 days/week x 40 weeks based on using the solar charging system at full capacity, except during the rainy season

Yearly operational cost: \$0.06 per student hour

## Mobile Learning Lab based on intrinsic motivation to learn

*60 million girls* developed the MLL with the explicit idea of immediately improving the quality of education for children in remote communities with large class sizes, untrained teachers and limited access to learning materials. The research we reviewed suggested that its use as an after-school, self-directed learning activity would enhance the intrinsic motivation of children to learn, as well as their self-confidence. Based on research from Dr. Sugata Mitra's Hole in the Wall<sup>3</sup> experiments, we know that children have the ability to teach themselves when given the opportunities and the resources to do so.

The self-directed, after-school implementation means that it puts learning directly in the hands of children. It ensures that children can access interactive educational software while choosing topics that interest them, or that correspond with an academic subject where they need extra help, without the intervention of teachers or other adults.

When not part of the school curriculum, the MLL does not require additional teacher training. Rather, it is led by a coordinator who learns how to use the installed solar charging system to charge the devices and who is present to hand out and retrieve the tablets and securely store them at the end of each session.

In **putting children first**, the MLL introduces activities that can spark interest in learning and, consequently, build intrinsic motivation and self-confidence by tapping into children's innate curiosity. This will lead to the following helpful learning behaviours:

- **Participation:** Improving school attendance, homework completion, reading, practising
- **Peer learning/problem-solving skills:** Engaging with others in the community to solve problems, learn and support one another
- **Level of aspiration:** Learning how to use digital technology; learning about career choices and the tools to attain them

Based on the customizable nature of the MLL content, its use can extend beyond the classroom to benefit the entire community by providing them with up-to-date information on health practices, teacher training pedagogy, human rights information, hygiene, nutrition or agricultural techniques, for example. The opportunities are limitless.

## Development of the Mobile Learning Lab

The MLL learning model has gone through several iterations since our first trials in 2013 as we updated it based on newly available technologies, research and the development of more extensive offline educational materials.

### First pilot projects (Nov 2013 – Apr 2017)

**Phase 1 (Nov 2013 – Jan 2014)** This first phase was based on delivery using USB keys and Netbook computers at a learning centre in Sierra Leone with our partner, CAUSE Canada. The 60 girls who participated initially had access to KA Lite for two three-hour sessions each week in a completely self-directed context. The girls continued to use KA Lite on their own, without instruction, as a math tutorial

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<sup>3</sup> [https://www.ted.com/talks/sugata\\_mitra\\_shows\\_how\\_kids\\_teach\\_themselves?language=en](https://www.ted.com/talks/sugata_mitra_shows_how_kids_teach_themselves?language=en)



to independently supplement classroom learning and to help with homework. After two months, the girls were keen to have access to additional subjects like science and business.

**Phase 2 (Feb 2014 – May 2014)** We introduced the RACHEL-Pi (Raspberry Pi technology) as a more dependable and effective way to deliver the program. In April 2014, children from four schools in grades 5, 8 and 12 were split into control and user groups. The children had access to the program for two hours per week. Initial assessments were positive, with discernible improvements in test scores. Unfortunately, however, the Ebola crisis and resulting school closures interrupted the program. Our partner on the ground implemented, instead, a mobile lab with 15 notebooks, which was taken to communities, on a rotating basis, to give the children access to math tutorials. This proved to be hugely popular with students, parents and village chiefs.

### **Conclusions from phase 2 of this pilot project**

- 1) Huge interest on the part of students to use computers as a tool to learn
- 2) Immediate impact of tutorial programs such as KA Lite, in an after-school setting (including mobile labs where the devices were brought to remote communities)
- 3) High motivation on the part of students to learn on their own; eagerness to learn; curiosity
- 4) Engagement of other stakeholders in the community: paramount chief, teachers, parents
- 5) Clear possibility, even in remote areas without access to electricity and the Internet, to reach vulnerable populations with computer-based learning in a cost-effective way

**Phase 3 (Jan 2016 – Apr 2017)** The Mobile Learning Lab then transitioned to the RACHEL-Plus server with scope for more content and delivered through tablets, which were easier to transport and store. It was used by our partner in a permanent setting – the Integrated Learning and Research Centre (ILRC) – which students attended after school to work on KA Lite with the support of IT supervisors. It included a mobile component where the MLL was transported weekly to different communities to enable students to work on KA Lite in a semi-supervised context.

