Designing for a Rural Online Learning Community

Aditya Vishwanath
Georgia Institute of Technology
Atlanta, Georgia
avishwanath6@gatech.edu

Neha Kumar
Georgia Institute of Technology
Atlanta, Georgia
neha.kumar@gatech.edu

ABSTRACT
As mobile technologies and internet connectivity fast penetrate rural, low-resource settings, there is tremendous potential for them to enable accessible and large-scale learning environments. We present findings from a needs assessment exercise conducted at after-school classrooms in three villages in Tamil Nadu (India). Using a tablet application as a design probe and iterating on its design through a six-week qualitative study, along with interviews with different stakeholders, led us to an enriched understanding of how the application of mobile technologies could contribute towards the design for a rural, online learning community. We conclude with our plan for future work to this end.

Categories and Subject Descriptors
H.5.0 [Information Interfaces and Presentation]: General

Keywords ICTD; HCI; learning; India

1. INTRODUCTION
As mobile technologies and internet connectivity become more affordable, they are increasingly being brought into formal and informal learning environments to leverage the role they might play towards engaging children and targeting learning outcomes. In 2004, Wang et al. contributed a methodology for centralized packaging of content appropriate for rural schools [7]. In 2009, Kam et al. explored the potential of mobile phones for language learning, targeting children in rural India [5, 6]. More recently, Cross' research has studied the potential of technology to target more effective learning outcomes [1, 2]. Our research builds on this work by contributing a study that introduces (and iterates on) a tablet application to assess the responsiveness of students and the receptiveness of tutors to this technology, both as a diagnostic tool and learning aid. Based on our findings, we make a case for our future work – an educational intervention that entails the design for a rural, online learning community.

2. METHODOLOGY
We conducted our needs assessment exercise in three learning environments (after-school classrooms) situated in the villages of Uthiramerur, Vadanallur, and Kulathakarai in the Kancheepuram district of Tamil Nadu (India). We obtained access to these classrooms through our collaboration with a local NGO that has been implementing learning projects in the state since 1996. We held interviews with 5 classroom tutors and 5 NGO staff, interacted with all 60 students (evenly distributed from third to sixth grades), and conducted participant observation over a period of six weeks. The goal was to understand the students' interaction with learning technologies introduced by their tutors in class. We used TFL – a mobile application developed by the NGO – as a design probe [3]. TFL was shown to the students in the after-school classrooms on a US$70 Android device. Students in two of three classrooms were taught how to use the device and application at the start of the study. In the third classroom, the application was introduced after two weeks to offer a point of comparison. Students engaged with the device on a one-to-one basis. We solicited feedback from students and factored it into the design through iterations every two weeks.

ACM DEV 2015, December 01-02, 2015, London, United Kingdom
ACM 978-1-4503-3490-7/15/11.
http://dx.doi.org/10.1145/2830629.2835219

3. LEARNING MATH ON TABLETS
TFL was designed by the NGO to present third to sixth graders with math problems, the content of which was determined in collaboration with local tutors (employed by the NGO). The user interface (UI) was designed to be minimal for first-time tablet users (all students were well-versed with basic/feature mobile phones but not computers or the internet). The first prototype of the app had a home screen with four test options – *Addition*, *Subtraction*, *Multiplication*, *Division* – and a *Summary* tab. If a student selected one of the four topics, she/he would be prompted to type out her/his name and then be presented with eight/nine problems on that topic, with increasing difficulty. Each screen had one problem on the selected topic on top, a number pad below, and a large rectangular box for rough work. There were two additional buttons, one for *backspace* and one for *next question*. Students received immediate feedback, with applause for a correct response and a squeak otherwise. By selecting the Summary button on the home screen, the tutors were able to view (and edit/delete) the names and responses of students who had taken the above tests. Tutors used these summaries to assess areas that needed attention for each student.

4. UNDERSTANDING CONTEXT
We now describe lessons we learned from our needs assessment exercise and motivate our future work in this space.

4.1 'Appropriate' Technology
The UI of the app was designed to be minimal in order to avoid any confusion/fear on the students' part, especially since most of them had never used a tablet before. We did not find the students confused by the design in any way. They also adapted quickly to minor application updates such as changing the rough work area to occupy more screen space in lieu of less space for the number pad. Our takeaway was that tablet applications, designed appropriately, could be a suitable technological medium for these children to interact with and learn on. Tutors also showed no hesitation in using and experimenting with a new platform. Since English was the medium of instruction at each of these schools (even though conversations largely took place in Tamil), there were no linguistic barriers to be concerned about either.

4.2 More Avenues for Exploration

The comfort level of tutors became apparent when we found that they had downloaded free third-party educational content from the Google Play store. One of the tutors mentioned that she had heard from someone about a good English learning application on the Play store, so she downloaded it and gave it to students to play with. Other tools downloaded by the tutors included apps that taught students how to count large sets of objects and conduct household science experiments. Students also displayed an interest to use the tablet to do their homework. The tablet thus came to be used more as a learning and practice tool, as against its original purpose to facilitate aptitude testing and skill-set analysis. We view this as significant, revealing the potential of such applications for teaching *and* learning in rural Indian settings.

