Abstract — In our research we have designed pedagogy for Low Cost Tablets (LCT) to enhance early grade reading in multi-grade classrooms in rural areas of India. The use of LCT helps meet the challenge of education in areas where there is a lack of qualified tutors and shortage of computing resources. The program has been implemented with (N=38) students in tribal areas of Kerala. Reading was the most common problem with the primary children, while mathematics and reading comprehension was a major challenge for children who were in middle school. Our pilot study students were able to learn faster on their own without requiring formal training due to the ease of use and the touch based interface of LCT, and they liked the idea of repeating lessons as many times as they wished. Teachers were trained in the use of LCT for assessment and early intervention and effective ways to bring up the reading skills of the students. Our findings confirm that LCT is a powerful motivator in education and has a huge potential to address the issue of school dropouts. Our proposed pedagogy for LCT and findings will be of interest to educational policy makers who are looking at LCT options such as Aakash tablets to improve literacy levels among early grade learners.

Keywords — rural, education, early grade reading, technology enhanced learning, tablets, immersion

I. INTRODUCTION

With the intensifying network expansion of information communication technologies (ICTs) across the world, educationists are keen on making the most of the advantages of contemporary technology to catapult the literacy levels amongst the world’s underprivileged population [1]. Technologies such as Low Cost Tablets (LCT) have emerged as a necessity in the present day context and have had a noteworthy influence on education.

Nearly 10 percent of the apps fall into the education category, predominantly, elementary education. Factors for tablets gaining acceptance for learning are portability, low-cost and an interactive interface. The touch-screen is convenient for children and easy for them to learn to navigate. [2]. Both developed and many developing countries are initiating tablet based learning regimes for their toddlers and children. Our definition of LCT is a 7 inch tablet running Android OS with a price range of $100-$150.

India has approximately 65% of its population living in rural areas. The Right to Education (RTE) act provides free and compulsory education to every child between 6 and 14 years, whether they reside in an urban or rural society. Access to education for rural communities is able to generate awareness about various issues that are commonly observed in rural areas: poverty reduction, control of disease, augmenting employment prospects, the importance of education, and increasing the literacy rate [3]. In spite of the RTE act, which aims to keep children in school, absenteeism is epidemic in rural areas of India due to a variety of reasons such as; being unable to read and keep up in school, taking care of younger siblings, lack of uniform or the school being too far from the village. The proportion of all children in Class 5 who read a Class 2 level text has declined by almost 15 percentage points since 2005 [4].

India is showcasing tremendous potential for collaboration of education with technology. India, being an IT global talent hub, has high expectations for technological solutions in education. Inspired by the global experimentation of tablet based learning, the Indian Government launched its much publicized “Worlds Cheapest Tablet - Aakash” in 2012. But it was met with scepticism [5]. However, by March 2013, 100,000 Aakash devices were being used in schools, and the order for the third generation of Aakash tablets is expected to be for around 5 million devices.

Other brands of LCT are also being rolled out in many states. For example, Uttar Pradesh, where the government wanted to eradicate the “digital divide” of the rural and urban areas, proposed the distribution of 2.5 million LCT for students completing their matriculation. The potential benefits of LCT are tremendous in India [6]. This can be attributed to
the huge population residing in backward and rural areas. The Indian population cannot afford expensive gadgets. LCT can prove to be a boon for rural students as their entire curriculum can be loaded into one tablet and it can be reused year after year, unlike text books. However, it requires an appropriate infrastructure of internet, technology and computer literacy [7]. Tablet based learning can help India to overcome challenges as highlighted by [8]; poor growth rate of the sector (16 % as compared to the global average of 27%), faculty shortage and lack of accredited institutions. Aakash is a promising LCT project which aims to link 25,000 colleges and 400 universities in an e-learning program. If well-executed, it can work remarkably well for fostering literacy and better quality of education across India, especially in linking rural students with superior faculties and universities [9].

Educating both boys and girls in a community through LCT can bring about the awareness needed to tackle various social and health issues [10, 11]. Many interesting educational topics on various social and health awareness subjects for children are already available. Education that is imparted to children through schools acts as a ‘social vaccine’. These children effectively spread information to the public and thereby act as an effective preventive tool against various social vices.

Adolescents (10-19 years) represent a key human resource that can and must contribute to the overall development of India. In the future, these children will become mothers and fathers and will guide their own children. Children must be provided with adequate knowledge to prevent them from becoming victims of social ills, or perpetuating social ills. At this tender age they are ready to be shaped according to the learning that is imparted to them.