From **November 2016 to April 2017**, a number of pre-evaluation project trials were completed to test the MLL as a 100% self-directed model for grade 5 students and to verify the quality of the math, literacy and non-cognitive tests that we had developed for the full evaluation project to be able to quantitatively track learning outcomes of the treatment and control groups.

### **The evaluation project (Jul 2017 – Jul 2018)**

This larger scale evaluation project was developed with the help of McGill University, as our academic consulting partner, to study the impact of self-directed digital learning on cognitive and non-cognitive outcomes for students of primary-school age in a randomized control trial. A literature review of non-cognitive skills research and the impact on learning was completed by a researcher from McGill's Institute for the Study of International Development (ISID) for this evaluation project.

There is considerable evidence of the positive effect of non-cognitive skills on human capital accumulation and labour market participation and performance. Non-cognitive skills might be equally and, some argue, even more important than measures of cognitive outcomes to evaluate a child's ability and capacity to learn in the long term.

The implementation of the intervention was done by our partner, CAUSE Canada, in the northern district of Koinadugu, Sierra Leone, starting in July 2017.

CAUSE Kids Program

Kathombo II Makeni- Kabala Highway, Kabala, Sierra Leone

Mobile: +23276 – 823-722 / +23278-307-862/+23278-147-528

### **Choice of communities in Koinadugu District (protocol, socio-economic context)**

The target communities were chosen to be as homogeneous as possible to enable us to compare across the communities:

- 1) Similar income level in the communities (no large disparity of income levels from one community to the other)
- 2) No outside interventions for education if possible (no CAUSE Kids, no Peer Literacy programs, no Mobile Library, no Mothers' Clubs)
- 3) Similar primary school infrastructure (public schools), class sizes, access to text books, teacher training level

Several communities were visited and evaluated using the above criteria and also including the interest of community leaders, such as school principals and village chiefs, at the outset.

#### **Treatment communities**

Alharrkhan Fadugu

Fadugu Kasunko

Kabala DEC Central

Dogoloya

Musaia

#### **Control communities**

Makakura

Kamabikni

### **Community engagement**

Our partner, CAUSE Canada, held a number of sessions with each of the seven communities before implementation of the evaluation project to explain to parents, teachers and community leaders what the evaluation project hoped to measure and what it expected to accomplish. Staff members at CAUSE Canada were available throughout the project period to oversee the implementation, the functioning of the equipment, the gathering of data and troubleshooting of any potential problems.

Parental consent form (see **Appendix 1**)

### **Goal of the program**

The goal of the evaluation project was to determine the impact of self-directed access to the MLL after school on the math and literacy skills of students in primary grades, as well as on the following non-cognitive skills: intrinsic motivation, self-confidence and level of aspiration.

### **Expected value and benefits to the children**

- 1) Improve learning to support students to complete their academic year at school (leading to decreased dropout rate) with access to a wide range of academic subjects
- 2) Improve literacy in English
- 3) Positively impact non-cognitive skills to support continued self-directed learning and improve learning outcomes at school, as well as retention of the students in the school system in the medium and long term
- 4) Make learning a fun and positive experience

### **Basis of this evaluation project**

- 1) Self-directed learning as a way to help students access content and support school learning through the use of current academic content not available to the students in class, via a tablet in an after-school setting for 120 minutes once per week
- 2) Self-directed learning as a way for students to improve their academic results by focusing on areas where they feel they need help the most – customized learning
- 3) Self-directed learning as a way for students to understand material at their own pace in different ways (audio, visual, interactive, games, exercises) – Universal Design for Learning: providing development of flexible learning environments that can accommodate individual learning differences
- 4) Self-directed and peer learning to support knowledge acquisition by students – enhance cooperative social skills among the children
- 5) Self-directed learning as a tool to access content which is of interest to the student – increase intrinsic motivation for learning
- 6) Self-directed learning as a way for students to take control of their need for knowledge and information – increase students' self-confidence in their ability to respond to their own needs
- 7) Self-directed learning as a tool for students to discover opportunities not otherwise known in their community, which can lead to a higher level of aspiration for the student's future
- 8) Familiarity with the use of IT for learning

### **Project rollout**

Provided access to 682 grade 4, 5 and 6 students from five community schools to the MLL for two hours once a week, after school from 2-4 pm, from November 2017 to June 2018. There were 358 girls and 324 boys. Access to the MLL was free of charge and on a voluntary basis. All students in grade 5, then grade 6, and then grade 4 (up to a maximum of 150 students per school) at the chosen schools were offered the chance to participate. No children from these grades were to be excluded. Attendance was taken at each session. Participants had the right to discontinue attendance at the MLL at any time and to withdraw from the evaluation project if they so wished.

