Learn2Earn: Using Mobile Airtime Incentives to Bolster Public Awareness Campaigns

SAIGANESH SWAMINATHAN, Carnegie Mellon University, Pittsburgh, PA, USA

INDRANI MEDHI THIES, Microsoft Research, Cambridge, MA, USA

DEVANSH MEHTA, Microsoft Research, Bangalore, India

EDWARD CUTRELL, Microsoft Research, Redmond, WA, USA

AMIT SHARMA, Microsoft Research, Bangalore, India

WILLIAM THIES, Microsoft Research, Cambridge, MA, USA

In rural parts of the developing world, spreading awareness about critical issues in health, governance, and other topics is challenging and costly. Traditional media such as print, radio and TV each have limitations and offer little guarantee that new information is absorbed or retained by the target population. This paper describes Learn2Earn, a system that leverages mobile payments to bolster public awareness campaigns in rural India. Users call an Interactive Voice Response (IVR) system, listen to a brief audio tutorial, and take a multiple-choice quiz to check their understanding. People who pass the quiz receive a mobile top-up (about $0.14) and have the opportunity to earn additional credits by referring others to the system. We describe a pilot deployment of Learn2Earn in rural India that spread via word-of-mouth to over 15,000 people within seven weeks. Usage was concentrated among young men, many of them students. In a mixed-methods study, we draw upon call logs, electronic surveys, qualitative interviews, and other sources of data to suggest that Learn2Earn could be an effective way to build awareness about important topics.

CCS Concepts: • **Human-centered computing** → **Human computer interaction (HCI)**.

Additional Key Words and Phrases: ICTD; HCI4D; awareness campaigns; mobile payments; India

1 INTRODUCTION

Public awareness campaigns are an important tool for sensitizing the public about contemporary issues in health, governance, emergency preparedness, and other topics. An ideal campaign is one that reaches a large audience, has a measurable impact, and keeps costs to a minimum. However, in practice it is difficult to achieve all of these goals at once. Provision of in-person outreach is often the most effective, but it is labor intensive and difficult to scale. An alternative approach is to utilize print or electronic media—such as billboards, TV and radio advertisements, newspaper ads,

Authors' addresses: Saiganesh Swaminathan, Carnegie Mellon University, Pittsburgh, PA, USA, saiganes@cs.cmu.edu; Indrani Medhi Thies, Microsoft Research, Cambridge, MA, USA, inranim@microsoft.com; Devansh Mehta, Microsoft Research, Bangalore, India, devansh76@gmail.com; Edward Cutrell, Microsoft Research, Redmond, WA, USA, cutrell@microsoft.com; Amit Sharma, Microsoft Research, Bangalore, India, amshar@microsoft.com; William Thies, Microsoft Research, Cambridge, MA, USA, thies@microsoft.com.
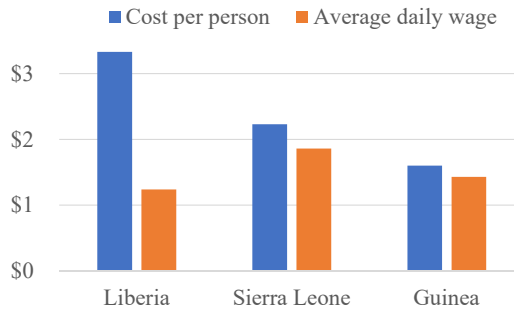
Fig. 1. Cost of the UN Ebola campaign in 2014 [37].

and so on—but these channels are expensive, and it is difficult to measure how many people pay attention to the message and what knowledge they gain from it. Targeting a message to a specific audience can also be challenging, especially when the audience is a "hidden" group, such as those who struggle with a stigmatized condition, engage in risky sexual behaviors, or live in remote and inaccessible areas.

As a concrete illustration of these challenges, consider the United Nations campaign to raise awareness about Ebola in West Africa in 2014. According to a UNOCHA Report [37], $49 million was required for social mobilization, community engagement, and messaging, with techniques that include radio and television broadcasts, door-to-door campaigns, cell phone messaging, printed brochures, and mobile announcement systems mounted on taxis. A budget of $49 million, while large by any measure, is exorbitant in the local context. As illustrated in Figure 1, when this budget is divided by the entire population of the countries targeted, the spending exceeds average daily wage. In other words, even if the campaign succeeded in reaching every resident of the country (which it did not), it would have been cheaper to hire each person for a full day of their time in service of learning about Ebola.