In rural primary education, LCT can be used to show digital textbooks, storybooks, animated pictures, videos or cartoons. Children understand and learn efficiently with the help of these visual aids. Using visual aids in schools makes classes efficient, less time-consuming, and creates a motivating flow of discussion [12]. This can spread the right message and reduce the school drop-out rates commonly observed in rural schools.

Our case study describes our pilot work in one of the most backward tribal areas in the hills of Idduki, Kerala where we work with low achieving and out of school tribal children directly in their settlements.

II. LITERATURE REVIEW

In a recent UNESCO report on the state of global education, India had the dubious honor of being number four of the ten countries with the highest rates for out of school children. When the children do attend class, they are usually not able to perform to the expected standard level and are discouraged. Thus, without intervention, these children often drop out and are condemned to a life as low paid often unemployed, day laborers like their parents.

The review of the “One Tablet per Child” project of Thailand highlighted an impressive array of the merits of mobile learning pedagogies [13]. Though the Thai government distributed 800,000 tablets so far, there are still many challenges to confront. It is the world’s largest tablet experiment in the world, thus, handling its magnitude is a challenge in itself. Also, catering to the needs of the students as well as the teachers’ training to enable a favorable classroom environment and also formulating assessment tools for evaluating progress and learning outcomes poses severe challenges [14]. The Thai government plans to extend this project gradually to higher classes as well. However, it is too primitive to adjudge the effectuality of the project [15].

A study of the role of tablet computers in the educational system of China shows that K-12 students, faculties and administrators favor the technological application, but a need for a better understanding of the new technology is noted [16]. Moreover, many feel that there is an ardent need to focus extensively on comprehending the structure of the educational system, the learning support system and instructional patterns, and then align the design and development of the subsequent software and technological resources.

More and more Chinese students are using the Mobile-assisted language learning (MALL) for learning English in the informal set-up outside of the classroom [17]. The tablets are ideal for independent language learning as they offer an interactive, collaborative and ubiquitous learning environment.

However, tablets are subject to a lack of affordability for the students, which is yet another challenge. Nedungadi & Raman describe the architecture of an adaptive learning system that offers personalized assessment and learning on both personal computers (e-learning) and mobile devices (m-learning) and showed that student engagement and learning on m-learning is comparable to e-learning [19]. The EduPad project proposed interactive literacy software on tablets to learn the alphabet [21].

The One Laptop per Child (OLPC) initiative active in many countries is indeed a commendable initiative. However, two of the drawbacks in the context of India are the higher cost of OLPC compared to LCT which run on free Android software, and the lack of support for Indian languages. The OLPC research project in Ethiopia, where children living in remote illiterate villages with no teachers, no exposure to print, and no access to technology, confirmed that the children were able to learn to use tablets without instruction or guidance. The village was provided with a solar panel and one village member was taught how to use it to supply power for the tablets with over a 100 applications. Children were able to use many of the applications at the end of a few months.
III. AMRITA RITE PEDAGOGY

Amrita Rural India Tabled enhanced Education (RITE) is an educational intervention and literacy program that offers technology enhanced learning (TEL) in rural India using solar charged tablets to overcome the lack of dependable electricity, internet or computer labs. We use a combination of new technology and pedagogy with a focus on individual assessment and evaluation, teacher training and increased parental awareness. Traditional stories using animation and video featuring Same Language Subtitling (SLS) and local language audio will help the children easily relate to stories and quickly learn to read. These techniques cater to visual, auditory and kinesthetic learners.

Our pedagogy integrates local educational context, folk stories and songs from the region and culturally relevant and local language. Besides the educational content delivered to students, we envision the tablet as being an excellent tool to deliver teacher-training on teaching strategies and methods. Teacher training lessons have been included in the LCT in video format for this purpose. The tablet is a fun and easy learning tool because children are able to learn how to use it intuitively.

A. Bloom's revised taxonomy for LCT

The apps are based on the objectives from our adaptation of the Bloom's revised taxonomy for tablet based learning (Fig. 1.). The Online Labs for Science experiments pedagogy (OLabs) is a complete learning environment based on Bloom's taxonomy, including theory, procedure, tutorial videos, animations and mathematically modeled simulations [20]. Students who used the OLabs pedagogy had a significantly increased STEM learning.