### **Student evaluation**

A math and a literacy test (see **Appendices 2 and 3**) were given to the 682 students assigned to the MLL, as well as the 358 control group students before and after the intervention. These tests were given in a classroom setting with approximately 30 students per group. Students were allowed a maximum of 45 minutes to complete each test. The test was in paper-pencil form with a minimum of one monitor to oversee it. Test results were being used solely for the purpose of the evaluation project. The results were not shown nor given to the school or any other person or group at any time.

A non-cognitive skills test measuring intrinsic motivation, self-confidence and level of aspiration was also administered orally by an evaluator to each of the 1,040 students (experimental and control groups) before and after the intervention. These results were only used for the purpose of the evaluation project. The results were not shown nor given to the school or any other person or group at any time.

Students were issued ID numbers to indicate their grade level, the community where they go to school, their age and whether the student is male or female.

The list linking the students' names with their ID numbers was kept by CAUSE Canada digitally only, username and password protected on a computer in CAUSE Canada's office in Kabala. This information was not given to *60 million girls'* project evaluation team.

The data were analyzed to note the impact of attendance at the MLL on math, literacy and non-cognitive skill scores. The raw data will be kept for a three-year period by *60 million girls'*

### **Benefits**

Students had access to high quality academic content in a child-friendly environment. The content was available in a number of forms (text, video, games, interactive exercises) to appeal to children who may learn in different ways. The variety of material was very broad to enable the students to find subjects of interest to them. The self-directed format enhanced the students' perception of control of their learning, which can lead to increased intrinsic motivation, self-confidence and level of aspiration.

### **Content**

The students did not have any access to the Internet. The only content available to the students was of an academic nature available on the RACHEL server or apps on the tablet itself. Content used for the evaluation project included: KA Lite (math, sciences and health), Wikipedia Academic, Fantastic Phonics, African Storybook Project, primary grade readers from Sierra Leone and Ghana, selected TED Talks, Hesperian Health Guide, Feed the Monster, Algebra2go, Cat and Dog Books, Career Girls, CK-12 STEM textbooks, Great Books of the World, Infonet-Biovision, MIT Scratch, Music Theory, Mustard Seed Books, OLPC Educational Packages, OER Africa, PhET, Radiolab, Saylor Academy Textbooks, national examinations (Sierra Leone and Tanzania), Wikivoyage, World Map, UNESCO Women of the World.

One tablet, turned off, was given to each student. The children were given no instructions as to how to turn the tablet on, how to use it or how to access the RACHEL server. It generally took under a minute for students to learn how to turn the tablets on. The students generally began by taking pictures of themselves. They also began playing with the calculator and with Feed the Monster. After exploring these three applications, their favourite programs in preferential order became: Fantastic Phonics, Reading Sierra Leone Textbooks and Khan Academy (KA Lite), which they learned to access on their own through the RACHEL server.

### **Impact on classroom learning**

Teachers were made aware of the MLL evaluation project. The MLL is not intended to replace classroom learning. It is meant to supplement classroom learning in a complementary way.

## **Role of the MLL coordinator**

The MLL coordinator ensured the tablets were being properly used (not banged or damaged) and that the room environment was child-friendly and safe. The MLL coordinator moved around the room only to encourage the children. If asked questions by the children, the MLL coordinator did not provide any direction on how to use the tablet or how to access the content.

In week 4 of the project, CAUSE Canada's local IT coordinator visited each of the MLLs to answer technical questions and explain what content was available when connected to the RACHEL. The explanation and Q&A lasted no longer than 30 minutes and students were not directed to use any particular content. The session was meant to allow them to understand the variety of content available. The CAUSE Canada local IT coordinators visited the MLL communities regularly to answer technical questions and oversee the use of the MLL. MLL coordinators in each community were given a smart phone in order to reach the CAUSE Canada IT coordinator at any time if technical questions came up.

