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RESULTS FOR DEVELOPMENT

Information and Communication Technology (ICT) Strategies to Track Out of School Children Enrolment, Attendance, and Retention:

A Case Study of Digital Monitoring Solutions in Kenya and Uganda

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December 2020

Foreword

This case study is the latest contribution in a series of such investigations offered by Educate A Child (EAC). Each case study provides insight into education interventions that seem promising and are potential contributions to the knowledge and practices leading to successful outcomes. Previously published case studies can be found on the EAC website.

The timing for the publication of this case study coincides with the ongoing COVID-19 pandemic, which gives it particular significance in a way not anticipated when the initial investigation was planned. Information and Communication Technology (ICT) has taken on necessarily urgent and relevant attention as educators around the world grapple with new realities in how to reach and teach children. While this case study does not focus on applications outside of monitoring student enrolment, attendance and retention for out of school children, EAC does acknowledge the potential of transfer for these technologies for other uses, including student virtual and distance learning.

Since its inception in 2012, EAC has partnered with organisations using varying levels and sophistication of technology tools, especially in the monitoring of students. As time has passed, more and more partner organisations have embraced ICT in their monitoring and programming of education delivery. While this case study explores more deeply two such partner programmes in Kenya and Uganda, it by no means suggests that these are the only two that exist or are worth highlighting. The study does demonstrate, however, the possibility and applicability of digital monitoring tools in often challenging environment.

There are two programmes highlighted in this case study, Digital Attendance Application (DAA) in Kenya, and Last Mile Mobile Solution (LMMS) in Uganda. Each programme is described in detail, key processes are explained, findings and recommendations are presented, and lessons learned articulated. As with most education interventions, it cannot be overstated the importance of involving and integrating potential solutions with the local Ministry of Education, the body with responsibility for carrying out education for the country, and the best resource for continuing and sustaining successful interventions over time.

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Acknowledgements

The authors would like to thank Educate A Child for its guidance, collaboration, and financial support throughout this engagement. They thank the entire EAC team for input, with special thanks to Noor Muhammad, Hassan Ali Mohamed, Michael Cacich, Farida Aboudan, Joshua Maina, David Mumo, Lynn Mortensen, and Mary Joy Pigozzi. This report would not have been possible without the reflections and insights of UNICEF Kenya, World Vision Uganda, and government representatives from Kenya and Uganda, specifically from the Karamoja region. These stakeholders provided extensive inputs to the report and generously contributed their time during interviews. The primary authors of this case study are Mark Roland and Arjun Upadhyay.

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List of Acronyms

ABER-K	Addressing Barriers to Enrolment and Retention in Karamoja
ASAL	Arid and Semi-Arid Lands
C4D	Computing for Development
DAA	Digital Attendance Application
EAC	Educate A Child Programme
EMIS	Education Management Information System
HCD	Human-centered Design
ICT	Information and Communication Technology
IPs	Implementation Partners
LMMS	Last Mile Mobile Solution
MoE	Ministry of Education
NEMIS	National Electronic Management Information System
NoKET	Northern Kenyan Education Trust
OOSC	Out of School Children
PTA	Parent Teacher Associations
VEC	Village Education Committees
WERK	Women Education Researchers of Kenya

Section I. Executive Summary

Background

Although meaningful progress in increasing access to schooling has been made, far too many children remain out of school. This challenge is particularly acute in Sub-Saharan Africa, where 32.2 of the 59.1 million primary school-aged out of school children (OOSC) live.[1] This does not include millions of more children who are affected by closure of schools and learning spaces due to the COVID-19 pandemic.

In order to reduce the number of OOSC, Educate A Child (EAC) is supporting programmes in over 50 countries to overcome the barriers that prevent children from receiving a quality education through proven, innovative, and locally appropriate interventions.

This case study examines two such EAC-supported programmes, located in Kenya and Uganda that leverage ICT in order to monitor attendance and retention. The study aims to draw out the contributions that such ICT tools have made to programme successes, EAC's role in shaping the ICT programmes, and the lessons that these applications have for other using ICT tools to improve education services for OOSC.

The Programmes

Digital Attendance Application (DAA)

In Kenya, cultural and societal norms, gender biases, poverty, conflict, crisis, and child labour have all contributed to high rates of OOSC.[2] To reduce the number of OOSC 'Operation Come-to-School' was introduced in 2015 and implemented by UNICEF Kenya.[3] Between 2015 and 2019, the project enrolled 349,460 OOSC into schools in nine counties. Project activities focussed on addressing the barriers to enrolment and retention at school and community levels, with specific attention given to the barriers affecting girls, nomadic children, children with disabilities, and children affected by emergencies.

Central to the success of Operation Come to School has been the development of the Digital Attendance Application, which allowed for real-time data collection and analysis of newly enrolled OOSC. Teachers download DAA on their personal mobile phones, and use the low-specification application to record and upload daily class attendance to the central DAA database. Data verification occurs via implementing partners and county government administrators who conduct regular monitoring visits.

Last Mile Mobile Solution (LMMS)

Recent UIS estimates show that there are about 328,897 OOSC of primary school age in Uganda, with barriers to education including, a nomadic pastoralist lifestyle that promotes child labour, persistent food insecurity, high levels of poverty, long distances to schools, and inadequate school infrastructure.[4]

Gender-specific cultural norms such as forced marriage of young girls, child labour, and gender-based violence further impede access to education for girls.[5]

In response, a three-year, USD$4.9 million project funded by EAC, World Vision Korea, and the Korean International Cooperation Agency, Addressing Barriers to Enrolment and Retention in Karamoja (ABER-K) aimed to enrol and retain 40,000 OOSC across three districts in the Karamoja province.[6] It leveraged a combination of community engagement activities, capacity building, and provision of teaching and learning materials, infrastructure development, and ICT use.

The Last Mile Mobile Solutions (LMMS) was created by World Vision as a digital service delivery tracking system originally envisioned for emergency response operations. LMMS uses mobile technologies (smartphones and laptops as remote servers) to digitally register beneficiaries and track the distribution of aid.[7] In Uganda, LMMS was customised to the education sector and used as a student registration and attendance monitoring tool for the ABER-K project, implemented by World Vision.

[1] UNESCO UIS, "New Methodology Show that 258 Million Children, Adolescents and Youth are Out of School," Accessed December 2019. http://uis.unesco.org/sites/default/files/documents/new-methodology-shows-258-million-children-adolescents-and-youth-are-out-school.pdf

[2] UNICEF, Final Proposal for Qatar EAC Funds, Operation Come-to-School Kenya, 2014.

[3] Operation Come-to-School had a budget of USD$32 million with EAC funding 50% of it.

[4] UIS UNESCO. Latest data available is for 2013. Last accessed May 15, 2020. http://data.uis.unesco.org/

[5] Ibid.

[6] The original budget for ABER-K was USD$5.3 million. Due to changes in commitments midway through the project, the budget was revised to USD$4.9 million.

Lessons from DAA and LMMS

As explored in more depth in the case study, a number of lessons from the DAA and LMMS that may be applicable for ICT programmes with similar aims emerged. The experience in these two contexts also highlight lessons for EAC and similarly situated funding partners. These include the following:

Impact/Contributions

- DAA and LMMS systems have proven to be effective platforms for collecting and analysing data. The DAA and LMMS systems represent improvements over traditional paper-based monitoring and tracking systems in terms of efficiency, speed, and quality of data collected.
- ICT monitoring systems like DAA and LMMS help to provide a clearer picture of whether and how well programme activities are working over time, providing information on how to better target such activities.
- Data collected via DAA and LMMS have led to better school-based interventions, including improvements in the targeting of food aid at schools and targeted efforts to retain students who were showing signs of leaving school.

Contributing factors to successes

- Having strong local partners design and oversee the programme has proven critical to the success of the DAA and LMMS projects. For example, in the case of DAA, partnering with the Computing for Development (C4D) Lab at the University of Nairobi, a local innovation incubator, was more cost-efficient and effective than working with an international commercial firm; whereas having a trusted partnership with World Vision has lent credibility to the ABER-K programme in Uganda.
- Stakeholders in Kenya and Uganda highlighted the strong need for product sensitisation and pre- and in-service training in order to ensure government officials and teachers understand, are committed, and take ownership of the ICT systems.

Factors influencing scale

- The experiences of implementing DAA and LMMS underscore the need to think about scale from the start of the project. Although neither ICT system was implemented nationwide, almost all stakeholders considered the ICT systems to be "scalable" given the appropriate approach. Four principles emerge as potential levers to scale: simplicity in design, technically appropriate specifications, leveraging existing structures, and training.
- As with other forms of development initiatives, a key pathway to facilitating system-wide adoption of education tech programmes is integration into government systems.

