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Towards an inclusive digital literacy framework for digital India

Prema P. Nedungadi, Rajani Menon and Georg Gutjahr
*Center for Research in Analytics & Technology in Education,
Amrita Vishwa Vidyapeetham, Kollam, India*

Lynnea Erickson
*University of Washington,
Seattle, Washington, USA, and*

Raghu Raman
Amrita Vishwa Vidyapeetham, Coimbatore, India

Abstract

Purpose – The purpose of this paper is to illustrate an Inclusive Digital Literacy Framework for vulnerable populations in rural areas under the Digital India program. Key challenges include addressing multiple literacies such as health literacy, financial literacy and eSafety for low-literate learners in low-resource settings with low internet bandwidth, lack of ICT facilities and intermittent electricity.

Design/methodology/approach – This research implemented an educational model based on the proposed framework to train over 1,000 indigenous people using an integrated curriculum for digital literacies at remote settlements. The model uses mobile technology adapted for remote areas, context enabled curriculum, along with flexible learning schedules.

Findings – The education model exemplifies a viable strategy to overcome persistent challenges by taking tablet-based digital literacies directly to communities. It engages different actors such as existing civil societies, schools and government organizations to provide digital literacy and awareness thereby improving both digital and life skills. It demonstrates the potential value of a comprehensive Digital Literacy framework as a powerful lever for Digital Inclusion.

Practical Implications – Policy makers can use this transformational model to extend the reach and effectiveness of Digital Inclusion through the last mile enhancing existing training and service centers that offer the traditional model of Digital Literacy Education.

Originality/value – This innovative mobile learning model based on the proposed Digital Framework for Inclusion instilled motivation, interest and confidence while providing effective digital training and conducting exams directly in the tribal settlements for low-literate learners in remote settings. Through incorporating multiple literacies, this model serves to empower learners, enhance potential, improve well-being and reduce the risk of exploitation.

Keywords Digital divide, Indigenous people, Digital inclusion,
Information and communication technologies (ICT), Digital competence, Digital learning

Paper type Research paper

1. Introduction

There is a digital divide in remote and rural India, perpetuated by inequalities related to physical access to ICT, low-literacy, low economic status and inadequate social and health awareness. Rural and tribal people are amongst the most disadvantaged segments of society and are often exploited due to their illiteracy and concomitant lack of awareness. They are deprived of development processes that were initiated and intended for their advancement, prosperity and security.

The Indian Government has launched and scaled the Digital India program, along with Skill India and multiple schemes for inclusion. In spite of significant efforts on the part of the Government, NGOs and different private agencies to safeguard the well-being of the tribal people, lack of Digital Literacy, education and awareness constitute

the main hindrances in their way to understanding and utilizing these initiatives. Empowering the tribals through education can exponentially expand awareness of their rights and privileges.

eLiteracy skills can support digital inclusion and allow tribal communities to benefit from various schemes, while the health and social awareness aspects can help in safeguarding them from exploitation. However, attempts to bring Digital Literacy Skills education to remote and rural areas have encountered numerous challenges, including low literate learners, low internet bandwidth, lack of ICT facilities and intermittent electricity. Moreover, literacy training schedules may temporarily reduce their livelihood time, a factor which has previously led to low attendance and dropout rates.

Thus, a Digital Education Framework for Inclusion must consider resource gaps, low literacy, and even exploitation, while suggesting a path for empowerment and use of technology that will help bridge the digital divide.

We propose an Inclusive Digital Literacy Framework (IDLF), and then describe an education model based on the framework that was applied to successfully train and certify more than 1,000 indigenous people over a period of three years.

2. Digital literacy frameworks

A number of digital literacy frameworks have been designed by various organizations and nations to suit their local populations and transform learners. These frameworks have included both technical and social dimensions with the goal of empowering individuals to develop not only technical abilities, but also life skills and access to services. They encompass universal literacy, creative literacy and literacy in multiple disciplines.

eSafety is an additional important component in most frameworks. Digital citizenship expands this concept to include an understanding of rights and responsibilities as well as legal and ethical behavior (American Library Association, 2013).