This led us to ask a simple question: in low-resource areas, could it make sense to pay people for a few minutes of their undivided attention, rather than trying to compete for their attention via more expensive means? This paper explores this idea via a system called Learn2Earn: if people learn, then they earn. More specifically, the concept is to deliver an awareness message via a personal mobile device, administer a quiz to check that the message is understood, and if so, to disburse an immediate mobile payment to the learner. People can also earn additional payments by referring others who successfully pass the quiz.

Compared to traditional awareness campaigns, Learn2Earn offers three potential benefits. First, instead of investing in expensive broadcast media or labor-intensive counseling, it transfers funds directly to the target population (contingent on passing a quiz). In this respect it has some similarity to conditional cash transfers, which are already a proven tool in global development [9, 28]. Second, usage of Learn2Earn spreads via word of mouth from one person to another. Once usage is seeded in a targeted group, the campaign could reach other members of the group via "inside" referrals, above and beyond what is accessible with "outside" interventions. Finally, by tracking each user's responses to quiz questions, one can directly measure the learning that was achieved as a result of the campaign.

In this paper, we instantiate the Learn2Earn concept into a practical system for public awareness campaigns in rural India and explore its feasibility via a real-world deployment. Our implementation uses an Interactive Voice Response (IVR) platform, whereby users place a free phone call and listen to a short (3 minute) audio tutorial. Following the tutorial, users take a short multiple-choice

quiz using the phone keypad. If they pass the quiz, they receive an instant mobile top-up, worth Rs. 10 (about[1] $0.14). A referral bonus of the same amount is provided for spreading the system to someone else who also passes the quiz. As an initial deployment, we launched a campaign about an important aspect of land rights in rural India, as well as a follow-up campaign that targeted a different message to the same participants.

Our results show that after seeding Learn2Earn with 17 users, the system spread to over 15,000 people who passed the quiz over the next seven weeks. Via a mixed-methods study, we characterize the growth of the platform, the demographics of people reached, the retention of knowledge over time, as well as the qualitative experiences of participants and perceived impact on their daily lives. Our experiments with Learn2Earn are still of an exploratory nature, and spurred uptake only with certain demographic groups (predominantly young men, many of them students). Nonetheless, the evidence thus far suggests that it could merit further consideration as a means to better support and assess public awareness campaigns.

2 RELATED WORK

The work most closely related to ours is Sawaal, a platform for administering voice-based quizzes in Pakistan [32]. Similar to Learn2Earn, Sawaal is an IVR system that promotes awareness of important topics and assesses users' understanding via multiple-choice questions. However, instead of relying on financial incentives to promote uptake and spread, Sawaal relies on social interactions and gamification. For example, users can create their own quizzes; share them with each other; upvote, downvote, and discuss the quizzes; and view leaderboards of users who have answered the most questions correctly. This mix of functionality and fun is ingenious.

In a 14-week deployment, Sawaal logged over 3,400 users, 120,000 calls, and 12,000 user-contributed questions. Learning and knowledge retention was rigorously assessed via selected repetition of administrator-authored questions. Sawaal users were predominantly young men, similar to Learn2Earn. Sawaal also saw a very high fraction (71%) of blind users, something that we observed in our qualitative sample (but did not quantify more broadly) on Learn2Earn. The deployment of the systems overlapped: Sawaal launched in two phases (Jan 2016 and Mar 2017) while Learn2Earn launched in between (Apr 2016).

Perhaps the highest level difference between Sawaal and Learn2Earn is the incentives for participation. While users of Learn2Earn are primarily seeking financial payment, users on Sawaal are seeking other rewards, such as having fun, building community, learning things, and being recognized. Such intrinsic rewards are desirable for a number of reasons, not least of which is that they avoid any perverse incentives for seeking out financial payments. Under most scenarios, such intrinsic rewards would also reduce operating costs. If there's any drawback to this model, it could be that it requires a sustainable, "always-on" service in order to retain users and keep them ready to hear new messages. In the hypothetical situation that a critical public awareness message needs to be disseminated in an area without a Sawaal deployment, or to prior users of Sawaal who were not retained over time, then Learn2Earn's incentive model may be a fast and reliable way to get people's attention and amplify reach quickly. The payments of Learn2Earn could also be helpful for disseminating information that is somehow unappealing—perhaps confusing, unpleasant, or just mundane—and benefits from having added motivation for users. Learn2Earn and Sawaal could also be complementary: Learn2Earn could attract new users to the platform, or direct the attention of existing users to important topics, while Sawaal could subsequently retain them and engage them in broader learning activities.

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[1]This paper uses an exchange rate of 1 USD = 70 INR.