EAC Contributions

- All stakeholders familiar with EAC's contributions noted that EAC served as a catalytic partner. Absent EAC's involvement, it is unlikely that LMMS or DAA would have developed these technologies at as large a scale or on as rapid a timeline.
- A key positive attribute of EAC was its flexibility: it provided the DAA and LMMS project teams with autonomy and agency to reach project objectives as they saw fit, taking into consideration contextual factors.
- One potential lesson for future engagements may be the importance in the timing of investments; in Kenya, the DAA may have more seamlessly integrated with the government's EMIS if it were developed concurrently.

[7] This includes food as well as non-food items.

Looking forward

The experience of the Digital Attendance Application and Last Mile Mobile Solution highlight the utility of using ICT to monitor attendance at the school level. They show the potential for such programmes to help collect more accurate, real-time data that, if leveraged properly, can be used to make efficient use of programmatic resources (e.g. helping to target resources for children at risk of not attending school). While well-designed ICT programmes will not, on their own, lead to the provision of more accessible, quality education; when paired with commitment from system-level actors and norms for using data for improvement, ICT can contribute to this aim.

Section II. Introduction

Despite significant efforts to reduce the barriers to education there are still 258 million out of school children, adolescents, and youth around the world. Of the 59.1 million primary school-aged out of school children (OOSC), 32.2 million live in sub-Saharan Africa.[8] Educate A Child (EAC) is supporting programmes in over 50 countries overcome the barriers that prevent children from receiving a quality education through proven, innovative, and locally appropriate interventions.[9] The use of Information and Communication Technology (ICT) is one strategy that EAC partners in Kenya and Uganda are using to capture enrolled OOSC and to track their daily attendance. This case study presents findings from the experience of two EAC-funded projects in Kenya and Uganda that have used ICT as a monitoring and reporting tool to track OOSC enrolment, attendance, and retention.

Roadmap

This case study is organised in eight sections. Following this introduction, we describe the study's methodology and limitations in Section III. We describe the context of OOSC in Kenya and Uganda and present the two programmes, UNICEF Kenya's *Operation Come-to-School* and the World Vision Uganda's *Addressing Barriers to Education in Karamoja (ABER-K)*, in Section IV. We describe the ICT strategies used in Kenya and Uganda in Section V, then present key findings in Section VI starting with a summary table that is followed by detailed findings. The lessons related to scaling up technology-enabled monitoring tools and recommendations for continued progress are presented in Section VII. Finally, the report concludes with a description of EAC's role and value added in the M&E systems in Kenya and Uganda.

Section III. Case Study Methods and Limitations

The case study is guided by eight research questions:

1. What is the impact of using ICT systems and tools on monitoring enrolment, attendance, and retention of individual OOSC at household, school, district or national levels, particularly in the contexts in which these tools are used in Kenya and Uganda?
2. How have these systems and tools stimulated or inhibited achieving the expected results of the projects?
3. How effectively have the partner projects used the acquired data for planning and decision making in relation to identification and enrolment of OOSC, tracking attendance and retention, and preventing student drop out?
4. What innovations (bold, unconventional) or changes in monitoring (compared to past and non-ICT based) practices, strategies, or policies are used or adapted by education providers at school, project, county or national levels?
5. What is the potential of these innovations for system-wide adoption and reaching a broader scale?

[8] UNESCO UIS, "New Methodology Show that 258 Million Children, Adolescents and Youth are Out of School," Accessed December 2019. http://uis.unesco.org/sites/default/files/documents/new-methodology-shows-258-million-children-adolescents-and-youth-are-out-school.pdf

[9] Educate A Child, "Our Approach", https://educateachild.org/about/our-approach

6. What are the types and size of resources – human, institutional, technical, administrative, financial, supply, communication - that contributed to the adaptation of the ICT tools for monitoring?
7. What are the lessons learned, challenges, and limitations in use of these ICT tools for improving education services for OOSC?
8. Was EAC's support valued by partners and users? Is there attribution to EAC for the customisation of the systems as perceived by the partners/users/local stakeholders perceive?

This case study applies an explanatory approach to answer the eight research questions by investigating how a programme operates and making causal inferences about reasons for success or failure.[10] This study draws on a combination of qualitative methods, including desk review of existing programme reports, semi-structured individual interviews, group interviews, and direct observation. Data was collected during a 2-week field visit to Kenya and Uganda in November 2019 during which the research team consulted 21 stakeholders, including representatives from state ministries of education and NGOs. Annex 2 contains an anonymised list of interviews.

Through purposive sampling, interviewees were selected based on stakeholder availability, feasibility of travel, and recommendations from UNICEF Kenya and World Vision Uganda staff. Care was taken to include diverse perspectives from different countries, organisations, departments and genders who could speak to various aspects of the selected ICT systems.

The primary limitation of this study is the lack of teacher perspectives. While teachers were interviewed in Uganda, they were not interviewed in Kenya. The timing of data collection in Kenya coincided with end of year examinations, which prevented the research team from visiting schools and capturing valuable user experience data. The researchers mitigate this issue by triangulating data within and across stakeholder interviews and key documents.

UNICEF Kenya/Nicola Simmonds

[10] According to USAID's Technical Note on Evaluative Case Studies (2013), an explanatory case study on program implementation investigates how a program operates and provides explanations by making causal inferences about reasons for success or failure.

Section IV. Background

OOSC in Kenya and Operation Come-to-School

There are nearly 1 million OOSC aged 6-16 in Kenya.[11] Cultural and societal norms, gender biases, poverty, conflict, crisis, and child labour have all contributed to high rates of OOSC.[12] These negative factors are pronounced in Arid and Semi-Arid Lands (ASAL)[13] where approximately 40 percent of Kenya's OOSC live and where poverty, child labour, ethnic conflict, and natural disasters have prevented hundreds of thousands of children from attending school.[14] In particular, OOSC in ASAL are especially vulnerable to structural inequalities across gender, disability, religion, and caste. These inequalities are exacerbated in a region where traditional values often prevent parents and community members from sending their children to school.[15]

To reduce the number of OOSC in ASAL regions, 'Operation Come-to-School' was introduced in 2015 and implemented by UNICEF Kenya and co-funded by EAC.[16] Between 2015 and 2019, the project managed to enroll 349,460 OOSC into schools in seven ASAL counties in Kenya: Garissa, Turkana, Marsabit, Wajir, West Pokot, Kajiado, Lamu and informal settlements of Nairobi and Mombasa.[17, 18], Project activities focused on addressing the barriers to enrolment and retention at school and community levels, with specific attention given to the barriers affecting girls, nomadic children, children with disabilities, and children affected by emergencies.[19] To improve traditional paper-based data collection techniques, Operation Come-to-School introduced Digital Attendance Application, which allowed for real-time data collection and analysis of newly enrolled OOSC.

UNICEF Kenya/Nicola Simmonds

[11] Kenya Education Management Information System, 2015. As seen in UNICEF Kenya's Operation Come-to-School Technical Reports.

[12] UNICEF, Final Proposal for Qatar EAC Funds, Operation Come-to-School Kenya, 2014.

[13] There are 23 ASAL counties in Kenya. They are Turkana, Marsabit, Mandera, Wajir, Garissa, Samburu, Isiolo, Tana River, West Pokot, Baringo, Laikipia, Nyeri, Meru, Tharaka, Embu, Kitui, Lamu, Kilifi, Kwale, Taita Taveta, Makueni, Kajiado, and Narok

[14] Ibid.

[15] Ibid.

[16] Operation Come-to-School had a budget of USD$32 million with EAC funding 50% of it.

[17] According to UN Habitat Programme definition and OECD's Glossary of Statistical Terms, informal settlements are 1) areas where groups of housing units have been constructed on land that the occupants have no legal claim to, or occupy illegally; 2) unplanned settlements and areas where housing is not compliance with current planning and building regulations (unauthorized housing).

[18] UNICEF Kenya, Operation Come-to-School Eighth Technical Report, July 2019

[19] UNICEF Kenya, Operation Come-to-School Seventh Technical Report, January 31, 2019

Community awareness was a crucial part of Operation Come-to-School. Twenty-five community mobilisation and enrolment drives were conducted in the nine focus counties with the active participation of community leaders, area chiefs, health volunteers and sub-county officials. Operation Come-to-School also engaged with youth and women groups, faith-based organisations, and parent teacher associations (PTA) to relay information on the importance of education. These messages were conveyed through local radio and TV, posters, microphone announcements, role plays, theatre, and community gatherings.

Project implementation was supported by a cast of partners including the national Ministry of Education (MoE), county governments, the Computing for Development (C4D) Lab at the University of Nairobi, and fifteen implementing partners[20] who carried out various community sensitization and mobilisation activities. Each implementing partner was allocated a geographic area and number of schools to work closely with.