Although digital literacy frameworks are being developed throughout the world, variations based on a variety of contextual factors can be observed. Efforts in USA, for example, tend to focus on individual empowerment and educational policy (Bryn Mawr College, 2016, "Bryn Mawr Digital Competencies Framework" while South Africa's National e-Skills Plan of Action emphasizes job skills and entrepreneurships as a path to development National e-skills Plan of Action, 2012).

The European Digital Competence Framework for Citizens (DigComp), which aims to build "digitally-competent citizens," describes information literacy, communication, content creations, safety and problem solving as key requirements (Carretero *et al.*, 2017). It also highlights the need to tailor programs to local, regional or national circumstances. Economic and cultural diversity and various national contextual factors may provide a challenge to develop a uniform European framework, and national policies may play a critical role in applying or adapting the framework.

3. eLiteracy of digital India

Digital India has the goal to ensure transparency and avoid corruption in services reaching the beneficiary, along with providing good governance and ensuring inclusion with an effective service delivery system. The Indian Government, under the Pradhan Mantri Grameen Digital Saksharata Abhiyan scheme, aims to make 60 million citizens digitally literate in rural India. The program also envisages equal opportunity to all rural citizens, enabling them in livelihood and services through digital technology. It partners with training organizations and encourages small rural entrepreneurship through the Central Service Centers to provide digital services to villages.

4. IDLF for a digital India

Inequalities within digital literacy contexts include variations in access and external support, literacy levels, and perceived relevance and value of the literacies. Strategies to promote inclusion of vulnerable populations attempt to address these inequalities, through both individual and community empowerment, through improved access to digital tools, relevant skills to development and ongoing support in the use of digital literacies.

The proposed IDLF promotes safe use of digital technologies to access information, communication, eGovernance services, job skills, learning, and financial services such as online banking and ehealth services. However, without awareness about benefits, services and rights, many low-literate populations are unwilling to invest the time and take advantage of the services provided by the government and NGOs. Hence to increase motivation and participation, awareness is included in each component of IDLF. The eGovernance Literacy component, for example, informs and offers easy access to relevant online Government services. In addition to its tailored focus on low-literate learners, the framework also considers those with learning difficulties and disabilities. Each component must incorporate accessibility features in the design so as to support those with reading disabilities (Figure 1).

Similar to the European DigComp framework, India's IDLF framework must work with multiple languages and cultural contexts. Unlike European Union, however the IDLF framework must cater to neo-literate and low-literate populations and focus on creating awareness about education, health, income generation, specific governance services meant for inclusion, along with access and digital skills.

Unlike, British Columbia's framework, the focus on content creation and media skills is secondary to awareness and understanding of the various components of IDLF (American Library Association, 2013). Similar to the USA, an inclusive framework must have goals of individual empowerment and education policy, but implement them in the context of low access, low literacy, low infrastructure and low awareness.

5. Indigenous people in settlements of the Kerala state

The Indian state of Kerala is considered as a role model for literacy and human development, however, the tribal population has been marginalized and the state has not achieved the required success in tribal development. Although Government programs are being implemented to reduce the wide gap between the tribal and non-tribal communities in the state, especially in the aspects of social developments, success has thus far been elusive.

Figure 1.
Inclusive digital literacy framework

As Tribal communities are facing an increasing number of challenges that could be significantly mitigated through improved literacy in Kerala (Chandran, 2012). These challenges include education, health, safety, access to potentially beneficial schemes and threats to livelihood and exploitation.

Education
The interactional environment of the tribal students in schools strongly influences academic success and is considerably influenced by familial, personal and structural factors (Jose, 2015–2016). The Unfavorable social relationships in schools in the form of poor social support, poor school integration, poor status of friendship in schools, and social rejections all lead to perception of identity threat among the tribal children. The consequences are absenteeism and increasing dropout rate. The educational levels of tribal communities in different regions of Kerala remain low with the majority being educated below primary level (Suresh and Rajasenan, 2015).

Many schemes and programs have been implemented in tribal areas of Kerala, and some have brought constructive changes in educating these populations (Babu, 2017). In many communities, the views have changed toward education, and the educational programs have a key role to play in this regard.

