Measuring the Learning Benefits of Electronic Teaching Aids in Low-Resource Classrooms

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ABSTRACT

Though there has been widespread enthusiasm to leverage technology to strengthen low-resource classrooms, to date very few programs have documented rigorous benefits from such interventions. In this paper, we describe an exploratory evaluation of the use of pre-packaged electronic teaching aids, consisting of presentation slides and multimedia content, in a government school in peri-urban India. Via a small-scale randomized controlled trial, encompassing 2 subjects, 72 students, and a 3-week intervention, we measure the impact of the electronic content on learning outcomes. In one subject (English), we find that the intervention significantly increases student scores, measured both by a custom exam as well as a standard unit test in the school. However, in another subject (science), we do not find any evidence for learning benefits. Despite its small scale, this study shows that it is possible to bolster learning in low-resource schools via use of electronic teaching aids, thereby justifying investment in larger scale trials in the future.

1. INTRODUCTION

Despite a long history of applying technology to bolster education in the developing world, very few programs have been rigorously evaluated to measure the impact on learning outcomes [3]. Moreover, the rigorous evaluations that do exist often fail to find strong effects [2] or are inconclusive [1] with respect to technology's role in improving learning in low-resource classrooms.

In this work, we advance the dialogue on the role of technology in resource-poor schools by measuring the learning benefits of an electronic teaching aid. The intervention, championed by an NGO called CLT India, is to supplement K-12 classrooms with display of pre-packaged electronic content. The content consists of presentation slides[1] with rich animations and multimedia elements, and is tightly synchronized with the state-level curriculum. As illustrated in Figure 1, the electronic content is intended as a supplement to a traditional lecture at the blackboard. The expected benefits are that the multimedia elements can increase student engagement; that the structured lessons can help teachers to emphasize key points; and that some information, such as pronunciation of English or real-world science experiments, may be conveyed better in the recorded content than by the local teacher, who often has limited training.

[1]An example of the content is available at http://bit.ly/ZrzBPj

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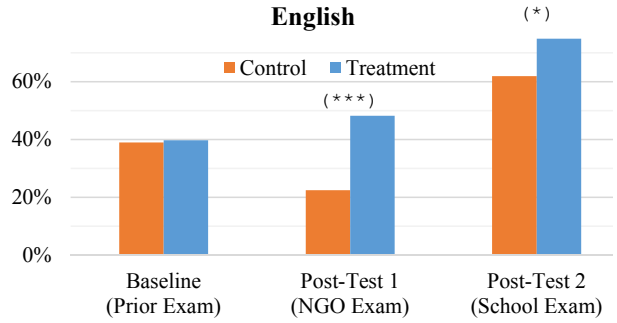
Figure 1: Example use of electronic content by a math teacher.

The NGO's intervention is gaining considerable traction, with over 700 schools and 2,000 teachers utilizing the content. Content has been developed to match the complete government syllabus for science, math, and English grammar for grades 5 through 10, and is available in both English and Kannada. Expansion to additional grades, subjects, and languages is underway, with several large-scale deployments planned. However, despite this momentum, until now there has not been a rigorous evaluation as to whether using the content can boost learning outcomes in a classroom. In the long term, our aspiration is to perform a large-scale evaluation which assigns the intervention to a random subset of schools and tracks long-term learning outcomes relative to the control schools. However, in advance of this ambitious project, we wanted to undertake a simple feasibility study that demonstrates that it is possible for the intervention to have a measurable impact on learning, even if it is in a single school and over a short period of time.

This paper provides such a validation via a small scale randomized controlled study, spanning two subjects and three weeks of intervention in a primary school in peri-urban India. Results show significant learning benefits in one of the subjects (English), but no measurable impact in another subject (science). Though further research is needed to understand the factors mediating the benefits of the electronic content, this study nonetheless provides important evidence that the intervention can have a measurable impact on learning in a real-world setting.

2. METHODOLOGY

Our experiment focused on a single government school in Bangalore. We focused on two 9th grade subjects (English and science) and introduced electronic content for a period of three weeks. The school (Government Jakkur High School) was Kannada medium and enrolled 75-100 students per grade. Most students were from lower-income households, encompassing farmers, auto drivers, watchmen, and daily-wage earners; household incomes ranged from about Rs. 1500 (USD 25) to Rs. 3000 (USD 50) per month. The school



*** *Significant at* $p < 0.0001$*;* * *Significant at* $p < 0.01$

Figure 2: Results in English subject.

randomly assigned students to two sections when they entered 8th grade; each section contained 35-40 students. Students sat with their section throughout the school day, while teachers rotated between sections; hence, all students received a given subject from the same teacher.