Operation Come-to-School had seven strategic interventions:

1. Scale county-level enrolment and attendance drives, with the aim of improving demand for education.
2. Improve school infrastructure through classroom construction, solar lighting, WASH facilities, and classroom rehabilitation, with the aim of improving the supply of education for OOSC.
3. Strengthen in-school teaching and learning processes through training in child-friendly school approaches in low-cost primary boarding schools, with the aim of improving the quality of education for OOSC.
4. Provide mobile schools and alternative basic education for nomadic education, with the aim of providing children in ASAL and pastoralist areas with increased access to education for OOSC.
5. Support girls' schooling by expanding UNICEF's Northern Kenyan Education Trust (NoKET) girls' scholarship scheme, mentorship programme and reading interventions, with the aim of increasing gender equity in the provision of education for OOSC.
6. Strengthen county education systems to develop model county education interventions for OOSC that can be replicated across all forty-seven counties in Kenya through devolution.
7. Expand UNICEF Kenya's innovative SMS/web-based Education Management Information System (EMIS) Light monitoring and evaluation system to better collect, analyse and act on real-time data about OOSC.

As part of strategic intervention seven, Digital Attendance Application (DAA) was introduced as an innovative ICT system to track and monitor former OOSC. DAA sought to improve the traditional data collection process through improved quality and speed, and to support Kenya's EMIS systems, which collects only 60 percent of the educational data needed to inform national policy.[21]

OOSC in Uganda and Addressing Barriers to Enrolment and Retention in Karamoja project

The latest UIS estimates show that there are about 328,897 OOSC of primary school age in Uganda.[22] The Karamoja region in Northern Uganda has the lowest levels of enrolment, attendance, and learning indicators in all of Uganda. In the Kotido, Abim, and Kaabong districts of Karamoja, there are an estimated 63,000 OOSC.[23] Barriers to education in Karamoja include a lack of understanding of the benefits of education, a nomadic pastoralist lifestyle that promotes child labour, persistent food insecurity and hunger, high levels of poverty, long distances to schools, and inadequate school infrastructure. Gender-specific cultural norms such as forced marriage of young girls, child labour, and gender-based violence further impede access to education for girls.[24]

[20] World Vision Kenya, Norwegian Refugee Council, African Rangelands Trust, Life Skills Promoters, Women Educational Researchers of Kenya, Windle Trust International, Francis Xavier Project, Konacho Nomadic Education Foundation, Finn Church Aid, Rural Organization for Advocacy and Development, Aga Khan Foundation, Turkana Education for All, Special Olympics of Kenya, WASDA and ALDEF.

[21] UNICEF, Final Proposal for Qatar EAC Funds, Operation Come-to-School Kenya, 2014.

[22] UIS UNESCO. Latest data available is for 2013. Last accessed May 15, 2020. http://data.uis.unesco.org/

[23] World Vision Uganda proposal, "EAC Addressing Barriers to Enrolment and Retention in Karamoja (ABER-K)", 2016, pg. 7.

[24] Ibid.

A three-year, USD$4.9 million project funded by EAC, World Vision Korea, and the Korean International Cooperation Agency, Addressing Barriers to Enrolment and Retention in Karamoja (ABER-K) aimed to enrol and retain 40,000 OOSC across three districts in the Karamoja province: Abim, Kaabong, and Kotido. Implemented by Word Vision Uganda between December 2016 and December 2019, ABER-K targeted 89 primary schools (21 community owned and 68 government-aided)[25] of which 40 schools were in Kaabong, 27 in Abim, and 22 in Kotido.

The ABER-K strategy to identify, enrol, and retain OOSC included a combination of community engagement activities, capacity building, provision of teaching and learning materials, infrastructure development, and ICT use. Community engagement activities included project awareness sessions, education campaign songs, and education awareness events. Through the education voucher initiative, parents received learning materials and class uniforms for their children. ABER-K also refurbished classrooms and supported the construction of inclusive WASH facilities. Programme activities were implemented in partnership with Mother Care Groups, Village Health Teams, Churches, and Village Education Committees (VEC), and the district education departments.[26] ABER-K used Last Mile Mobile Solutions (LMMS), a digital monitoring system, to capture OOSC enrolment, attendance, and retention. ABER-K programme activities were guided by three strategic interventions:

1. Improve the school learning environment to reduce drop out
2. Reduce negative social, cultural, and economic barriers to enrolment and retention
3. Strengthen education systems

In 2017, ABER-K introduced Last Mile Mobile System (LMMS), an ICT based solution developed by World Vision, to improve the traditional process of tracking enrolment of former OOSC, which was found to be labor-intensive and prone to data entry errors.[27] LMMS combines software applications with custom hardware to digitise new student registration, data management, and reporting.

World Vision, Uganda

[25] Government-aided schools receive statutory grants (teacher salary, capital development grants, capitation grants, and instructional materials) at a rate determined by the Government. Uganda Education Act of 2008.

[26] Ibid.

[27] World Vision Uganda, EAC Partner Semi-Annual Technical Report, July 2017, pg. 27

Section V. Overview of the ICT systems and their key features

Operation Come-to-School and ABER-K used two different ICT systems to support the collection and analysis of enrolment, attendance, and retention data. Operation Come-to-School used the Digital Attendance Application (DAA) and ABER-K used Last Mile Mobile Solution (LMMS). We describe each ICT system in turn below.

The Digital Attendance Application

UNICEF Kenya in collaboration with the Computing for Development (C4D) Lab at the University of Nairobi designed the DAA to collect and monitor enrolment and attendance data in all Operation Come-to-School schools. The DAA system included a digital database of all students and an in-phone application that allowed teachers to fill out daily attendance forms electronically.

Traditional process for identifying OOSC

Operation Come-to-School used a variety of programmatic approaches to identify and encourage OOSC to enroll in school. At the start of the project, UNICEF Kenya conducted a baseline survey to identify OOSC in the seven targeted ASAL counties and two informal settlements in Nairobi and Mombasa. Survey results, which included information on why children drop out or do not attend school, was used to develop targeted activities to encourage enrollment and attendance by UNICEF Kenya. These included a door-to-door advocacy campaign and adoption of UNICEF Kenya's highly successful Child-to-Child enrolment drives.[28]

Traditional data collection process

The traditional approach to registering new students and collecting attendance data in Kenya is paper based. At school level, teachers fill out government issued attendance forms daily. For schools that were part of Operation Come-to-School, head teachers filled out a second paper-based tool – the Child Tracking Survey – which was developed by UNICEF Kenya to record and track the daily attendance of all students in the programme (see Annex 3 to view the Child Tracking Survey). The survey included a background sub-section for newly enrolled students (formerly OOSC) and a section where head teachers could input the daily attendance record for each student that month. These forms were collected monthly by Operation Come-to-School implementing partners (IPs) and manually entered into an Excel database. Every quarter, the implementing partner shared the Excel sheet with C4D Lab who uploaded the data into a central digital database that was accessible to stakeholders at the national level (Ministry of Education and UNICEF).

1) Teachers record daily attendance using paper-based form

2) Head teacher fills paper-based Child Tracking Survey

3) IP collects Child Tracking Survey and enters into excel database every month

4) IP shares excel database with C4D Labs every quarter to upload to digital database

[28] Other activities include building the capacity of school boards and local chiefs, identifying income generating activities at school level, cash transfer modalities to ensure the retention of students, and sensitising religious leaders and parents on the benefits of education.

DAA data collection process

DAA was developed to improve the efficiency of data collection and track attendance in real-time. Teachers were asked to download DAA on their personal mobile phones and use the application to record and upload daily class attendance to the central DAA database. Uploaded data was verified in several ways. At school level, implementing partners and government county administrators conducted regular monitoring visits to schools and cross-checked a sample of the uploaded DAA data with paper attendance forms.[29] At county level, every month district officers compared DAA records with their own paper-based attendance and enrolment forms.

At national level, UNICEF staff and C4D Labs continually scanned, cleaned, and organised DAA data in search for duplicate records, mistyped information, and other errors. All DAA administrators (head teachers, UNICEF, implementing partners, federal government, and C4D Labs) had access to the uploaded data as soon the teacher submitted the digital attendance forms through DAA.

1) Teachers record daily attendance using DAA

2) IP verifies sample of DAA data (monthly)

3) DAA administrators (Head teachers, UNICEF, IP, government, and C4D) view data on a real-time basis

Features of the DAA

The DAA had two user-facing features, the application itself and the central data dashboard linked to the central database.

The application allowed teachers to register new students into the project database, mark attendance of each student, and view specific analyses including class attendance reports, drop-out risk analyses, and provides an option to call guardians. All implementing partners and a subset of head-teachers under Operation Come-to-School were trained by UNICEF and C4D on the DAA system. DAA was also a low specification application (less than 2 megabytes) that runs on an Android operating service.[30]

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[29] It is important to note that DAA is a pilot and used only in schools under Operation Come-to-School. The paper-based traditional data collection system has not been replaced by DAA and is kept in place as manual back up. UNICEF Kenya, Operation Come-to-School Seventh Technical Report, January 31, 2019, pg. 19.

[30] Androids have a +80% share of the operating service market in Kenya (UNICEF, Operation Come-to-School, Kenya, Digital Attendance Presentation, UNICEF Kenya Country Office, 28 April 2018.)