Health
The tribals suffer from a wide range of diseases – leprosy, TB, scabies, malnutrition-based diseases and other communicable diseases and so on (Nithya, 2014). Despite several healthcare measures taken by government, in many cases the medical facilities are still out of reach to those people as the hospitals and healthcare centres are situated far away from their settlements. Many tribal villages are yet to know about sanitary systems and health education.

Safety
Some tribal women have been victims of physical harassment and sexual exploitation by employers or fellow workers in tea estates and other fields (Nithya, 2014). Furthermore, cases of human trafficking have been reported (Uddin, 2014).

Government schemes
Various schemes and programs have been formulated and implemented to help the schedule tribes of Kerala. Remote settlement of the tribal populations, ignorance and sometimes indifference to the development programs, corruption at different levels are some of the reasons responsible for failure of the programs to overcome the challenges and issues faced by the tribals (Baiju, 2011).

Skills
The introduction of forest rules, deforestation and other environmental factors have negatively affected the survival strategies of the tribals in different regions of Kerala as they are dependent upon the forest ecosystem (Ramachandran, 2013).

As the economy of the tribal population is largely dependent on forest and agriculture, deforestation has seriously influenced the tribal economy. In addition to deforestation, other factors such as in-migration to the hilly areas, use of hilly land for different other activities and introduction of modern but inappropriate techniques of cultivation have brought a drastic change to the living pattern and financial condition of the tribals (Haseena and Meera Bai, 2006). Hence training for alternative skills is becoming increasingly necessary for livelihood.

Exploitation due to lack of awareness

The increasing number of landless tribals in Kerala is a result of exploitation by outsiders as the innocent tribal communities are largely dependent on non-tribals for their credit requirements (Haseena, 2014). Poor economic conditions, long standing indebtedness, alcoholism, industrialization, urbanization, lack of legal knowledge, and lack of land records are some of the reasons that have alienated tribals from their land.

A study on the ST cooperatives, started to help the backward communities, and the financial status of the members reveal that more than 80 percent of the members find it difficult to meet their expenditure because of low level of income and hence, borrowing is very common (Bhaskaran and Meera Bai, 2006). More than 75 percent of the borrowers cannot repay their loans and are being exploited in various forms.

Various social issues such as alcoholism and domestic violence are closely related to the status of women and the need for measures related to women empowerment, most of which are related in some way to literacy. The government sponsored Mahila Samakhya is an innovative approach with its wide range of programs from literacy camps, vocational training and adult education classes, to addressing social issues such as alcoholism and domestic violence (Kandpal *et al.*, 2012). This program redefined education for women as an empowering tool is which beyond basic literacy. The program was visualized as a unique approach to design learning processes for women that would change their way of thinking and acting, but has had only partial success in reaching out to women of all levels (Jandhyala, 2012).

6. Digital literacy education model

Our overall objectives are to empower rural people, particularly youth, through computer education, to create awareness about IT, social services and health education, and most importantly to improve the quality of life, build resilience and offer accessibility to various plans and projects for tribal benefit. The Education Model was designed using the IDLF, encompassing Information, Health, Education and Financial Literacies, eGovernance Services and e-Safety.

The beneficiaries included adults in remote tribal settlements; youth in tribal schools; girls who had dropped out of the school system and received intervention at Mahila Shikshan Kendras; and girls from Nirbhaya hostel, who have rescued from human trafficking or other high-risk circumstances.

m-Learning

With the proliferation of smartphones and mobile devices in rural India, m-Learning is a natural choice for education. Though challenges in India still include access to ownership of smartphones, the government's Make In India scheme will increase the reach of low-cost smartphones, along with eGovernance Services in regional languages.

The tablets themselves initially attracted students to the program. Factors for tablets gaining acceptance for learning are portability and an interactive interface, with the touch-screen being convenient and easy to learn to navigate (Couse and Chen, 2010). Mobile Android tablets were used to teach skills such as using a word processor and creating spreadsheets. Game-oriented apps and eBooks on low cost android tablets in Malayalam language were developed and adapted for effective learning.