B. Technology Overview

Our program runs on Android Open Source Project (AOSP) and can access millions of apps via Google Play. We developed a custom launcher application with an intuitive design that facilitates category based viewing of apps, and within category listing apps by levels like Easy, Medium and Hard and by age groups. (Fig. 2.)

We have developed a unique android based multilingual writing app. (Fig. 3.) This application enhances the writing experience to be more like a game, rather than a regular writing exercise. An intuitive and graphic-rich user interface, together with real time evaluation, audio and visual feedback, makes this an effective one of a kind application to learn alphabets in various languages including Hindi, Malayalam, Tamil, and English etc. Real time evaluation is achieved using character recognition algorithms which are further modified to deliver improved performance for LCT and are trained to recognize Indian languages with good accuracy. With the help of short animations, pictures and audio, students can learn how to write each letter, correlate a letter to a word or an object and pronounce it correctly listening to the audio.
apps with age inappropriate contents and accidental changing of the device settings, etc.

Educational applications are rich in graphics, multimedia and 2D/3D animations which provide a good learning experience, but a serious downside of LCTs is the limited processing capability available for the application execution. RITE apps are developed following standard industry practices, adopting suitable algorithms & design paradigms which ensure proper hardware utilization, reduced memory footprints and conservation of battery life.

IV. CASE STUDY AT IDUKKI, KERALA

The Idukki district has the second largest tribal population in Kerala. Both men and women are poorly educated and work as labourers in the nearby cardamom plantations. They live in the deepest parts of the forest and the children have no easy access to education. The number of out-of-school children is also very high. We conducted an initial analysis of the educational needs of the village through a simple survey of school-age children, adult learners and their family demographics.

Our tablet based education program was piloted with 38 students and with 12 LCT starting with a hands-on session by the master trainers. A local teacher was trained on our methodology for 3 days. Training included how to use the tablets and to access the reading and writing apps. Furthermore, a comprehensive monitoring and evaluation training on how to establish a baseline and assess periodic progress was also provided.

A baseline test administered in Math’s, Reading (both in the regional language as well as English) and Writing assessed the initial student performance levels. Thereafter, the test was administered after six weeks, and then every three months to systematically track student progress.

Our research methodology included both qualitative and quantitative research. Our findings, from interviews and surveys, show that many tribal children, especially boys, don’t like to write. With the tablet based pedagogy, they loved the motivational learning environment including scores, trophies, applause. After only 18 sessions, 26 of the original 38 students had learned the Malayalam alphabet using the writing app. (Fig. 4.)

Raman et al. have found that motivations for adopting LCT are strongly associated with innovation attributes such as; relative advantage, compatibility, ease of use, peer influence, perceived enjoyment and perceived usefulness [22]. Our initial observations are students appear to have greater engagement with learning. Since the LCT was shared, collaboration became the norm as students shared the device, but the teachers were still able to monitor student progress effectively. (Fig. 5.)

Because of the portable nature of LCT, teachers found it very easy to integrate them into their outside classroom teaching, which is not possible with desktops. The students used the audio application to record their voice and take pictures. This kind of interactivity motivated students to come back to the classroom.

Fig. 4. Students learning on their own

Fig. 5. Students collaborating in small groups
V. CONCLUSION

Reading remains a challenge in developing nations such as India and there is tremendous scope for LCT to address this important issue. Results of a field study in India, Kerala, involving 38 children of mixed age groups reveals the effectiveness of LCT based pedagogy for significant reduction in time required to learn the complete Malayalam alphabets when compared with traditional learning using slates. Overall management of the teaching sessions was easy, not to mention the savings from not using paper; as the daily practice of writing, activities and assessments was done using LCT.

The teachers observed that the LCT provided a teaching-learning environment which was much more student-centered and they were very motivated by the enthusiasm shown by the students to explore and learn using LCT. It was interesting to observe that students felt their teachers were using the latest gadgets and this led to tremendous teacher motivation. Since LCT and mobiles have an extensive reach in both urban and rural areas, they can be used for improving the literacy levels in the country. Also, learning in vocational and informal training can prove to be highly effective for a diverse country like India, where poverty and illiteracy are the key issues and majority of the population dwells in rural areas [18].

A few areas of concern that need to be addressed for successful implementation are: security of the LCT due to its small form factor, better solar chargers in areas with inconsistent electricity supply, sturdiness of the LCT in dusty environments and the cost to provide more LCTs per center. Some of the challenges we face as we deploy this solution, using 1000s of tablets in over 100 villages are periodic updates of tablets, given the multiple versions and languages.

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