The data dashboard was customised for UNICEF staff, government officials, implementing partners, and head teachers, with each stakeholder having a different data access feature. For example, implementing partners only had access to data from schools within their jurisdiction, while C4D Labs and UNICEF could view the entire DAA database. Implementing partners are strictly prohibited from publishing or sharing data in order to ensure child protection. The dashboard provided an overview of total enrolment and attendanc disaggregated by gender, implementing partner, school, and grade (see first image of Figure 4). Daily attendance trends could be aggregated on a daily and monthly level.[31] At the school level, head teachers were able to analyse daily and monthly attendance and enrolment trends by gender, as displayed in the second image of Figure 4.

The dashboard also provided biographical and guardian contact information for each pupil. It included an overview on daily and monthly attendance record with an in-built computation and drop-out risk assessment. A student was determined to be at risk if their attendance dropped below 50 percent. Dashboard alerts were visible to implementing partners and head teachers who would contact the parents of the identified at-risk students (parents did not receive notifications). This drop-out risk assessment[32] feature covered all students under Operation Come-to-School and not just the newly enrolled students.

Figure 1. Registering new students

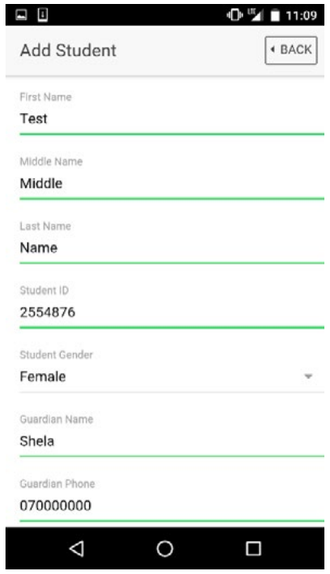


Figure 2. Marking attendance

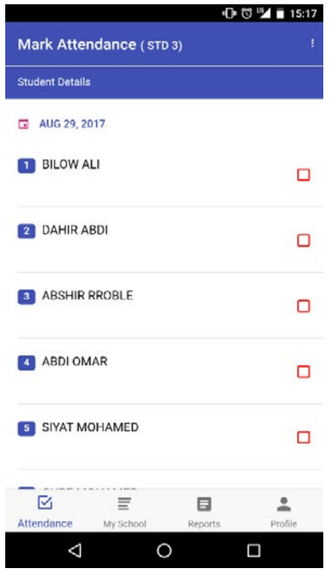
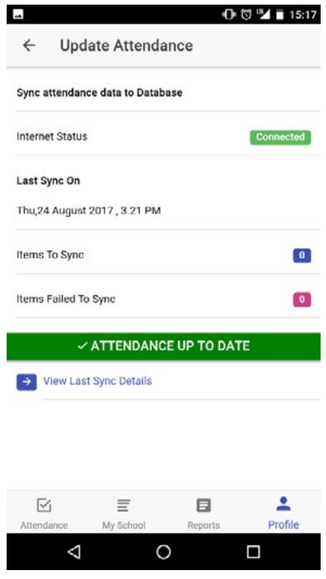


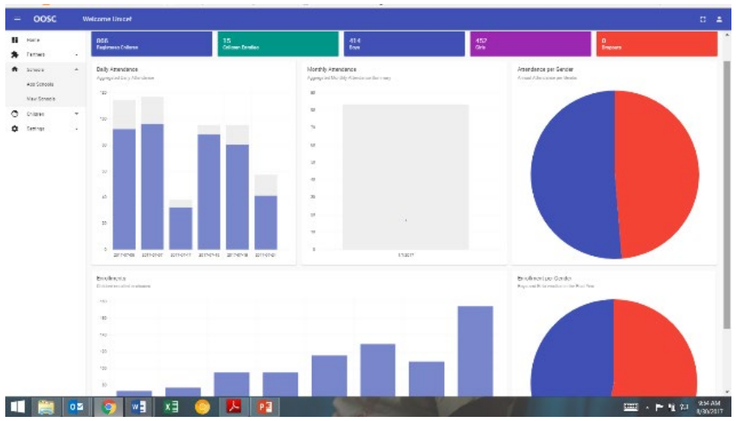
Figure 3. Online syncing

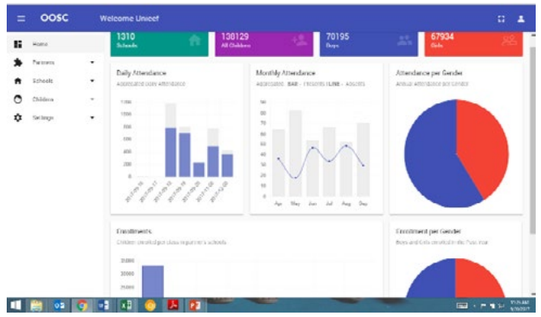


[31] UNICEF, Digital Attendance Application, PPT presentation, September 25, 2017.

[32] The drop-out risk assessment feature is not displayed in Figure 4.

Figure 4. Snapshots of data dashboard





Last Mile Mobile Solutions (LMMS)

The Last Mile Mobile Solutions (LMMS) was created by World Vision as a digital service delivery tracking system originally envisioned for emergency response operations. LMMS uses mobile technologies (smartphones and laptops as remote servers) to digitally register beneficiaries and track the distribution of aid.[33] In Uganda, LMMS was customised to the education sector and used as a student registration and attendance monitoring tool for World Vision Uganda's ABER-K project.

Traditional process for identifying OOSC

ABER-K relied on a variety of programme activities to identify OOSC. At the center of ABER-K's OOSC identification strategy was community engagement and support of Village Education Committees (VEC). VEC were community groups composed of individuals who were selected by the community and resided close to ABER-K beneficiary schools. World Vision Uganda provided training to VEC members on ways to identify OOSC and engage with their parents to encourage them to send their children to school. Once a parent agreed to enroll their child in school, the VEC member accompanied the child to school and ensured that they were registered and enrolled. Through school visits, the VEC monitored whether the newly enrolled students stayed in school. If students were found to have stopped attending school, the VEC conducted home visits to inquire why the child dropped out.[34] ABER-K provided VEC members with booklets so they could record the name, age, and parent details of every OOSC they identified in the village.[35] ABER-K staff collected these records from VEC booklets at the end of every month and they were used to verify school enrollment and registration records.

[33] This includes food as well as non-food items.

[34] In addition to supporting VECs, ABER-K provides education voucher incentives that give enrolled children scholastic materials and class uniforms. In partnership with district officials, ABER-K also conducts awareness sessions in bazars to raise awareness about the value of education, the dangers of negative attitudes and cultures towards girl child education and the need for parents to support their children's education.

[35] VEC booklets include information on OOSC age, gender, name and parental information.

Traditional data collection process

In Uganda, the traditional approach to registering new students and tracking attendance data is paper based. At school level, directors register new students by filling out government issued class registers with information on the name, age, gender of students and the date of enrollment. Once registered, teachers record the attendance of students through daily attendance sheets. ABER-K data enumerators collected the class registration sheets and daily attendance records twice every month. ABER-K enumerators filtered newly enrolled student data to identify former OOSC. Enrolment and attendance data were reviewed for data entry errors such as missing figures and duplication of student ID by ABER-K Monitoring and Evaluation officers in each district. Records of newly enrolled students were cross checked with data from VEC booklets. After data verification, the data was manually entered into the central Last Mile Mobile Solution (LMMS database.

LMMS data collection process

LMMS was introduced in Karamoja to improve the efficiency of tracking enrollment and to reduce the frequency of transcription errors, missing/invalid data, redundancy, and duplication of registration and daily attendance data that were found in the traditional paper-based collection process. After registration, LMMS used a mix of traditional and digital-based processes to track the registration, attendance and retention data of students.

The main difference between the LMMS and traditional data collection processes is during registration. Data enumerators who are trained in data collection, research ethics, data quality protocols, and respect for child rights used LMMS specific smartphones to register the student using the in-phone LMMS application.[36] The LMMS application allowed enumerators to register the student digitally, create a unique identifier, and enter biographical data such as name, date of birth, sex, and community into the digital system. Smartphone cameras were also used to take head shots of newly registered children. The LMMS architecture allowed registration data to be synced to the local LMMS server without the need for an internet connection.[37] The ability to sync data to the roaming server offline allowed ABER-K staff to view the data in near real-time. After registration, LMMS used the same traditional based approach to track daily student attendance.

1) Directors register new students using paper-based forms.