Tablet-based education can foster literacy and education, link rural students with faculty at universities (Das and Singha, 2012), train teachers remotely (Bijlani *et al.*, 2012), offer online science virtual labs to students who do not have access to traditional labs (Nedungadi *et al.*, 2013), assist in learning disabilities (Geetha *et al.*, 2013; Haridas *et al.*, 2018) and remotely monitor classrooms (Nedungadi, Jayakumar and Raman, 2018; Nedungadi, Mulki and Raman, 2018). It can also provide the awareness needed to tackle various social and

health issues (Chaudhary *et al.*, 2010; Nedungadi *et al.*, 2017). More advanced techniques such as personalization (Nedungadi and Raman, 2012), using character recognition (Jayakumar *et al.*, 2016) and speech recognition (Jayakumar *et al.*, 2016) for language learning provide detailed, individualized feedback to the learner while customizing presentation to suit the learner. Our education model utilized low-cost tablets that were adaptable to low-resource environments with intermittent electricity.

Multi-lingual adaptability
Training materials included a Malayalam app and videos for basic computer literacy, financial literacy, health literacy, accessing eGovernance services, eSafety and basic societal functioning, health, hygiene and diseases.

Relevant content
The educational content in these studies was customized to the needs of tribal youth and adults, taking into consideration the language as well as lack of consistent connectivity and low processing power. The integrated program (Figure 2) is designed to teach novices to operate computers and use the internet by integrating content relevant to individual learners, such as accessing e-Governance applications, making digital payments, engaging in online banking, setting up and accessing e-mail, performing basic word processing and gaining access to educational resources, health services and government schemes. It also provided access to digital libraries, games and apps for e-learning.

The Social and Health Awareness segment included videos and apps on the tablet that provided education on issues such as drug and alcohol addiction, human trafficking awareness, lack of hand sanitization, spitting in public places, dangers of open defecation, in addition to providing inputs on advantages of boiling water and benefits of organic and healthy food habits (Roberts *et al.*, 2015). As noted, beneficiaries also learned basic financial literacy, such as using online banking, as well as how to gain access to educational resources and government schemes. On completion of the course, examinations were conducted and course completion certificates issued to successful candidates.
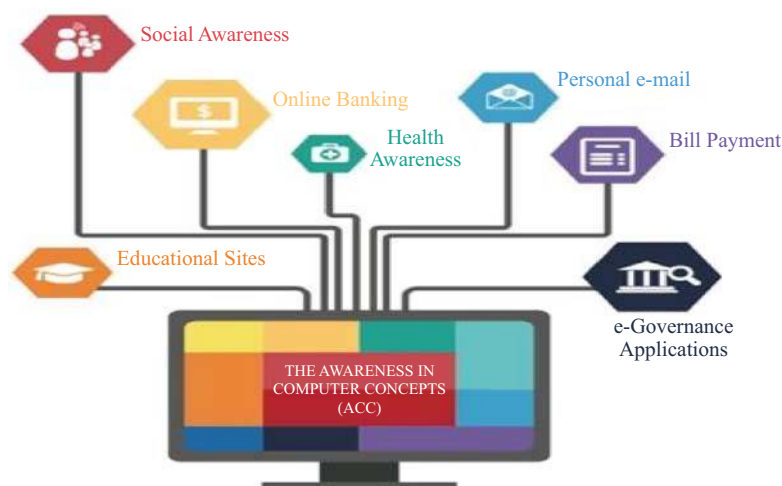

Figure 2.
Awareness in computer concepts along with other digital programs

7. Performance in an external exam

In our study, exams for the Awareness in Computer Courses were taken directly to tribal settlements or schools and offered via laptop and connected tablets. The student tablet received randomly assigned questions from the assessment laptop and answer data logs were saved in the laptop and integrated to the cloud for analysis when internet was available.

A total of 1,110 students and adults completed the computer training; see Table I. Participants, all of whom were from tribal communities in Kerala, were between 8 and 50 years old, with a mean age of 17.1 (SD 5.5). 319 (28.7 percent) of the participants were adults (i.e. at least 18 years old). Of the participants, a total of 678 (61 percent) were female; among children, 523 (66 percent) were female, while among adults, 155 (49 percent) were female. In total, 22 percent of the participants had never used a computer or a smartphone before the training. Figure 1 shows a histogram of the age of the participants.

