THE EFFECTS OF ELM SOFTWARE ON THE LEARNING MATHEMATICS IN KENYAN ELEMENTARY: A BRIEF REPORT ON THE 2019 STUDY.

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Use of ELM software to teach and learn mathematics
in grade-one Kenyan classrooms. A brief report of the 2019 study.

While countries in Sub-Saharan Africa have made signficant progress towards achieving universal school enrollment, millions of students lack basic literacy and numeracy skills (WorldBank, 2018). For instance, only one in five third-grade students from this region have second-grade reading and mathematics skills, and less than one third of students can solve a simple subtraction problem by the end of primary school (Uwezo, 2016). Just as in the case of literacy, for children to succeed academically solid foundations in mathematics need to be laid by grade three. The Kenyan context, in which the government mandated one digital device per child in elementary grades, made it possible for us to test if the need for early numeracy intervention can be addressed by introducing Emerging Literacy in Mathematics software (ELM) in teaching and learning mathematics.

ELM is an online interactive tool created to aid elementary school teachers with mathematics instruction. ELM's mathematical activities are designed to help students grasp fundamental mathematical skills and to avoid "math anxiety". Explorations and building from concrete examples to an understanding of abstract symbols and concepts are the main instructional strategies driving students in the ELM environment. A collection of support materials is offered to teachers to assist them in using ELM with their students and are in sync with Kenya PRIEDE curriculum. Topics covered include Counting, Comparing, Adding, Subtracting, Decomposing, Place Value, Geometry (shape recognition), Data (sort data/generate tables & graphs to represent data), Pattern Recognition and Number Line. Figure 1 is an example of the ELM student environment.

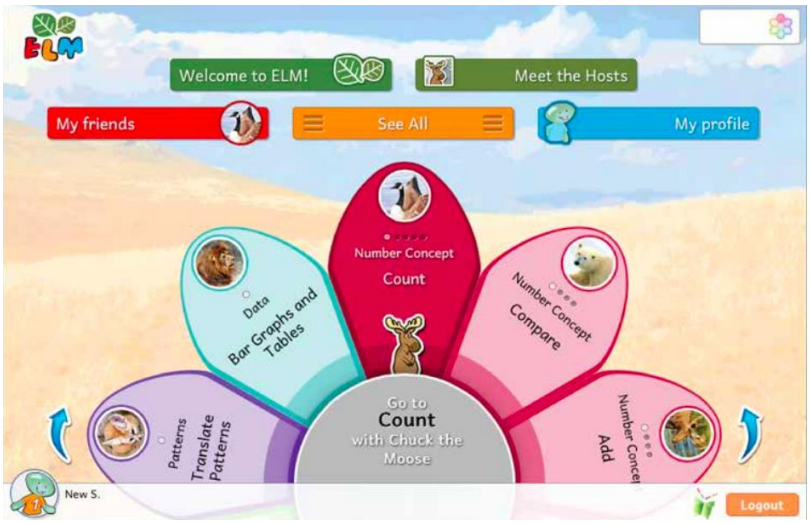
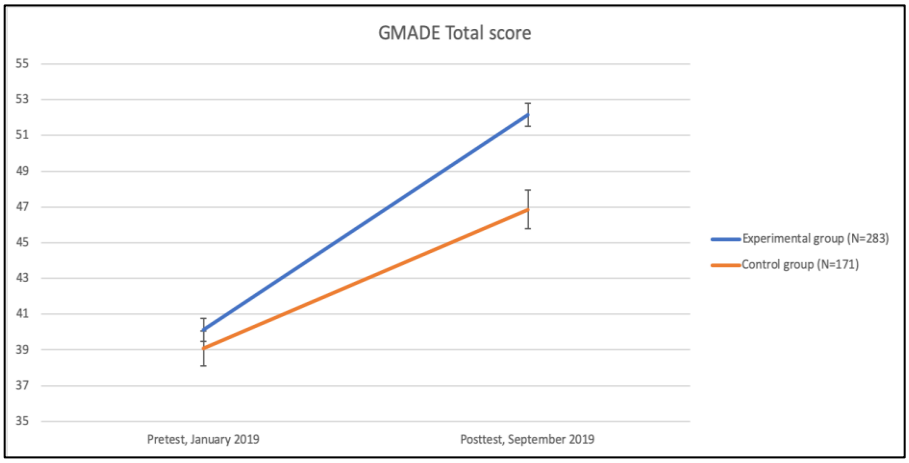


Figure 1

This is the brief report of the 2019 study conducted in 14 grade-one classes from 7 primary public schools in Mombasa area. Designed as a strong test of ELM, it unfolded in the authentic conditions of Kenyan classrooms. For several months, 9 teachers used ELM to teach mathematics curriculum to their grade-one students whereas 5 teachers continued teaching in a regular fashion. To measure student learning gains, we assessed all students at the baseline using a standardized test of mathematic achievement (GMADE), and then tested them again at the conclusion of the intervention. To learn about math instruction, we also collected data from the teachers and their classrooms.

Overall, the outcomes of this study suggest that the use of ELM significantly improved young students' mathematical abilities over those of students from the control group. Graph 1 illustrates the average total gains of students after they worked in dyads or triads on ELM activities in the school computer lab during one weekly math lesson for a few months. Notably, the effects of ELM instructions were most important on the complex skills where students took language and concepts of mathematics and applied appropriate operations and computation to solve word problems in a number of areas such as algebra, geometry, measurement, money, numeration, quantity, sequence, statistics and time. On this set of skills, the magnitude of difference between the groups was .71 implying that, after learning with ELM, an average student will improve by 27 percentile points and score at the 77th percentile.

Graph 1



This study also revealed shifts in the teachers' perceptions about their practice. At the conclusion of the intervention, the ELM teachers reported having gained more confidence in mathematics and comfort in teaching mathematics with computers. On average, their level grew from "somewhat unconfident" to "confident" in early mathematics and from "neutral" to "very comfortable" in ability to use computers for teaching math. Such shifts were expected since ELM to support teachers' classroom instruction and to ensure they cover important mathematical concepts and deliver them to students correctly and confidently. Math content traditionally taught in grade-one classes was diversified as a result of the ELM intervention. In addition to concepts of counting, adding and subtracting, teachers also focused on teaching geometry, place value and patterns. A multi-vector support system was put in place to aid with the implementation of ELM. This includes initial one-day training in ELM pedagogies, professional development workshops held once per term, regular school visits of external LTK+ Ambassadors and assistance offered by the school-based Ambassadors. Consequently, teachers enjoyed the autonomy to integrate ELM as they see fit with the curriculum and PRIEDE-based grade-one mathematics syllabus.

The results of this study complement and extend prior research on ELM conducted in both Kenya (SESEA report, 2017) and Canada (Lysenko et al., 2016). They unequivocally demonstrate the potential impact of the ELM computer software on developing essential numeracy skills important in both STEM and non-STEM disciplines later in school and after graduation. As teachers experience the rewards and challenges of using of ELM, ongoing support to teachers becomes a key to successful implementation, teacher comfort, and student success.

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