## **Start of first treatment group (120 hours of MLL access): Phase 1**

November 2017 – July 2018 (8 months) 145 students total: 80 girls, 65 boys  
2 hours per day/5 days per week (10 hours per week from November 2017 to February 2018)  
2 hours per week for 16 weeks (February 2018 – June 2018)  
Approximately 30 students in each of five communities  
Total treatment hours: 120 hours per student

## **Start of second treatment group (32 hours of MLL access): Phase 2**

February 2018 – June 2018 (4 months) 537 total: 278 girls, 259 boys  
Baseline testing of additional students  
2 hours per week, students in each of five communities  
Total treatment hours: 32 hours per student

## **Completion of evaluation project: July 2018**

Endline testing done on 682 treatment group students and 358 control students

Quantitative data received by *60 million girls* from CAUSE Canada in September 2018  
Qualitative data received in October 2018

## **Results of evaluation project**

### **Attendance**

**Phase 1** students (120 treatment hours over 8 months)  
Average attendance: 92%  
(varied from 79% Kabala DEC Central to 97% Alharrkhan Fadugu)

**Phase 2** students (32 treatment hours over 16 weeks)  
Average attendance: 86%  
(varied from 81% Fadugu Kasunko to 89% Dogoloya)

Students repeatedly asked for more time at the MLL. After the evaluation project, students, teachers and parents suggested that sessions be lengthened to three hours, at least twice per week.

Attendance did not diminish over time. The increased attendance rate of the full treatment group seems to indicate that more time at the MLL further motivates the students to participate.

### Literacy and math scores

	Math	% increase vs baseline	Literacy	% increase vs baseline
Baseline (all)	45%		48%	
Endline (control)	51%	13%	57%	19%
Endline (32 hours)	53%	18%	63%	31%
Endline (120 hours)	56%	24%	63%	31%

- 1) Math test score increases were almost doubled (85%) for the full treatment group (120 hours) vs the control group, and literacy test scores increased by 63% vs the control group.
- 2) Test scores increased significantly in math for the partial treatment group (32 hours) but increased as much as the full (120 hour) treatment group in literacy.
- 3) The literacy increase was the most significant in all students in the treatment groups. This was expected since the students were not directed towards any particular subject and all apps and software are in English. Even with only 32 hours of time at the MLL, literacy results went up significantly in comparison to the control group.

### Comparative outcomes for girls and boys

Test Group	Overall population			Female Students			Male Students		
	# students	Math	Lit	# students	Math	Lit	# students	Math	Lit
Baseline (June 2017)	750	45%	48%	413	44%	45%	337	46%	51%
Baseline (Feb 2018)	308	45%	48%	157	44%	48%	151	45%	49%
Final (32 hour treatment)	537	53%	63%	278	53%	63%	259	54%	63%
Final (120 hour treatment)	145	56%	63%	80	54%	62%	65	57%	66%
Final (control group)	358	51%	57%	193	49%	56%	165	53%	59%

- 1) Girls started with lower baseline scores in math and literacy than boys.
- 2) For the 32-hour treatment group, the gains were the same for boys and girls in math, though higher for girls (31% increase for girls vs 26% for boys) in literacy.

- 3) For the 120-hour treatment group the gains were stronger for boys in math (25% increase for boys vs 20% for girls), though the girls did better in literacy (37% increase for girls vs 32% for boys)
- 4) For the control group, boys improved more in math than girls (17% increase for boys vs 11% for girls) while literacy gains were about the same for girls and boys (20% increase for girls vs 18% for boys)
- 5) The MLL seemed to favour a better learning environment for girls than a regular classroom setting. Stereotypical results showed that boys seemed to perform better in math than girls, and girls performed better than boys in literacy.
- 6) As indicated in the coordinator reports, Fantastic Phonics, Reading Sierra Leone, Feed the Monster and Khan Academy math and science were the most popular programs.

## **Results from the non-cognitive skills questionnaire**

### **General questions**

- 1) Students generally thought that math was an easier subject to learn than English – both before and after the treatment intervention.
- 2) Students indicated that they liked to read (82%) but there appeared to be fewer opportunities to read books other than school textbooks (64%).

### **Discipline**

#### **“What do you like least about going to school?”**

This question elicited a strong consensus from all students at baseline testing. The most indicated answer (among 15 choices) was “discipline”: 31% of all students at baseline, 25% at endline for the control group. However, 57% at endline for the treatment group stated they most disliked the discipline at school.

This is in line with qualitative data we had from pilot tests. In November 2016, during the first pre-trial pilot with 30 grade 5 students, one of the first comments made by a student at the end of the session was the fact that he liked learning without violence and threats – he said this despite the presence of teachers in the room. It was remarked at the time that it was surprising that the student had the courage to say this in front of everyone and that he was able to so quickly and clearly formulate such an answer.