Learn2Earn is related to the idea of conditional cash transfers, which are a well-proven and widely utilized strategy to promote positive behaviors in global development [9, 28]. A conditional cash transfer makes a cash payment to a person or household, contingent on them completing one or more well-defined tasks that benefit them or their community, e.g., attending school, being vaccinated, and so on. Learn2Earn could be viewed as a "conditional micropayment", which thus far has received less attention. One recent exception is an initiative called Triggerise [36] that seeks to give reward points for positive behaviors in developing countries, including India. Points can be spent similarly to cash with affiliated vendors. To the best of our knowledge, this initiative has yet to test or reward a learning task. It also seems to require access to a smartphone and local participating vendors.

In addition to conditional transfers, there is also increasing interest in unconditional transfers as a tool in global development. Organizations such as GiveDirectly [10] utilize mobile payments as a channel for unconditional cash transfers in sub-Saharan Africa, a program that has demonstrated rigorous benefits [12]. There is ongoing debate regarding the relative merits of conditional and unconditional transfers [27]. Critics of conditional transfers argue that, to the extent that cash transfer are required for poverty alleviation, selectively denying payment to a subset of people, based on any condition, could be a violation of human rights [17]. Learn2Earn may fall somewhat outside of this important conversation, as the amounts transferred are not large enough to have a significant impact on livelihoods.

In both high- and low-income contexts, it is common practice to award both monetary and non-monetary incentives to promote new products and services. Often these are also linked to referral bonuses. For example, until recently, PayPal offered a $5 credit when opening a new account as well as a $5 bonus for referring others [26]. In many scenarios consumers are incentivized to watch and understand ads, e.g., in exchange for free data services in developing regions [15] as well as in Western contexts. Learn2Earn has similarities to such advertising platforms, though the content promoted is in the public interest. Delivering and measuring attention to more general advertisements could potentially be a way of monetizing and sustaining Learn2Earn in the future.

Our work relates to paid crowdsourcing platforms that have targeted low-resources areas. Karya [7] and mClerk [11] disburse mobile micropayments in exchange for workers digitizing local-language text. ReSpeak [41] offers micropayments to workers for fresh narration of audio snippets, making them more suitable for automatic recognition and transcription. Learn2Earn has similarities in its infrastructure, but favors tasks that offer learning benefits for users.

There is a mature body of research surrounding IVR services in low-resource environments. Voice-based social platforms such as Polly [29], Baang [31], Mobile Vaani [23] and Sangeet Swara [38] have shown the ability to spread virally to a large number of users, including blind and visually impaired users [39]. Polly Health [43] is an example of how this viral spread can be leveraged to disseminate health information between peers. Voice forums in additional domains such as citizen journalism [21, 23], agriculture [25], and maternal health [6] have shown strong usage and impact. Learn2Earn seeks to build upon the lessons learned in these projects.

It is well known that there are complex social dynamics surrounding the appropriation, sharing and use of mobile phones in low-resource environments [2, 33, 34, 44]. Learn2Earn encounters these complexities as it seeks to understand which people are using a set of phones to access and learn content. Researchers have also studied how information spreads through social networks [4, 19], as well as incentive schemes for optimizing that spread in low-resources areas [40, 42, 45]. One lesson from these studies that was particularly impactful on the design of Learn2Earn is that a small, guaranteed payment that is issued immediately can cause a simple mobile survey to spread to up to 1,000 people in a single day [40]. Berger's framework for understanding virality [4] may help to explain why such instantaneous payments are especially conducive to viral spread: they
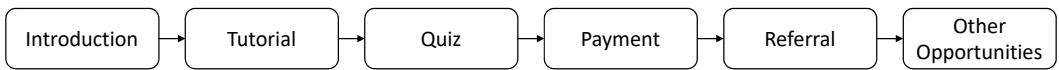
Fig. 2. IVR call flow of the Learn2Earn system.

offer practical value, lead to positive emotion, and may offer social currency for the person who shares the earning opportunity with others. Recent work has explored how to dynamically adapt the incentives offered to match learned characteristics of a social network, leading to simulated gains in cost effectiveness for the network of referrals gathered by Learn2Earn [24].

To summarize, while independent work has explored the role of voice-based media and financial incentives in promoting positive changes in low-income communities, to the best of our knowledge this is the first effort to combine these two approaches by using mobile airtime incentives to bolster public awareness campaigns.

3 LEARN2EARN SYSTEM

In our first implementation of Learn2Earn, we sought to minimize complexity while also making it as inclusive as possible of rural and low-literate populations in India. The system was implemented using an Interactive Voice Response (IVR) server.