2) Teachers record daily attendance using paper-based form

3) Attendance records are collected by enumerators and sent to ABER-K

4) ABER-K staff manually enter attendance data into LMMS database

Data enumerators register newly enrolled students into the LMMS database

Teachers record daily attendance using paper-based form

Attendance records are collected by enumerators and sent to ABER-K

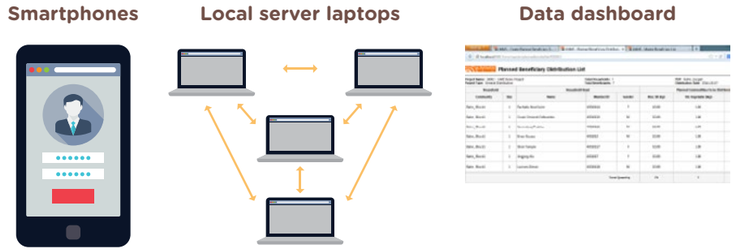
ABER-K staff manually enter attendance data into LMMS database

[36] World Vision Uganda, EAC Partner Semi-Annual Technical Report, January 2019, pg. 4

[37] A roaming server is a computer or computer programme, which manages access to a centralised resource or service in a network.

Figure 5. The LMMS new student registration process

Figure 5. The LMMS architecture in Uganda



Features of LMMS

The LMMS architecture in Uganda had three primary components: 1) smartphones pre-loaded with the LMMS application, 2) laptops that act as local servers, and 3) a data dashboard that is linked to the central LMMS database. Smartphones were provided by World Vision Uganda to all data enumerators who were trained to use the LMMS application and the smartphone. After registration, enumerators synced data to the local server without the need for an internet connection or a physical connection to the laptop. ABER-K has three laptops that are local servers for each of district of Abim, Kotido, and Kaabong. A fourth laptop acts as the master server linking all the data from the district laptops. The laptops do not need an internet connection to operate as all the data is connected and managed within the local servers.

The LMMS system also included data management, analytical, and customer-service features. These features were accessed through the LMMS application installed in the roaming server laptop. LMMS could produce custom-built dashboards and project reports that allowed for the disaggregation of data by district, school, gender, and age. The LMMS laptop application could identify duplicates by cross-checking name, age, sex, and district values. Data dashboards and other analytical features were not part of the LMMS application on smartphones. Expert LMMS staff provided on-site training to organisations using the programme, as well as in-service consulting, to troubleshoot any technical issues. Word Vision International had a team of LMMS specialists who were available to train programme officers and provide them with technical assistance.[38]

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[38] Last Mile Mobile Solutions, Support page, https://lmms.org/about-lmms/support/

Section VI. Key Findings

In this section, we present findings that explore, among other topics: the impact of these ICT systems and tools on monitoring enrolment and attendance of students and former OOSC, how projects have used the acquired data for planning and decision making, and what monitoring practices have been used or adapted by education providers at school, project, and national levels as a result of using ICT systems. A summary table of our findings and recommendations mapped to the research questions outlined in Section III are provided below.

Research question	Summary of key findings
• What is the impact of using ICT systems and tools on monitoring enrolment, attendance, and tracking of individual OOSC at household, school, district or national levels, particularly in the contexts in which these tools are used in Kenya and Uganda?	• DAA and LMMS systems have proven to be effective platforms for collecting and analysing data. The DAA and LMMS systems represent improvements over traditional paper-based monitoring and tracking systems in terms of efficiency and the quality of data collected. However, there are challenges related to the level of effort needed to collect data and design shortcomings that affected the use of the ICT systems. [See Findings 1 and 4 for more detail]
• How have these systems and tools stimulated or inhibited achieving the expected results of the projects?	• All stakeholders in Kenya and Uganda noted that it would have been challenging to meet project requirements of collecting daily attendance data without the use of the DAA and LMMS tools. As one implementing partner in Kenya remarked, "it would have been impossible for us to meet project requirements of tracking the daily attendance rate of newly enrolled OOSC if we had continued to use the paper-based system." [See Finding 1]. It is therefore important to note, however, that ICT systems in and of themselves do not lead to lower rates of OOSC. The structural nature of access barriers described in section IV, require holistic, systemic solutions that include shifts in parental attitudes and mindsets, financial support, and better infrastructure. ICT monitoring systems like DAA and LMMS help to provide a clearer picture of whether and how well programme activities are working over time, providing information on how to better target such activities.
• How effectively have the partner projects used the acquired data for planning and decision making in relation to identification and enrolment of OOSC, tracking attendance and retention, and preventing student drop out?[39]	• Although both programmes saw instances in which data was used at school and district levels to encourage attendance and create follow-up programmes targeted at at-risk students to prevent drop out, data is not being fully used to inform decision making and resource allocation at the national level. It is important to note, however, that the limited use of data for decision-making is a sector-wide issue, rather than specific to DAA and LMMS or Kenya and Uganda. [See Finding 3]
• What innovations (bold, unconventional) or changes in monitoring (compared to past and non-ICT based) practices, strategies, or policies are used or adapted by education providers at school, project, county or national levels?	• Implementing partners were able to adapt the ICT tools and link it with other programme activities. For example, the Aga Khan Foundation, one of the fifteen implementing partners in Operation Come-to-School, linked the use of DAA to its conditional cash transfer programme to schools. In Karamoja, LMMS has been used to help the World Food Programme (WFP) distribute the proper amount of food to schools. WFP uses the LMMS-sourced data on school attendance to make sure that they are matching food quantity with the number of students attending particular schools to avoid wasting resources. [See Findings 2 and 3]
• What is the potential of these innovations for system-wide adoption and reaching a broader scale?	• The experiences of implementing DAA and LMMS underscore the need to think about scale from the start of the project. Although neither ICT system was implemented nationwide, almost all stakeholders considered the ICT systems to be "scalable" given the appropriate approach. Four principles emerge as potential levers to scale: simplicity in design, technically appropriate specifications, leveraging existing structures, and training.
• What are the types and size of resources – human, institutional, technical, administrative, financial, supply, communication - that contributed to the adaptation of the ICT tools for monitoring?	• Having strong local partners design and oversee the programme has proven critical to the success of the DAA and LMMS projects. • In the case of Kenya, partnering with the Computing for Development (C4D) Lab at the University of Nairobi, a local innovation incubator, was more cost-efficient than working with an international commercial firm. [See Finding 2 and Recommendation 2 in the next section]. • Stakeholders in Kenya and Uganda highlighted the strong need for product sensitisation and pre- and in-service training in order to ensure government officials and teachers understand, are bought-in, and take ownership of the ICT systems.
• What are the lessons learned, challenges, and limitations in use of these ICT tools for improving education services for OOSC?	• Key success factors include the use of local partners; focus on training, and importance of product sensitisation among all stakeholders. • Where possible, leverage human centred design or rapid lean testing before going scale. [Recommendation 1] • It is critical that scale be considered early in the design of an ICT intervention. • As with other forms of development initiatives, a key pathway to facilitating system-wide adoption of education tech programmes is integration into government systems.
• Was EAC's support valued by partners and users? / Is there attribution to EAC for the customisation of the systems as perceived by the partners/users/local stakeholders?	• All stakeholders familiar with EAC's contributions noted that EAC served as a catalytic partner. Absent EAC's involvement, it is unlikely that LMMS or DAA would have developed at as large a scale or on as rapid a timeline. • EAC was seen as a flexible partner that gave the project team autonomy and agency to reach project objectives as it saw fit. • One potential lesson for future engagements may be around timing of investments; in Kenya, the DAA may have more seamlessly integrated with the government's EMIS if it was developed concurrent with it.

[39] It is important to note that ICT tools were not used for OOSC identification.

Finding 1. DAA and LMMS systems have proven to be effective platforms for collecting and analysing data.

The DAA and LMMS systems represent improvements over traditional paper-based monitoring and tracking systems in terms of efficiency and the quality of data collected.

Efficiency of data collection

ABER-K and Operation Come-to-School implementing partners credited the ICT systems with helping them meet project goals. One implementing partner of Operation Come-to-School remarked that "it would have been impossible for us to meet project requirements (goals) of tracking the daily attendance rate of newly enrolled OOSC if we had continued to use the paper-based system." The DAA system also allowed for Operation Come-to-School offices to **receive and view enrolment and attendance data faster than they would have using traditional data collection process.** As of January 2019, 91.6 percent of all children enrolled as part of Operation Come-to-School were registered on DAA.

In Uganda, ABER-K successfully enrolled, registered, and tracked the progress of 29,829 OOSC by using the LMMS system. Most ABER-K staff noted that LMMS simplified the registration process with one head teacher in Karamoja stating that "LMMS has made the work of enrolling children so easy. Before LMMS was introduced, the manual registration of new students took so much time (longer)." The mid-term evaluation of ABER-K concluded that the project's two monitoring and tracking tools - VEC data booklets and LMMS - have proven to be **"effective in tracking and monitoring the enrolment and retention of newly enrolled students."**[41]

Improved quality of data

There is consensus among interviewed stakeholders that data from DAA and LMMS are of higher quality than data from traditional paper-based data collection systems. In Uganda, the introduction of LMMS system allowed programme staff to identify the duplication of student profiles in the database, prompting World Vision to conduct a project-wide data verification initiative Programme staff were deployed to verify schools with suspected cases of student duplication. This effort improved the accuracy of ABER-K's database by correcting nearly 2,300 duplication cases. According to World Vision Uganda's January 2019 technical report, the data verification initiative sparked by LMMS "not only increased the quality of data but also enabled the project to identify risk areas in data collection and management, and introduce mitigation measures to ensure high data quality in the project life time."[42] Interviewed stakeholders cited that duplication issues in the paper-based registration method was due to the problems with generating unique student ID numbers. The ease with which the LMMS system correctly identified duplicates was noted by stakeholders in Uganda as a signal of improved data quality.