Corporal punishment is still very much used in schools in Kabala and outlying areas where the evaluation project took place. Caning is used quite frequently. Despite support by CAUSE Canada to change this practice, it still is widely used as a form of discipline. It is probably, in part, a result of the large class sizes and the fact that a majority of teachers have received little or no formal training in pedagogy and often are not paid or supported in their work.

The large difference between the MLL treatment group and the control group (57% vs 25%) seems to underscore the students’ appreciation of a more child-friendly environment (no direction or interventions by the MLL coordinator, freedom to work on what the students wanted, a calm room environment, ability to talk and share with their peers, equal access and support for girls and boys) and/or their lowered tolerance for the strict discipline. Qualitative data shows an increase in self-confidence of the MLL students (more participative in the classroom, asking more questions, more enthusiastic than control

group students) and this response seems to suggest that the students realize that their capacity to learn is diminished in a violent/threatening environment.

It would be interesting to see what impact the removal of corporal punishment and the development of a child-friendly environment would have on learning outcomes in schools.

### **Intrinsic motivation**

#### **“If I try hard I can improve my situation in life”**

Baseline score was 98%. After the intervention, the score decreased to 90% for both the treatment and control groups. The children seemed to have significantly retained a very optimistic view of their chances at a better life through hard work.

The attendance data bears out this statement. Students were very motivated to attend the MLL with participation at an average of 89%. There were no incentives provided to the students and attendance was completely voluntary. Since the MLL was open from 3-5 pm while school classes finished at noon, many students went home and returned later, which could have meant an extra 30-minute walk or more each way. Many students still have only 1 meal per day, and there is extreme heat and humidity in this district, so attending the MLL required a significant effort for them.

It was often reported that students would line up outside the MLL, even when it was not their assigned day, in the hopes of taking the place of a student who might not show up.

We consider intrinsic motivation for these students to have been high.

### **Self-confidence**

#### **“I like to work on projects with my friends”**

The responses of both the treatment and control groups increased to 90% from the baseline score of 74%. Peer collaboration seemed to be very important to the students and they showed a high degree of self-confidence that they could complete a project when they worked with friends – that their input was important and they could learn together.

Teachers and coordinators noticed a strong level of peer collaboration with the students at the MLL, which spilled over to their community activities. It was felt by these adults to have developed more strongly in the MLL than in the classroom where the children spent more of their time. This might have been because of a natural peer-working environment at the MLL, while discipline was much stricter in the classroom.

The children who lived close together spent much of their spare time with each other sharing what they had learned on the tablets that day.

Teachers, coordinators and parents of students attending the MLL saw improvements in children’s friendships and socializing.

The children began teaching their parents at home about topics learned and how to use smartphones. Parents greatly appreciated the fact that their children were learning how to use technology.



## **Level of aspiration**

### **1) “Which flower (level of happiness) represents how you personally live at the present time?”**

The average response at baseline was about even for low level of happiness (46%) vs a higher level of happiness (54%). After the evaluation period, these results changed quite dramatically for both the control and treatment groups. Low level was cited 28% (treatment group) and 23% (control group), while high level was cited 72% (treatment group) and 77% (control group).

Overall, the students had a much higher perspective of how they live. Participating in the study may have had an impact in that the students may have felt positively that their situation was of interest to the evaluators and that perhaps change would result from the study – such as access for all to digital learning.

### **2) “What is the highest grade you hope to achieve in school?”**

At baseline, the majority of students (88%) indicated that they hoped to complete studies up to university level. After the evaluation project, the answer was very similar (90%) for both the control and treatment groups. This indicated, again, that students were quite optimistic for the future and aspired to the highest level they could hope to achieve in terms of education. It would seem to indicate that they have a deep belief in education being a good road to follow for a successful life.

## **Status of the MLL equipment after 8 months in the field**

### **Malfunctions**

**RACHEL:** One RACHEL became dysfunctional at the end of the evaluation project. It was replaced at no cost by World Possible and shipped to Sierra Leone in November 2018.

**Tablets:** All 150 tablets were still operating well. One tablet was dropped during an MLL session and the screen cracked, but it is still useable and is being used in the community MLL.

**BBOXX:** One unit malfunctioned when two wires short-circuited. The local CAUSE Canada staff was able to replace it and keep the MLL running.