Among participants who completed the training, 89 percent passed the exam, while among adults who completed the training, 92 percent passed. For passing the exam, the odds ratio between children and adults was 1.28 (95% CI 0.80–2.06), and the difference was not statistically significant ($p < 0.29$). There was no significant difference between the pass rates of female and male participants: odds ratio 1.39, 95% CI 0.91–2.14, p value 0.12. Figure 3 shows a histogram of the marks, where more than 10 marks are required to pass the exam.

While the pass rates are not significantly different between age classes and gender, there are statistically significant differences in the specific marks obtained. Table II and Figure 2

Table I.
Number of participants who completed the training, attended the exam and passed the exam

	Overall	Children ⩽ 18 yrs	Adults > 18 yrs
Completed training	1,110	791	319
Attended exam	1,043	757	315
Passed exam	1,003	710	292

Figure 3.
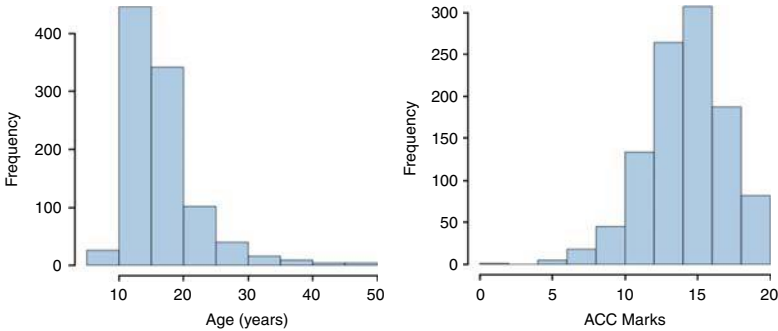Histogram of the marks from the ACC exam and of the age of the participants

Table II.
ANOVA table for the natural spline model of ACC marks depending on age and gender

	df	F	P
Gender	4	2.75	0.03
Age	6	3.13	0.01
Interaction	3	2.86	0.03

Note: The table contains the degrees of freedom, the F statistics and the p-values for age, gender, and interaction term between age and gender

show the fit from an natural spline model of ACC marks depending on age and gender. High marks were obtained from older children in school (age 16 to 18 years) and from older women (age 35). The difference between male and female is significant both at a young age (up to age 15) and at older age groups (30 years and above), but not within the main age range between 16 and 29 years (Figure 4).

8. Post-training questionnaire

One-on-one interviews were conducted with 224 participants of the training program six months after completion of the training. Questionnaires were used to collect relevant information, to assess the impact of computer education and awareness program, and particularly on the overall performance of the program. In total, 66 percent of the participants were female and 25 percent were adults over 18 years. In an open-ended post-survey question, "What is the most important thing you learned in the Amrita ACC program," 90 percent of the students described feeling much more confident using the computer and the internet.

Digital literacy

Digital literacy was demonstrated by a large number of certified candidates. Improved abilities were also demonstrated through self-reported changes, changes in computer and internet use, and computer-related vocabulary among participants. 91 percent of the participants indicated during the interview that they feel confident in using office software, such as Microsoft Word and Excel, and 56 percent feel confident in using e-mail. When asked about their most common use of computer, the participants typically mentioned e-mail, social media and online games.

eGovernance literacy

Of the participants who had completed the program six months prior to the interviews, 32 percent have filled government forms online and 22 percent have booked bus and train tickets through a website. More importantly, after completing the training, most participants are aware of the possibilities of eGovernance such as the filling of online forms.
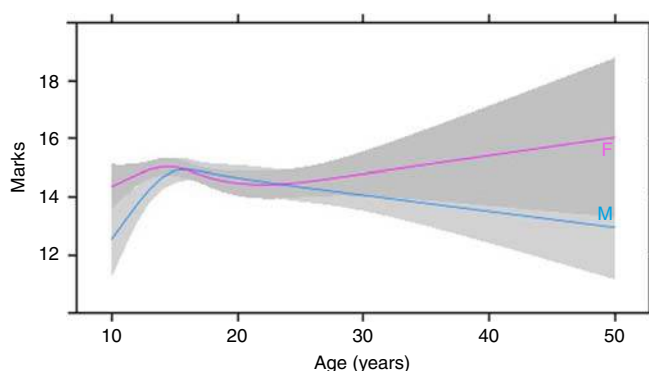
Notes: Red line denotes predicted mean marks for female; blue line denotes predicted mean marks for male; gray areas indicate 95 percent confidence bands