We introduced the electronic content in one of the school's sections and used the other section as a control group. The content was used by three teachers; on average, they were 46 years old, had been teaching for 22 years, and had completed a B.A. / B.Sc. and B.Ed. The NGO conducted a half-day training for the teachers, spanning content navigation as well as how to integrate the content with blackboard teaching. They also set up the classroom to display the content, including installation of a laptop and 40-inch LCD monitor.

The primary metric of our evaluation was student learning outcomes, which was measured with three exams:

(i) **Baseline exam**. The purpose of this exam was to ensure that the sections were balanced in terms of overall ability. For this purpose, we retrieved test scores for the school's final exam from the prior year (before the intervention). This exam was designed and graded by teachers at the school.

(ii) **Post-test 1 (NGO)**. This exam was designed by teachers and content developers at the NGO, and was administered immediately after the intervention period. Most questions were short-answer and probed general knowledge about the subject. Some questions deliberately used examples similar to the electronic content, in order to test the sensitivity to examples used (an effect we consider in our analysis). The exam lasted for 30 minutes. It was graded by teachers at the NGO, who were blind to treatment condition.

(iii) **Post-test 2 (School)**. This exam was the normal unit test for the school, designed and graded by the school's teachers. It covered a total period of 8 weeks; the intervention occurred during weeks 5-7. Thus, the exam tested some things that were not addressed by the intervention.

To better understand usage of the content, a representative from the NGO observed every class period in the intervention group.

3. RESULTS

The content was deployed from January 17 to February 10, 2014. The content was used in about 70% of the class periods, with about 25 slides displayed per period. During two periods, the classes were combined (due to scheduling constraints) and the control group was exposed to the content. The sections had similar rates of attrition over time, and similar rates of absenteeism on examination days.

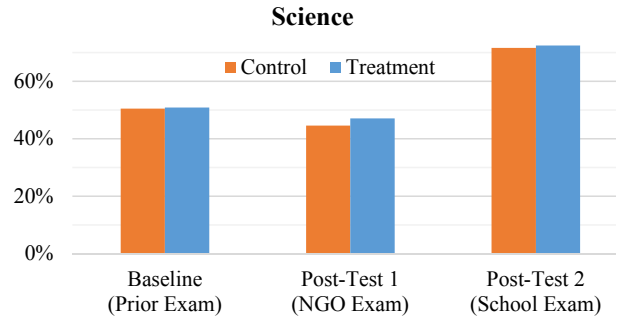


Figure 3: Results in science subject.

Exam scores are illustrated in Figures 2 and 3. In both subjects, the baseline exams were comparable across sections, confirming that the two sections had similar starting knowledge and ability. Following the three-week intervention, the section using electronic content saw a 2.1x improvement in scores on the NGO's exam ($t(70) = 7.56, p < 0.0001$) and a 1.2x improvement on the school's unit test ($t(68) = 3.07, p = 0.003$). The smaller impact on the unit test was expected, as it covered topics beyond the scope of our intervention. Detailed analysis of the NGO exam questions shows that the benefits offered in English were significant for both general questions (intervention score = 49%, control score = 28%, $t(70) = 4.41, p < 0.0001$) and questions with examples similar to the electronic content (intervention score = 48%, control score = 13%, $t(70) = 7.44, p < 0.0001$). However, in science, both sections performed similarly on the follow-up exams (Student's t-test, not significant).

Our observations of the classrooms revealed that the content led to high engagement by teachers and students, especially when multiple-choice "quiz" questions were displayed on screen. As illustrated in Figure 1, students came to take ownership of the computer, preparing it for use by the teacher and advancing the slides during class. In part due to this involvement of students, there were very few technical challenges, apart from a handful of power cuts.

4. DISCUSSION & CONCLUSIONS

In this exploratory study, usage of electronic content over a period of 3 weeks was found to significantly improve students' learning of English in a low-income government school in peri-urban India. However, the same benefits were not observed in a science class. We attribute this difference partially to the teacher; the English teacher was more enthusiastic about using the content and integrating it with the classroom. The difference may also be linked to aspects of subject matter, including its amenability for audio/visual representation and the actual representations used.

While this study illustrates the potential of electronic content to improve learning outcomes, it also has some limitations. The short intervention period of 3 weeks (with 3 teachers) is insufficient to demonstrate sustained learning gains. In addition, each period of usage was observed by an NGO staff member, which may have influenced the teacher's performance. We look forward to building on the results of this exploratory study via larger and long-term studies in the future.

5. REFERENCES

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