There were several episodes of tablets being locked accidentally by the students as they tried a number of moves and inadvertently added a password code. These codes were then deleted by the CAUSE Canada IT coordinator. Some plug-ins needed to be updated or possibly deleted to avoid these problems.

The tablets became ‘hot’. Since the students were trying so many programs and apps, particularly in the early weeks as they were becoming familiar with the tablets, the tablets would heat up because a great number of web pages would be opened and never closed. The CAUSE Canada IT coordinator then went to each MLL group to explain to the children that they should close a tab when they were no longer using it. That seemed to resolve this issue.

## **Sustainability in the communities following the completion of the evaluation project**

After the evaluation project concluded in July 2018, a hand-off ceremony was performed with each community. The community was given the BBOXX solar charging system, the RACHEL-Plus server and 15 of the 30 tablets that were used in the community. The other 15 tablets were taken back by CAUSE Canada to use at their ILRC and to bring the MLL to other remote communities.

Each community was free to decide how they wanted to continue using the equipment.

In November 2018, a visit to the five communities indicated that all had chosen to continue providing access to the MLL to the students in their area, many for more hours per week than our evaluation project provided. Some community teachers also decided to access the RACHEL content for their own training and learning. Since July 2018, no funding has been given to the communities. The roles of MLL coordinator and security guard have been taken on by local volunteers.

Technical support is still available to the communities through one CAUSE Canada IT coordinator who visits a different community each week to answer any questions they may have. Also, three communities still have working smartphones that were given to the MLL coordinators at the beginning of the evaluation project. They can use them to contact the CAUSE staff member by text or by phone call.

The work done at the outset of the evaluation project in informing the community and discussing the purpose of the project resulted in strong community engagement. The success of the project and the enthusiasm of the children for the MLL seemed to have persuaded the communities to continue ensuring that the MLL stays open with their own local resources.

The **60 million girls Foundation**, along with our partner, CAUSE Canada, will be following the five MLL communities from January 2019 to December 2019 to see how the MLL continues to be used without funding but with continued technical support when needed.

## APPENDIX 1

### PARENTAL CONSENT FORM



Date \_\_\_\_\_

Student name \_\_\_\_\_

Parent name \_\_\_\_\_

I agree that I will let my child participate in the evaluation project by attending the Mobile Learning Lab located in our community, after school.

My child can leave the program at any time and will attend on a voluntary basis.

I have been informed about the purpose of the evaluation and the role my child will have in this project and understand that any data collected will be kept confidential and used only for the purposes of this project.

Signed \_\_\_\_\_





## APPENDIX 2

### MATHEMATICS QUESTIONS FOR HOUSEHOLD SURVEY

NAME: \_\_\_\_\_ TOTAL SCORE:  $\frac{\quad}{20}$

#### QUESTION 1

Which shape is a triangle?

- a) 
- b) 
- c) 
- d) 

Answer: \_\_\_\_\_

#### QUESTION 2

How many dots are there?



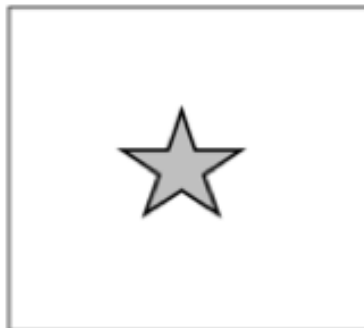


- a) 3
- b) 4
- c) 5
- d) 6

Answer: \_\_\_\_\_

#### QUESTION 3

Which box has the most stars?

- a) 
- b) 
- c) 

Answer: \_\_\_\_\_

QUESTION 4

Which number is the number *five*?

- a) 6
- b) 3
- c) 5

Answer: \_\_\_\_\_

QUESTION 5

Which number represents *twenty-one*?

- a) 21
- b) 8521
- c) 2425
- d) 12
- e) 42

Answer: \_\_\_\_\_

QUESTION 6

$2 + 3 =$ _____
-----------------

- a) 5
- b) 1
- c) 6
- d) 3

Answer: \_\_\_\_\_

QUESTION 7

$15 + 12 - 3 =$
-----------------

- a) 30
- b) 0
- c) 24
- d) 27

Answer: \_\_\_\_\_

QUESTION 8

Which number is closest to 900,000?