4.3 Opportunities for Personalized Learning

Tutors utilized the app data to maintain an official record of each student's individual progress, and began to assign content that was appropriate for each child. Each student's progress was independent of the rest of the class's progress. Over six weeks, tutors prepared a comprehensive record of the required math focus areas for each student, and gave the student appropriate math problems for practice in class and as homework. Students thus received a personalized curriculum and engaged in self-paced learning of math for six weeks.

Opportunities for personalized learning are particularly relevant here because the students are from different grades. Tutors are cognizant of each student's grade and background and therefore appreciated being able to test whether the different students' performances were satisfactory. Sixth graders did ask for more challenging problems and we will factor this in for future work.

4.4 Improved Learning Outcomes

None of the students had been exposed to a tablet prior to this study. As mentioned, one classroom of students was not given the tablet for the first two weeks. Midway into our study, at the end of three weeks, we found that students in the classrooms that were provided with a tablet practiced more math than the students who did not have the tablet, all else unchanged, and the students in the former group were able to verbally convey the procedures to carry out three digit multiplications with more confidence than the students in the latter group.

The tutors told us that after the introduction of the tablet in the classroom, students engaged themselves in more group discussions on difficult math problems, and voiced their opinion to the class more often than before the tablet was introduced. There were multiple instances of self-organized learning, where students sat in a circle around the tablet, and tried to collaborate and solve a difficult math question, or a technical glitch in the software, with varying success levels. The NGO's hope was that with this model of learning, the increase in classroom engagement would reduce dropout rates, which remains a serious concern.

5. FUTURE WORK

Given our lessons from the six-week study, we propose a holistic model to incorporate mobile technologies into a larger online learning environment. Our model is centered on the design of a rural, online, learning community with participation from students, tutors, NGO staff, and curriculum designers. We will continue work with the same NGO and classrooms to ensure that our lessons remain applicable. This NGO has been operating after-school classrooms in 35 villages in the vicinity, including the three we studied. The tutors voiced the intent of connecting students across these classrooms to a centralized database of educational content that is both engaging for students and valuable for tutors. The NGO is keen to support this intent.

At the core of this social learning environment will be a forum for questions, ideas, announcements, and general threads of interest. The content would – by design – be open-source and comprised of a repository of books, texts, videos and other supporting educational material, such as curricula and testing guides. Tutors would have the ability to curate the content so that it is within the broad guidelines of being meaningful, updated, and inclusive. The platform will allow for hosting video sessions, where students and tutors may participate in discussions and collaborations. Tutors will organize and lead lecture sessions and review discussions in such a space. Students will be able to use this space for team projects, personal discussions, and interactions with students from other schools and/or social backgrounds.

From a technical standpoint, the platform must have the capability to support large volumes of data and large numbers of users in the presence of low data transfer speeds and low rendering capacities of browsers and machines. The platform must also exist as a real-time communication system, with cloud storage. We note that 3G connectivity was available consistently across these villages although it may not be reliable enough for video sessions. We will start with sharing text and audio content. Tasks requiring larger bandwidth will be postponed until better connectivity is available – potentially via "small-scale cellular networks" [4].

A curriculum with an online platform for communication and collaboration as a central component can facilitate partial self-organized learning along with supervised learning, especially in after-school learning spaces. An online platform could grant users a large resource and the ability to experiment with new strategies backed by scientific data. This model provides a support system for a student to fall back on and derive additional support from outside the classroom. Students may use this community as a tool to aid them in academic as well as co-curricular development such as moral skills, leisure reading, and exposure to new hobbies, ideas, and innovations. We hope that provision of meaningful content will overcome the constraints imposed by poor infrastructure to address existing gaps in formal and informal learning environments, thereby overcoming the last mile challenge in offering effective education.

6. REFERENCES

[1] Cross, A., et al. "VidWiki: Enabling the crowd to improve the legibility of online educational videos." *(CSCW '14)*.

[2] Cross, A., et al. "TypeRighting: combining the benefits of handwriting and typeface in online educational videos." *(CHI '13)*

[3] Gaver, B., Dunne, T., and Pacenti, E. "Design: cultural probes." *Interactions* 6.1 (1999): 21-29.

[4] Heimerl, K., et al. "Local, sustainable, small-scale cellular networks." *(ICTD '13)*

[5] Kam, M., et al. "Designing digital games for rural children: a study of traditional village games in India." *(CHI '09)*

[6] Kumar, A., et al. "An exploratory study of unsupervised mobile learning in rural India." *(CHI '10)*

[7] Wang, R., et al. "The Digital Study Hall." Computer Science Department, Princeton University, Tech. Rep. TR-723-05 (2005).