

# Learning Analytics for Last Mile Students in Africa

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**ABSTRACT:** Although technology is ubiquitous in the homes and classrooms in the Global North, access to educational technology in the Global South is still out of reach for much of the population. This work describes an educational technology system, Yiya Air Science, to reach “last mile” students in Africa (specifically rural Uganda) where access to basic computers or smartphones is rare. Courses are deployed on a system of radio broadcast and basic texting phones (USSD). Yiya Air Science has deployed three courses focused on STEM skills and entrepreneurship as key learning outcomes. In this research, we are adopting state of the art learning science and engineering principles with fine-grained data collection and a continuous improvement loop.

**Keywords:** Global South, Rural Africa, Phone, USSD, Multimodal Learning

## 1 INTRODUCTION

Yiya Solutions, Inc.<sup>1</sup> is building and studying an offline virtual classroom created for adolescent learners in rural Uganda that provides STEM education through radio broadcasts and basic keypad phones called Yiya Air Science. Their remote learning model does not require access to the internet, smart devices, or other advanced technologies. Thus, using simple interactive technologies, radio broadcasts, and keypad phones eliminates both physical and financial barriers that prevent many African children from receiving any sort of educational experience. Yiya Air Science ultimately aims to provide equitable access to higher quality education through interactive technologies for all Ugandan children living in under-resourced and remote communities. The curriculum develops resilience and problem solving in African youth through its advanced STEM educational content. Our primary goal in this research is to develop a research driven implementation with rich learning analytics and strong feedback loops for learning centered system improvement.

## 2 THE EDUCATIONAL TECHNOLOGY

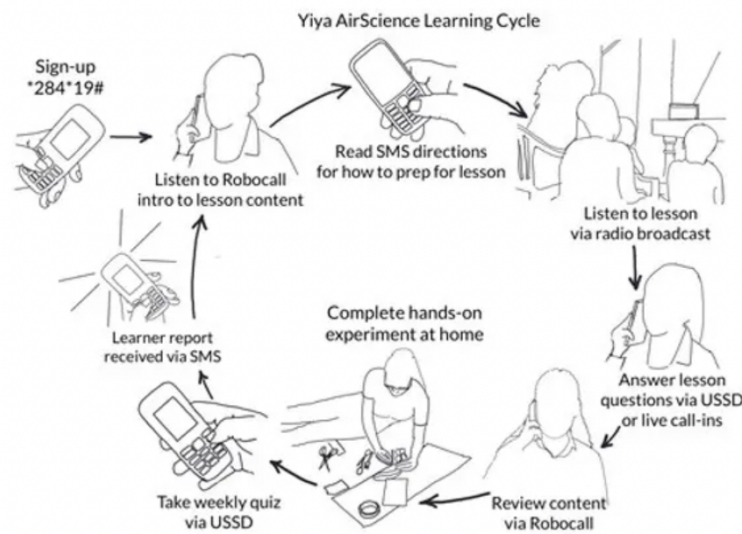
The STEM content within Yiya Air Science aims to increase learner competencies and passion in pursuing STEM education. The course is structured to provide learners with skills to solve problems in their local communities and to make a change within their developing communities. The STEM content within the curriculum centers on students performing hands-on technological experiments at their homes, creating innovative quotidian products, such as solar food dryers and pedal powered

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<sup>1</sup> <https://www.yiyasolutions.org/>

washing machines. Yiya Air Science's course content is taught to students on a daily basis, each week focusing on a step to construct the final innovative product. Every week, instructors inform students on the science and engineering methods behind each step in building the final product, interacting with students through daily questions, product building exercises, and creative examples related to the product. The duration of each course is about twelve weeks, beginning with an initial baseline survey and finishing with a final assessment and endline survey.

Even today, radios and basic keypad phones are the most commonly used and present technologies in Ugandan households, with 74% of these households possessing radios and eighty-seven percent possessing keypad phones (BBC Media Action, 2019). These technological items are also shared amongst neighboring households, making them easily accessible for all learners in Yiya Air Science. The modality of how learners utilize the interactive technologies, radios and keypad phones, used in Yiya Air Science is shown in Figure 1, and can be informed by the use of multimodal learning analytics (Liu et al., 2018). Each day, students will turn on the radio to access and listen to the channel that provides the lesson. Students prepare the materials needed to conduct a step in building the final product of the course, and follow the instructions on completing the step given by the instructor speaking in the radio broadcast. Instructors ask questions for listeners to answer through live call-ins or through the USSD application. Learners also complete weekly formative quizzes on phones.



**Figure 1: Students listen to lessons on the radio and interact with the course through USSD texting.**

At the end of the course, students are given a final summative assessment to review their knowledge and developed skills from the course. Instructors give the final assessment on radio by reading out each question and the answer options. Students provide their answers through the USSD application. Students who receive a passing grade of 75% or higher receive a certificate. Students are also encouraged to complete the endline survey to provide data on the impact of the course, compared to the baseline taken at the start of the course.

While courses are available to anyone, Yiya Air Science is designed for youth in low-resourced regions that are typically ruralistic, which prevent access to a multitude of basic educational opportunities. Youth living in rural areas must overcome cumbersome obstacles in order to receive the most basic

educational experience. These obstacles include long physical distances from homes to the closest school, which may be hazardous for these children to travel, and expensive schooling fees (Uchidiuno et al., 2018). Children's labor is also unavoidably needed for subsistence farming, as it is the main source and income for many families living in rural regions, and other core responsibilities at their homes. Girls are more likely than boys to be kept home to fulfill household responsibilities. Living in rural areas also restricts youth from accessing technical resources, including internet connectivity, let alone basic educational resources (Uchidiuno et al., 2018). A survey conducted in 2017 showed that only 4% of Ugandans had used a computer in the previous 3 months (UNHS, 2018). Yiya Air Science is centered around youth in Northern Uganda who struggle from these impediments, compounded by decades of internal conflict. There are twenty-two million children in Uganda, of which only thirty-five percent of those children complete primary school (UNHS, 2018). The lack of education for younger Ugandan children is concerning, as forty-six percent of Ugandan children of ages six through twelve have never attended school. The impact of COVID-19 has only significantly decreased the number of children who attend schooling institutions.

### 3 LEARNING ANALYTICS

Three different courses have been created and run in Yiya Air Science. Each course focuses on building a STEM based tool that can be used by the student. These include a solar food dehydrator, solar cell, and pedal-powered washing machine. All USSD phone data is logged to a SQL database backend that allows for robust analytics on the fine-grained interaction data. In addition, we apply multi-modal analyses that line up the student interactions with the radio broadcast similar to research on log data and video (Lui et al., 2019). This allows us to understand which broadcast the student is listening to and provide interventions to students through texts or robocalls. We examine a number of learning analytics including tracking learning by demographics and are building models to predict engagement and dropout utilizing existing model designs (Chatterjee et al., 2020) with the goal of adding interventions to encourage students to continue in the course.

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