- a) 203,000
- b) 413,000
- c) 878,000
- d) 823,000

Answer: \_\_\_\_\_

QUESTION 9

Which difference is closest to 300,000

- a) 100,000 - 50,000
- b) 500,000 - 300,000
- c) 900,000 - 800,000
- d) 800,000 - 100,000

Answer: \_\_\_\_\_

QUESTION 10

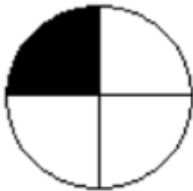
$$2.34 + 7.65 = \underline{\hspace{2cm}}$$

- a) 99.9
- b) 0.99
- c) 9.99
- d) 999

Answer: \_\_\_\_\_

QUESTION 11

What part is shaded?



- a)  $\frac{1}{4}$
- b)  $\frac{3}{4}$
- c)  $\frac{1}{2}$
- d) 1

Answer: \_\_\_\_\_

QUESTION 12

$$9 \times 2 = \underline{\hspace{2cm}}$$

- a) 18
- b) 11
- c) 7
- d) 17

Answer: \_\_\_\_\_

QUESTION 13

$$85 \times 5 = \underline{\hspace{2cm}}$$

- a) 425
- b) 405
- c) 4025
- d) 90

Answer: \_\_\_\_\_

QUESTION 14

Which number is half of 6?

- a) 12
- b) 3
- c) 2
- d) 4

Answer: \_\_\_\_\_

QUESTION 15

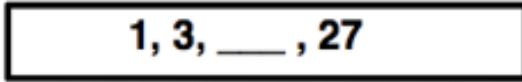
$$2488 \div 8 = \underline{\hspace{2cm}}$$

- a) 11
- b) 311
- c) 2480
- d) 2496

Answer: \_\_\_\_\_

QUESTION 16

Fill in the appropriate number in the following sequence:



- a) 9
- b) 4
- c) 5
- d) 15

Answer: \_\_\_\_\_

QUESTION 17

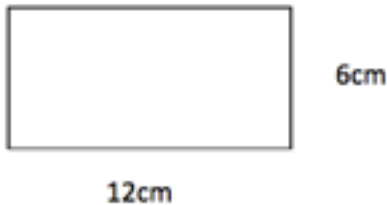
What is the average of 10, 12, 18 and 24?

- a) 64
- b) 16
- c) 54
- d) 60

Answer: \_\_\_\_\_

QUESTION 18

Calculate the perimeter of the following rectangle:

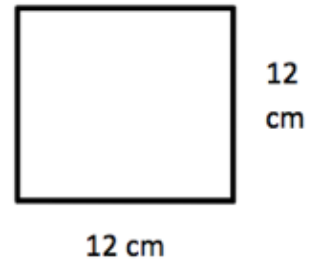


- a) 18 cm
- b) 72 cm
- c) 36 cm
- d) 24 cm

Answer: \_\_\_\_\_

QUESTION 19

What is the area of the square?



- a) 24 cm<sup>2</sup>
- b) 48 cm<sup>2</sup>
- c) 144 cm<sup>2</sup>
- d) 240 cm<sup>2</sup>

Answer: \_\_\_\_\_

QUESTION 20

What is the area of the shaded region?



- a) 65 m<sup>2</sup>
- b) 49 m<sup>2</sup>
- c) 59 m<sup>2</sup>
- d) 16 m<sup>2</sup>

Answer: \_\_\_\_\_

## APPENDIX 3

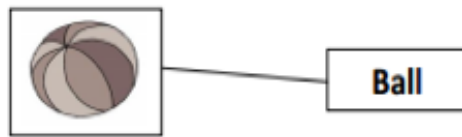
### LITERACY QUESTIONS FOR HOUSEHOLD SURVEY

NAME: \_\_\_\_\_ TOTAL SCORE:  $\frac{\quad}{24}$

#### QUESTION 1 /5

Please link each word to the most appropriate picture.

Example:



Now match the following words and pictures.



Elephant



Table



Dog



Bus



Key



## QUESTION 2 /3

Please link each word to the most appropriate picture.

1. The dog sleeps.



Please link each word to the most appropriate picture.

2. The table is broken.



Please link each word to the most appropriate picture.

3. The teacher gives the children books.



### QUESTION 3 /4

Pick the word that completes the sentence best.