Ease of data analysis

The ability to easily analyse data collected from the digital systems was also noted by stakeholders as an improvement from traditional databases. The DAA database, for example, allowed implementing partners to aggregate data by gender and distance to school – a method of sorting and organising data that was previously tedious and laborious to undertake through traditional processes. The LMMS database also includes digital biodata on the student's age, gender, and location among others that allow for easy aggregated analysis.

Integration with programme activities

Both Operation Come-to-School and ABER-K rely heavily on a variety of community engagement and sensitisation strategies to identify, enrol, and ensure attendance of OOSC – these activities are the foundation for reductions in OOSC. It is therefore important to note that ICT systems in and of themselves do not lead to lower rates of OOSC. The structural nature of access barriers described in section IV, require holistic, systemic solutions that include but are not limited to shifts in parental attitudes and mindsets, financial support, and better infrastructure. What ICT monitoring systems like DAA and LMMS can do is help to provide a clearer picture of whether and how well programme activities are working over time, providing information on how to better target such activities. **While monitoring on its own can spotlight at-risk students, it is the combination of programme activities targeting barriers to education alongside effective monitoring that can lead to reductions in the number of OOSC.**

[40] The life of project OOSC enrolment target is 40,000. Based on the January 2019 report, 29,829 OOSC had been enrolled by the end of December 2018.

[41] Pazel Conroy Consulting Ltd, Mid-Term Evaluation, Addressing Barriers to Enrolment and Retention in Karamoja (ABER-K) project, December 2018, pg. 50.

[42] World Vision Uganda, EAC Partner Semi-Annual Technical Report, January 2019, pg. 17.

Finding 2. Having strong local partners design and oversee the programme has proven critical to the success of the DAA and LMMS programmes.

Importance of flexibility, dynamism, and strong engagement from local partners

Having a local partner as the application developer gave Operation Come-to-School a number of benefits. UNICEF staff noted that "C4D Labs were quick to respond to technical and usability questions from implementing partners and were able to accommodate visits to schools to demonstrate how to use the DAA tool."[43] C4D Labs has shown itself to be nimble in responding to user feedback and has demonstrated a robust understanding of local context. In addition, one UNICEF stakeholder remarked that "there was very good leadership from the University, with Chancellors engaged in the project."[44] UNICEF stakeholders **doubted that an international vendor would have provided the kind of value-of-money, understanding of local context, and flexibility that C4D Labs offered.** One official from UNICEF noted that "because C4D is a non-profit, their priorities were to have solutions and show impact. As a result, they are more cost-efficient than a commercial firm and they brought an impact-first perspective rather than a profit motive."[45]

Partners can enhance the credibility of ICT tools

In Uganda, strong buy-in of LMMS among stakeholders can be largely attributed to World Vision, an organisation that has built a **strong reputation for their high quality and valuable work in Karamoja.** For government officials in Uganda, LMMS is believed to be credible because it is implemented and managed by World Vision Uganda. In addition, World Vision ensured that government officials had a strong understanding of how the data was collected, organised, and managed. In addition, the fact that LMMS was a proven system that has been used in other sectors and contexts also provided stakeholders with more confidence in its utility. More specifically, the use of LMMS in humanitarian settings in Somalia and the Philippines (among other contexts), gave government and schools in Karamoja confidence that the LMMS could be used in the Karamoja context.

In Kenya, **DAA is considered credible due to the strong understanding of the data collection process by government officials, teachers, and programme implementers.** Because DAA was developed by C4D Labs of the University of Nairobi, an in-country institution that is technically part of the Ministry of Education, staff from the Ministry of Education consider DAA as being a product that was developed using local capacity, resulting in strong ownership of the product and understanding of its limitations by local stakeholders.[46]

Agency and entrepreneurship

Implementing partners in Kenya introduced innovative ways to incentivise uptake of DAA among teachers hesitant to use the application. According to interviews with UNICEF, "some implementing partners decided to be creative," with UNICEF supporting such agency and autonomy. For example, the Aga Khan Foundation, one of the fifteen implementing partners in Operation Come-to-School, linked the use of DAA to its conditional cash transfer programme to schools.[47]

Teachers concerned about the financial cost of using DAA from their phone were informed by an implementing partner that sending digital attendance sheets electronically required approximately the same amount of data as sending a WhatsApp message. To improve teacher uptake, implementing partners encouraged district education officers to visit schools to demonstrate government ownership. Although sensitisation efforts during the pilot phase certainly contributed to getting buy-in from teachers, schools visits reinforced the idea that DAA was part of the government's long-term plans.

[43] Interview with UNICEF stakeholders

[44] Interview with UNICEF stakeholders

[45] Interview with UNICEF stakeholders

[46] Local stakeholders include government officials, program implementers, and schools.

[47] There are two conditional cash transfer modalities implemented by Aga Khan Foundation. The first is targeted to households who are taking care of orphans. A cash amount of KES 700 is directly sent to a selected member of the household (parent or guardian) if the child attends school 80 per cent of the time per month. The second cash transfer modality is school based. Schools receives an amount of KES 400 per month for each child, based on 80 per cent school attendance for the month.
The link of DAA to cash transfers is linked to the school-based cash transfer modality (UNICEF 2019 Technical Report).

Finding 3. Although both programmes saw instances in which data was used to prevent drop-out and encourage attendance, there is limited scope to ensure that data is being fully leveraged for decision making and resource allocation.

School-level data

In Kenya, DAA data have been frequently used by project implementing partners. Staff from the implementing agency Lifeskills, for example, **have used DAA data to identify children at high risk of dropping out** (e.g. students who have less than 50 percent attendance rates). Once identified, programme staff study the family background of at-risk students and develop targeted approaches to prevent the at-risk student from actually dropping out.[48] Lifeskills have also used DAA to target home visits and follow up with parents of children who have inconsistent attendance rates or have dropped out. Another implementing partner in Kenya, Women Education Researchers of Kenya (WERK), used DAA data in meetings with the Ministry of Education and for their quarterly reports. Analysis of DAA data was used to present information on the number of newly enrolled students, percent of schools that are using DAA, number of DAA trained teachers, and the categories of technical issues that schools experienced using DAA.

District-level data

Stakeholders in Uganda have also used ICT systems to identify at-risk students. One district official described following up with schools about students who had missed class regularly after identifying them through the LMMS database. Information on students who have dropped out or have missed several classes is relayed to the Village Education Committee (VEC) who are deployed to visit households and communities to gather more information about the reasons for the child's absence.[49] LMMS was also used to help the World Food Program (WFP) distribute the proper amount of food to schools in Karamoja. WFP uses the LMMS-sourced data on school attendance to ensure that they are matching food quantity with the number of students attending particular schools to avoid wasting resources. In other instances, district officials use LMMS data to cross-check government data and have used LMMS data to plan for joint monitoring inspections by prioritising visits to schools that have high rates of dropouts.[50]

However, stakeholders in Uganda also cited constraints in gaining access to the data. A few district education officers remarked that LMMS data "needs to be more accessible to the government." Currently, district officials must visit World Vision offices in order to view the LMMS database. Despite strong buy-in of LMMS from government stakeholders, stronger ownership of the LMMS data collection and management processes may result in increased levels of data use. According to the mid-term evaluation of ABER-K, "the project should build the capacity of district education departments to independently collect and manage primary education data, including the developed LMMS, without necessarily depending on the partners and the Ministry of Education and Sports."[51]

World Vision, Uganda

[48] Using data from DAA, Lifeskills also developed a psychosocial programmes to address low self-esteem among identified high-risk students.

[49] LMMS does not have a defined threshold for when a child is determined to be at-risk of drop out. According to interviews with staff, risk assessments are based on a review of attendance records and the identification of students who have attendance rates lower than 90 percent.

[50] Joint monitoring inspections typically occur three times per term. They are conducted by the District Education Office and ABER-K staff.

[51] Pazel Conroy Consulting Ltd, Mid-Term Evaluation, Addressing Barriers to Enrolment and Retention in Karamoja (ABER-K) project, December 2018, pg. 73.