Figure 4.
Effects displayed from a natural spline model of ACC marks depending on age and gender

Health literacy

With regards to malnutrition, over 90 percent of the participants mentioned that the training helped them to understand malnutrition better, and 16 percent of the participants started a kitchen garden after the training. In total, 96 percent of the participants mentioned that they have been influenced by the awareness videos on health issues.

eSafety literacy

During the interviews, 66 percent of the participants stated that the training has made them more aware and cautious of human trafficking. Furthermore, after the training, 90 percent of participants are only giving out personal information on the internet on trusted sites.

9. Discussion and implications

An innovative mobile learning model based on the proposed Digital Framework for Inclusion was used to teach computer skills, increase awareness and life skills, enhance a sense of empowerment and conduct for low-literate learners living in remote tribal settings. Specially this model offers the benefits of eliteracy and empowerment to tribal people, particularly the youth, through computer education.

The program acknowledged that Computer Literacy by itself is not sufficient for empowerment. Program design and methodology were based on a detailed analysis of the background of disadvantaged people in remote and rural India, that considered culture, language, context, socio-economic problems, low infrastructure and low literacy. This study is a part of an ongoing project that aims to empower with computer literacy, life skills, eSafety, awareness about education and health among the scheduled tribes using tablet technology in native languages.

The methodology of primarily using low-cost android devices, along with an assessment methodology that worked without internet is transformational in that it allows computer literacy to reach remote areas while instilling confidence and increasing awareness of topics critical to the health and welfare of tribal communities (e.g. governmental and nonprofit schemes to enhance tribals' livelihood, health and economic situations). This education model can be replicated and scaled by the Digital India program by extending the reach of existing rural Common Service Centers centers to reach remote areas that lack infrastructure, thereby reaching the last mile for a transformative impact across the nation.

The relatively low drop-off rate and the high percentage of success amongst those who complete the training may be attributed to: the additional hours spent in training; flexibility in schedule based on the target learners; translation and context adapted to their needs; integration of various literacies that benefit them along with multiple modalities of presentation; and examination that could be conducted in their local area.

Our challenges included additional unplanned time requirement by master trainers, limited content in the regional language, and designing tailored awareness materials that were suitable for the local context. While most of beneficiaries became confident about using spreadsheets and documents, the majority use their skills for communication such as e-mail and social media. The majority were aware of eGovernance services that could benefit them, with 32 percent availing of the services within six months following the training. A substantial majority improved in understanding of nutrition using the multimedia elearning material, with about 16 percent starting organic kitchen gardens for healthier dietary practices. Furthermore, a high percentage of users understood the risks of providing personal information at untrusted websites, thereby reducing online security risks that often accompany increased use of e-mail, social media and using online services. Looking at the feedback received during various visits and at the training sessions in different villages of Kerala, there is a repeated pattern of interest and enthusiasm for tablet based education among tribal students.

Both qualitative and quantitative feedback mechanisms were designed to gauge the success and benefits of this training program. Quantitative measurements of the impact of the training program verified the substantial improvements in eLiteracy skills that were observed among participants of the computer education and awareness program. Improvements were evident among all age groups and for both men and women.