1. The \_\_\_\_\_ where Adia lives is very big.
  - a. House
  - b. Dog
  - c. School

Answer: \_\_\_\_\_

2. The school \_\_\_\_\_ rings loudly every day.
  - a. Bell
  - b. Classroom
  - c. Lunch

Answer: \_\_\_\_\_

3. Elewa is reading a \_\_\_\_\_.
  - a. Meal
  - b. Book
  - c. Car

Answer: \_\_\_\_\_

4. In the day, the \_\_\_\_\_ is shining.
  - a. Moon
  - b. House
  - c. Sun

Answer: \_\_\_\_\_

### QUESTION 4 /1

Read the following sentence carefully.

**Martin likes to draw animals with coloured pencils.**

5. What does Martin like to draw with coloured pencils?
  - a. Landscapes
  - b. Animals
  - c. Flowers

Answer: \_\_\_\_\_

QUESTION 5 /2

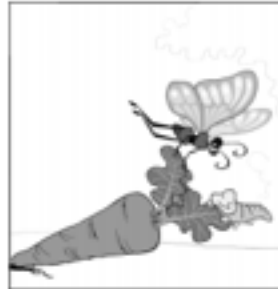
The worm and the carrot



A worm found a carrot so big that it couldn't get it out of the ground.



Shortly, a butterfly came to help the worm.



Both the worm and the butterfly pulled with all of their strength and managed to get the carrot out of the ground.

1. Why couldn't the worm pull the carrot out of the ground?
  - a. Because the butterfly didn't want to help.
  - b. Because the carrot was too big.
  - c. Because the carrot wasn't ripe.


Answer: \_\_\_\_\_

2. What happened at the end of the story?
  - a. The worm found a carrot.
  - b. The worm and the butterfly pulled out the carrot.
  - c. The butterfly came to help the worm.

Answer: \_\_\_\_\_

## QUESTION 6 / 3

Read the following text carefully.



**The dove and the ant**

One day an ant fell into a river. A dove, which was passing by, helped the ant get out of the water.

After that, a man saw the dove and tried to kill it. The ant, seeing what the man wanted to do, bit him on the foot. The man dropped his weapons because of the pain he felt and the dove managed to fly away and save its life.

1. Who fell into the river?

- a. The dove
- b. The man
- c. The ant

Answer: \_\_\_\_\_

2. Why did the ant bite the man?

- a. Because it was passing by.
- b. Because it wanted to save the dove.
- c. Because it wanted to annoy the man.

Answer: \_\_\_\_\_

3. What happened first?

- a. The ant saved the dove.
- b. The dove helped the ant.
- c. The ant bit the man.

Answer: \_\_\_\_\_

QUESTION 7 /6

On Sunday, the parrot went out with its family to have a walk in the jungle. Suddenly, they heard a very strange noise. All the animals that were walking by ran to see what was happening. When they arrived to where the noises were coming, they realized a monkey was chopping down some trees.

The parrot asked:

— Hello monkey. What are you doing?

The monkey answered:

— I'm chopping down some trees. I will chop them to make myself a new table.

Very worried, the parrot said:

— But you don't need to chop down trees for that. There are lots of dry trunks near the river. You can use those trunks to make your table.



After the monkey left, the parrot and the rest of the animals decided to plant the same amount of trees that the monkey had chopped down.

Later on, the monkey and the parrot got together to talk about what had happened.

The monkey felt very sad. He didn't know how important it is to protect the trees. Because of that, since that day he takes care of the trees so they can grow strong and healthy.

1. Why did the animals run to see what was happening?
  - a. Because they wanted to see the new trees.
  - b. Because they heard a strange noise.
  - c. Because the jungle was very dangerous.

Answer: \_\_\_\_\_

2. The parrot told the monkey that near the river:
  - a. There was a new table.
  - b. There were dry trunks.
  - c. There were very strong trees.

Answer: \_\_\_\_\_

3. What did the animals do after the monkey left?

- a. They went to take a walk in the jungle.
- b. They made a table for the monkey.
- c. They decided to plant other trees.

Answer: \_\_\_\_\_

4. Why did the monkey feel very sad?

- a. Because he had chopped down the trees.
- b. Because he had to take care of the trees.
- c. Because he had made a lot of noise.

Answer: \_\_\_\_\_

5. In the text, what does “a monkey was chopping down some trees” mean?

- a. That he was planting trees.
- b. That he was cutting trees.
- c. That he was taking care of trees.

Answer: \_\_\_\_\_

6. What is the main idea of the text you just read?

- a. It talks about the monkey’s new table.
- b. It talks about a walk in the jungle.
- c. It talks about taking care of the trees.

Answer: \_\_\_\_\_