National-level data

There are few examples of the use of DAA or LMMS data in Kenya and Uganda at the national level, suggesting that the introduced ICT tools have had minimal impact on the use of data for decision-making. Although UNICEF and the Kenyan Ministry of Education have access to the entire DAA database and can analyse "big picture trends," stakeholders from the national government and UNICEF noted that more could be done to improve the use of data for decision making and resource allocation. Similarly, in Uganda, there is little evidence to suggest that the national government has used LMMS data for decision-making. The use of LMMS data is region-specific, with district education officers the primary users of LMMS data. It is important to note, however, that the limited use of data for decision-making is a sector-wide issue, rather than specific to DAA and LMMS or Kenya and Uganda.

Finding 4. Data collection challenges, turnover among key stakeholders, and design limitations have affected the use and effectiveness of ICT tools in achieving their intended aims of improving monitoring efficiency.

Despite the advantages and overall effectiveness of the DAA and LMMS platforms, the use of these ICT tools is not without several challenges. These include the following:

Labour intensity of data collection

Teachers who are part of Operation Come-to-School are asked to complete two sets of attendance sheets with the same information – the paper-based attendance sheet and the digital form for DAA. For teachers, particularly those teaching in large classrooms, completing two sets of attendance forms (manual and DAA) requires a longer roll call period than previously needed. As a result, the introduction of DAA was initially met with hesitation from teachers. One implementing partner remarked that "programme staff initially had difficulty convincing teachers to use DAA because it created more work for them." This sentiment was corroborated by other interviewed stakeholders.

The benefit of LMMS is its ability to rapidly create digital profiles of newly enrolled students that can be synced to the LMMS database after registration. However, it has not improved the efficiency or reduced the labour requirements of collecting daily attendance rates because LMMS still relies on traditional data collection processes to track daily attendance.

Turnover and training

Staff turnover in key project positions was noted in Kenya and Uganda. Under Operation Come-to-School, teachers are trained through a cascading trainer-of-trainers model where experienced head teachers subsequently train other teachers. In this model, the head teachers are particularly important, as they are selected by implementing partners for their technical knowledge of ICT and their ability to coach teachers on using the DAA system.

However, due to Kenya's delocalisation policy, which aims to advance teacher mobility and spread qualified teachers across the country to prevent regional inequities, head teachers trained in DAA are frequently moved to different schools or regions. Teacher turnover required implementers to spend considerable time training new teachers. In Uganda, World Vision highlighted data entry as a critical part of the data collection and management process that requires significant training to build the capacity of staff. High turnover has required World Vision staff to invest frequently in training new hires about data entry.

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Design limitations

Although there are a number of design features, including the ability to operate offline, that account for the contexts in which DAA and LMMS work, both applications possess design shortcomings. For example, teachers in Kenya are required to take attendance twice – once in the morning and again in the afternoon. DAA, however, is currently designed only to take attendance in the morning, potentially omitting the tracking of students who miss out on school in the afternoon. Technically, customising DAA to include an afternoon[52] attendance feature is simple. However, UNICEF staff remarked that asking teachers to use DAA again in the afternoon would require additional sensitisation efforts. Teachers already perform several activities for the programme and taking attendance in the afternoon would require strong buy-in from teachers.

In addition, not all teachers in Kenya have the smartphones required to use DAA. In schools where this was the case, implementing partners have asked teachers who have them to share their smartphones with other teachers.

In very remote areas of Karamoja, the lack of electricity to charge the LMMS hardware presented a significant challenge. Enumerators using LMMS explained that not having electricity to charge the remote server (laptop) and the smartphones had, at times, caused delays in student registration. On occasion, when smartphone batteries died, the date and time of new data entries reset to a default date (e.g. 01/01/2000), which required manual clean-up to fix.

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[52] 70 percent of lessons are conducted in the morning session and 30 percent in the afternoon.

Section VII. Discussion and Recommendations

Several factors underpinning the success of the applications emerge from the findings above, including the importance of committed local partners and a robust set of programme activities. Beyond these success factors, there are a number of other lessons of potential relevance to education tech programmes seeking to scale in an effective, sustainable manner. These lessons include the following:

Recommendation 1. Where possible, leverage human centred design or rapid lean testing before going to scale

The experience of the UNICEF Kenya programme demonstrated the ways in which early stage testing with a focus on end users can matter. In keeping with the Principles for Digital Development, guidelines that are designed to help integrate best practices into technology-enabled programmes, C4D Labs chose to use a human-centred design (HCD) process.[53] Human-centred design processes are intended to place a particular emphasis on the needs, capabilities, and constraints of those that will be using a particular product. During this pre-pilot phase, the C4D team tested beta versions of the tool with teachers, school administrators, and UNICEF personnel in an interactive manner, collecting qualitative information about the digital application, then leveraging that information for improvement. As part of the ongoing process of engaging users regularly and documenting their feedback, several insights emerged.

For example, the original testing of the DAA listed names of students alphabetically. However, the piloting process, leveraging HCD principles, highlighted that attendance in the classroom is usually taken according to sex, with boys called first, then girls (or vice-versa). As a result, the ordering of the names in the application was changed to reflect this norm; teachers did not need to alter their routine in order to collect data. The process used to collect data therefore mimicked the analogue process to ease the burden on teachers. **Such seemingly small design tweaks can have important implications for the usability of the application.**

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[53] Principles for Digital Development, Accessed January 17, 2020: https://digitalprinciples.org/

As another example, the application originally used a red font on the attendance page. However, teachers noted that the colour red conferred negative associations related to marking an exam; as a result, the application changed to the use of a blue font. By engaging in a human centered design process, the end application avoided potential user blockages while allowing designers to hit what one stakeholder called "the sweet spot between rigor of the process of collecting data and the usability of the application." **While human centered design does not guarantee that all potential challenges will be surfaced, it does provide an opportunity for tech-focussed applications to better position themselves for greater relevance for their intended users, leading to higher uptake and more sustained use.**

Recommendation 2. It is critical that scale be considered early in the design of an ICT intervention

Laudably, both UNICEF and World Vision designed their application with an eye towards potential scale, consistent with expectations of EAC. As with the principle of designing with the end user in mind, this choice was consonant with the Principles for Digital Development. Several features of the respective applications demonstrate **early consideration of questions of scalability and wider adoption,** in recognition of the fact that LLMS and DAA would initially be rolled out in targeted geographies.

One such element is the **simplicity** of their applications. In the DAA, users avail themselves of an intuitive platform. Rather than using an iris scan or fingerprint-based systems, designers decided to use DAA in its current form, given the complexity of these alternatives and the level of available technical infrastructure. This simplicity also extended to the process used to collect data; as noted above it mirrors the analogue process for data collection. This simple platform also allows for additional features to be built. Developers noted, for example, that it could easily be expanded to be linked to individual student performance data. As noted in Finding 2, the simplicity of the applications allows them to be adapted by implementing partners to, for example, linking the DAA to a conditional cash transfer programme.

Programme developers also **designed for the context** in which the digital applications would be leveraged. Contextual considerations informed the choice to use the Android platform, which has the largest market share in Kenya among phone providers, with nearly 80% of smartphone users having Androids.[54] Moreover, in order for teachers to consistently use the platform, it was important that little data be used, as teachers were using personal phones to upload information. In order to assuage users, trainers pointed out that uploading attendance information required less data than sending a single WhatsApp Message.

Designing for the context also meant ensuring that the applications in both Uganda and Kenya would have offline capabilities. Users in both contexts have limited connectivity, so a web-based platform would pose significant challenges. The DAA application, for example, stores information for 30 days, obviating the need for an immediate internet connection – though inconsistent electricity in rural areas remains a challenge.

Another key consideration for scale is also **cost and cost-effectiveness.** In order to facilitate the sustainability of the DAA platform, recurring costs have been kept low. UNICEF chose to leverage a database management system, meaning that no license had to be purchased. In addition, the decision to use Android phones means that new hardware rarely needs to be procured, an important consideration for sustainability reasons. Although ABER-K purchased new hardware to ensure offline data access and management through localised servers, the LMMS system allows for cloud-based access as well, and the LMMS application can be downloaded on Android devices. In environments where internet connectivity is widespread and consistent, hardware procurement is not necessary. However, the need to purchase and learn new hardware is a constraint in achieving sustainability in remote areas such as Karamoja.

Finally, both case studies demonstrate the **need for pre- and in-service training** in order to ensure government officials, teachers, and/or enumerators understand, are bought-in, and take ownership of the ICT systems – key elements to consider not only for scale but also sustainability. Although labour-intensive, providing trainings in Kenya and Uganda have helped project implementers meet objectives by ensuring key stakeholders (teachers in Kenya and data enumerators in Uganda) continue to understand the ICT tools.[55]

[54] Androids have a +80% share of the operating service market in Kenya (UNICEF, Operation Come-to-School, Kenya, Digital Attendance Presentation, UNICEF Kenya Country Office, 28 April 2018.)