In terms of qualitative assessment of the impact of the training program, participants of the program reported increased confidence in a wide area of applications related to eLiteracy. As noted, in the open-ended post-survey question, "What is the most important thing you learned in the Amrita E-Literacy ACC program," most students described feeling much more confident using the computer and the internet. While nearly all of the participants were first time computer users, they reported a feeling of comfort with the technology and applications. Furthermore, many participants reported actual changes in behavior due to the acquired skills and the increase in confidence. With regards to digital literacy, most participants indicated during interviews that they feel confident in using computers and, as a result, they also report changes in the ways that they use the internet for a variety of tasks. A representative example from such an interview is as follows: "I could learn more about computer. After the first sessions, I could remember spreadsheet and Word. I have seen education games and awareness videos, mathematics games on the tablet. I want study more about IT."

Participants across all age groups interacted very well with the touch tablets and demonstrated a strong preference for tablets over the traditional desktop. After training, participants were more inclined to use their phones for simple learning interactions. In addition to self-report, increases in the participants' ability to use the computer and negotiate the internet were assessed through observation of computer and internet use and increased computer-related vocabulary among participants. We found a very strong sense of improved computer ability among study participants as a result of the ACC training course: 90 percent reported an increase in their ability to use computers after completing the ACC course.

Significantly, in addition to improvements in digital literacy, participants also reported positive changes in areas such as eGovernance Literacy, Health Literacy and eSafety Literacy. For example, some participants have subsequently completed government forms online or used the internet to book bus and train tickets. Most importantly, many participants became aware of various eGovernance services that could benefit them. With regards to Health Literacy, many participants mentioned that the training helped them to better understand malnutrition. Finally, with respect to eSafety Literacy, most participants reported increased awareness about human trafficking; furthermore participants reported that they are now more cautious about giving out personal information on the internet.

Providing such eLiteracy training can have a real impact on the life of the participants. Here is one such example from an interview: "There was a video about how one village doubled their rice cultivation using new techniques. We really need to use these in our village. I am very fortunate to be able to see and learn these new things."

10. Conclusion
The research proposes an IDLF as a powerful lever for Digital Inclusion. The framework offers challenges, ideas and methodology to government and civil society stakeholders in digitally inclusive education projects. The success rate in the examination is higher and the dropout rates are significantly lower with this model compared to the traditional model for Digital Literacy education, where students come to a computer center to learn.

The research further implemented an innovative education model based on the IDL framework. The education model exemplifies a viable strategy to overcome the challenges that have heretofore hindered efforts to bring digital literacies and its concomitant benefits

(e.g. awareness and ability to access beneficial schemes) to tribal communities. Goals were achieved and obstacles minimized through use of tablet based education – including the ability to function without internet and only intermittent electricity – which included social and health awareness programs presented in the local language. Furthermore, the IDLF engages a variety of already established entities, such as civil societies, schools and government organizations, to provide multiple digital literacies thereby reducing costs and optimizing existing structures. In this way, empowering learners with both digital and life skills and reducing the risk of exploitation can be achieved without reinventing community infrastructures.

Success rates in the examination are higher and the dropout rates are significantly lower with this model compared to the traditional model for Digital Literacy education, where students come to a computer center to learn. In addition, while Hindi has traditionally been readily available, our findings suggest that all technology based literacies need to be available to rural India in other regional languages, including in the dialects spoken by indigenous people. This education model can be replicated by the Digital India program to reach rural areas that lack infrastructure, having a transformative impact across the nation. Policy makers can use this transformational model to extend the reach of Digital Inclusion to the last mile through existing training and service centers that offer the traditional model of Digital Literacy Education.

IDLF has identified six forms of digital literacies to support inclusion. For each of these, future work can define a scale to assess specific levels of literacy. Such future work would be useful in quantifying the degree of digital literacy in different communities. Additional future research planned include longitudinal studies on the effectiveness, benefits and limitations of digital literacy training as well as studies to identify factors associated with gender, age and other demographic variables that might enhance ability to target training more effectively.

The provision of digital literacies to remote communities holds the promise of improvement, well-being and success at all levels – for individuals, families, tribal communities, and the nation as a whole. As citizens become confident, aware, knowledgeable and empowered, their potential to both benefit and contribute expands exponentially, not only in health, education, and livelihood, but also in terms of preserving and extending cultural heritage.

Acknowledgment

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Corresponding author
Prema P. Nedungadi can be contacted at: prema@amrita.edu