[55] Pazel Conroy Consulting Ltd, Mid-Term Evaluation, Addressing Barriers to Enrolment and Retention in Karamoja (ABER-K) project, December 2018, pg. 73

Recommendation 3. As with other education initiatives, a key pathway to facilitating system-wide adoption of technology programmes is integration into government systems

As noted above, both DAA and LMMS have proven to be valuable applications insofar as they played a role in tracking attendance and identifying children who are regularly missing school, therefore initiating action that can prevent such children from dropping out. In order to boost the likelihood that they are scaled, a **careful consideration of if and how to systematise them through government channels is essential.** Indeed, several interviewed stakeholders spoke to their desire for clear linkages with government processes and procedures. Yet, the experience of DAA and LMMS to date demonstrate that such integration can be challenging.

For example, neither application has been fully integrated into existing government data management systems. Integrating these applications into national electronic management systems would allow OOSC data to be collected alongside other national level data in a unified fashion. Doing so would allow for regular analysis on trends in OOSC, thereby informing policymaking with evidence that can help target geographies or demographics of particular need.

A key reason why DAA and LMMS were not integrated into national management information systems relates to timing and sequencing. While DAA was launched in 2017, a new National Electronic Management Information System (NEMIS) was announced in late 2017 and the roll-out to schools started in 2018/19. As a result, the DAA system did not have the luxury of understanding the technical specifications of NEMIS, which would have allowed it to seamlessly feed into it (despite an interest on the part of UNICEF in doing this). As NEMIS is built, it is important that efforts be made to ensure alignment of systems – ideally with unique identifiers that track children over time. Similarly, the LMMS does not currently feed into the EMIS directly. Instead, the LMMS-produced information is manually uploaded by teachers. Stakeholders noted that direct synching of LMMS data would simplify the process and create efficiencies that would free up teachers to take on other tasks.

Encouragingly, at the time of the study, UNICEF was in discussions with national actors regarding lessons learned from DAA and how best to integrate it into NEMIS. Governmental stakeholders have professed an interest in learning from DAA and trying to feed it into NEMIS in order to improve its functionality and to ensure harmonisation of data.

In addition to merging with government-run management information systems, the **prospect of system-wide adoption would also be enhanced by further involvement of governmental actors at all levels in the collection and use of data to track enrolment and attendance.** This point is highlighted by the evaluation of the ABER-K programme, which recommends that "the project should build the capacity of the district education departments to independently collect and manage primary education data, including LMMS, without necessarily depending on partners and the MoES. Over time, the work that is being done by implementing partners to provide training and track and use data would ideally be transferred to district-level governmental officials, thereby strengthening ownership of the programme by the government and supporting the sustainability of the programme by not having to rely on – and finance – the activities of external partners. Furthermore, involving governmental actors may, in some instances, improve the effectiveness of efforts to increase uptake. For example in the early stages of roll-out, teachers did not use DAA regularly, therefore limiting its effectiveness. To overcome this challenge, one implementing partner in Kenya asked education officials to explain the benefits of DAA to teachers during organised sensitisation meetings. This strategy proved to be effective, with implementing partners coming to recognise that teachers were more likely to use DAA when it was introduced by government official rather than implementing partners. This shift in strategy led to improved rates of uptake of DAA among teachers.

Section VIII. EAC role and value added in the M&E systems

All stakeholders familiar with EAC's contributions noted that EAC served as a catalytic partner, both for the ICT programmes as well as the broader projects they support – ABER-K and Operation Come to School. Absent EAC's involvement, it is unlikely that LMMS or DAA would have been developed at as large a scale or on as rapid a timeline. Moreover, EAC served as a key advocate for developing digital applications, making the case for why such applications would facilitate high quality and regular data collection and support the broader aims of their respective projects. Their push to identify means of tracking individual students not only helps to achieve the aims of ABER-K and Operation Come to School but also may have systems-implications insofar as it demonstrates the achievability of such tracking on a large scale. National governments in Kenya and Uganda can build upon the lessons learned from these applications as they attempt to bolster efforts to collect more precise data.

In general, stakeholders lauded EAC for giving programme implementers agency and autonomy to achieve their stated enrolment targets in the way that they saw best fit. They appreciated this flexibility and trust, which empowered them to make decisions in the best interest of project beneficiaries. At the times of data reporting, they noted increased interaction with EAC staff to answer questions, but neither programme cited such interactions as overly burdensome. Stakeholders in both Uganda and Kenya also noted that site visits from EAC were helpful; for example, the September 2017 site visit to Kenya offered a critical, constructive perspective on project set-up and implementation.

Lastly, as it relates to EAC support, one key question pertains to the timing of the funding, particularly with respect to the support to the DAA. More specifically, given the importance of integrating ICT programmes into government systems, an alternative strategy would have been to fund the development of the DAA to coincide with the re-development of NEMIS, thereby ensuring - as noted would have been useful by several stakeholders - alignment and easy integration of the two systems. This would remove the need to retrofit the design of the DAA to fit the specifications of the NEMIS. While this may not have been feasible given funding windows or concerns about the timing of NEMIS development, it may offer a lesson for the future around aligning funding, where possible, to the timelines of related governmental initiatives.

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World Vision, Uganda

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Annex 2. List of Interviews

Kenya

1. UNICEF Kenya Staff 1. In-person interview with Operation Come-to-School manager
2. UNICEF Kenya Staff 2. In-person interview with Operation Come-to-School ICT specialist
3. UNICEF Kenya Staff 3. In-person interview with leadership
4. C4D Lab – University of Nairobi- Staff 1. In-person interview with technical specialist
5. C4D Lab – University of Nairobi- Staff 2. In-person interview with technical specialist
6. Women Education Researcher of Kenya Staff 1. In-person interview with Project Manager
7. Women Education Researcher of Kenya Staff 2. In-person interview with Data Analyst
8. Lifeskills Staff 1. In-person interview with Project Manager
9. Lifeskills Staff 2. In-person interview with M&E Officer
10. Lifeskills Staff 3. In-person interview with Field Officer
11. Ministry of Education Staff 1. In-person interview with Chief Economist
12. Ministry of Education Staff 2. In-person interview with NEMIS Project Manager

Uganda

13. World Vision Uganda Staff 1. In-person interview with ABER-K Field Office Manager
14. World Vision Uganda Staff 2. In-person interview with ABER-K M&E Officer
15. World Vision Uganda Staff 3. In-person interview with ABER-K Project Manager
16. World Vision Uganda Staff 4. In-person interview with ABER-K Data Enumerator
17. World Vision Uganda Staff 5. In-person interview with ABER-K Data Enumerator
18. Ministry of Education and Sports Official 1. In-person interview with Kaabong District Education Office
19. Ministry of Education and Sports Official 2. In-person interview with Kotido District Education Office
20. Primary School Teacher 1. In-person interview with Head Teacher in Kaabong school
21. Primary School Teacher 2. In-person interview with Head Teacher in Kotido school

Annex 3. UNICEF Child Tracking Survey

CHILD TRACKING SURVEY (For new enrolment)

Please complete section (A) prior to interviewing the individual pupil. Information for section (B) and (C) can be obtained from the child and/or their parent.

Survey Date: ...../...../..... Name of person conducting survey: .....

SECTION A: SCHOOL INFORMATION PROFILE

1. School name: ..... 2. School EMIS code: .....

SECTION B: NEWLY ENROLLED PUPILS 1.

Name (First, Middle, Last): .....

2. Admission number: ..... 3. Unique ID (EMIS/Year/Adm.Nr.)[1]: ...../...../.....

4. Gender: Male Female 5. Age: .....

6. Admission into Class (current year): Std 1 ☐ Std 2 ☐ Std 3 ☐ Std 4 ☐ Std 5 ☐ Std 6 ☐ Std 7 ☐ Std 8 ☐

7. Have you ever attended school (in the past)? : Yes ☐ No ☐ *(if no, skip the question 10)*

8. What was the name of your previous school? .....

9. Which class were you in? ECD Std 1 ☐ Std 2 ☐ Std 3 ☐ Std 4 ☐ Std 5 ☐ Std 6 ☐ Std 7 ☐ Std 8 ☐

10. If child was not attending school, what was the reason? (Tick up to three)

No money (school costs are too expensive)	Insecurity / safety concerns	Early marriage or pregnancy
Too far / difficult terrain (distance or accessibility)	Have to work	Other:
Not necessary (school not important)	Disability	

Other examples include: include failed exams, violence in school (corporal punishment, bullying) too old, too young, lack of WASH facilities, schoo full, no birth certificate, etc.

11. Name of parent/guardian ..... 12. Phone number: .....

SECTION C: PUPIL PERSONAL INFORMATION

1 How will you come to school (mode of transport)?
walking ☐ bus/matatu/car/boda boda ☐ bicycle/cart ☐ other ☐

2. How long will it take you to reach from your home to school?
Less than 30 min ☐ 30 min to 1 hour ☐ 1 to 2 hours ☐ more than 2 hours ☐

3. Who do you live with? Father AND Mother ☐ Father OR Mother ☐ other guardian ☐

4. How many people live with you in the same house? .....

[1] 9 digit EMIS Code/4 digit Year of admission/admission number

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