The IVR call flow is illustrated in Figure 2. It contains the following steps:

(1) **Introduction:** As a substitute for a toll-free number (which can be costly and is not universally understood), users placed a missed call (one that rings without being answered, a common signal to return the call in low-income contexts [8]) and our server called back immediately. At the beginning of the call, users were given a brief introduction and asked to "press 1" to continue; this simple interaction ensured that they could understand IVR menu navigation before investing time in learning content.

(2) **Tutorial:** Users listened to a short dramatized dialogue, detailed in the next section, that explained a topic of interest.

(3) **Quiz:** Users were presented with three multiple-choice questions, which they answered using the keypad on their phone. Questions were presented in the same style as a popular TV game show, *Kaun Banega Crorepati* (a local version of *Who Wants to Be a Millionaire?*). The correct answer to every question was revealed and explained immediately following the user's response. The order of answers was randomized in each call to inhibit blind sharing of answers between participants. (Future systems could also explore randomizing the order of questions, or drawing questions randomly from a larger set, though in this pilot we fixed the questions and their ordering to ensure that they formed a natural sequence.)

(4) **Payment:** If a user answered all questions correctly, they were awarded an immediate mobile top-up of Rs. 10 (approximately $0.14). Telecom service providers in India notify users of such top-ups via an immediate text message.

(5) **Referral:** Users were given the option to refer additional people to the system. A referral worked by users entering the full 10-digit phone number of someone they wanted to refer. If a caller from that phone number eventually passed the quiz, then the referrer was also awarded a bonus of Rs. 10. Our system sent a brief SMS advertisement to each referred person, and also encouraged the referrer to propagate the system via word of mouth. If multiple people referred the same user, then only the first referrer was awarded any bonus.

(6) **Other opportunities:** Over time, we also added additional earning opportunities for those who had already passed the quiz. For example, users could complete a 20-question survey in exchange for a larger top-up (approximately $0.72). New earning opportunities were

Example Dialogue	Example Quiz Question
Arvind: I am also wondering what happens to our rivers, trees and so on. Does the Forest Rights Act offer any protection over community resources such as water bodies, timber and sal trees? Or does it only protect my individual land?	Does the Forest Rights Act offer protection for community resources such as water bodies and saal trees? Or does it only protect your individual land?
Bajju: Arvind, so far we have been talking about protection of individual land. However, there is another section of the Forest Rights Act that protects community resources, such as water bodies, timber, sal trees, Laak, Bamboo trees, and fishing bodies. You can learn more by talking to your village's forest rights committee.	If you think that community resources can also be protected, press 1. If you think that only individual lands are protected, press 2.

Fig. 3. Example content from our pilot campaign, focused on the Forest Rights Act.

advertised via SMS to people who had passed the quiz; if they called again, they skipped straight to the menu for referrals and additional earning opportunities, instead of taking the quiz again. In future instantiations, we envision a system where users can call a single number to access the latest set of tutorials, quizzes, surveys, and other earning opportunities.

The network of referrals constructed by Learn2Earn may have independent value in understanding the social relationships in communities, and exploiting those relationships to maximize influence of the system. In addition, the set of users collected via word of mouth in one campaign could potentially be targeted directly by future campaigns, enabling new awareness messages to instantly "flash" across a large and disperse network.

Technical implementation. We implemented the IVR server using Asterisk [3], an open-source telephony platform, supported with digital PRI phone lines. We used SMS Achariya [1] as a payment gateway, though have transitioned to IMWallet [13] for recent deployments. Most payment gateways require the user's current telecom circle and mobile carrier in order to deliver a mobile top-up. We used an HLR (Home Location Registry) lookup service [20] to retrieve this information.

4 PILOT CAMPAIGN

Any new deployment of Learn2Earn needs a strategy for three contextual elements: developing content, seeding uptake, and targeting beneficiaries. This section describes each of these activities in the context of a pilot campaign. We designed and implemented the campaign collaboratively with a local NGO, CGNet [5], that is a long-time champion for marginalized groups in rural India.

The campaign focused on the issue of forest rights, which are of particular concern for indigenous populations in rural India. Though they have lived on the land for generations, often they lack formal documentation of their land ownership. This makes them vulnerable to encroachment by companies or other organizations that seek to use the land for other purposes [35]. In 2006, a law called the Forest Rights Act was introduced to protect indigenous groups and formalize their rights over ancestral lands. While this law can be transformative for the security and livelihood of rural communities, our partners at CGNet saw limited awareness of what the law provides and limited knowledge about how to assert those rights in practice. This makes it a prime target for an awareness campaign, especially one that can reach remote and low-literate populations.

Developing content. To develop the audio content of the campaign, we consulted with several subject matter experts, including lawyers, activists, and community liaisons suggested by CGNet.
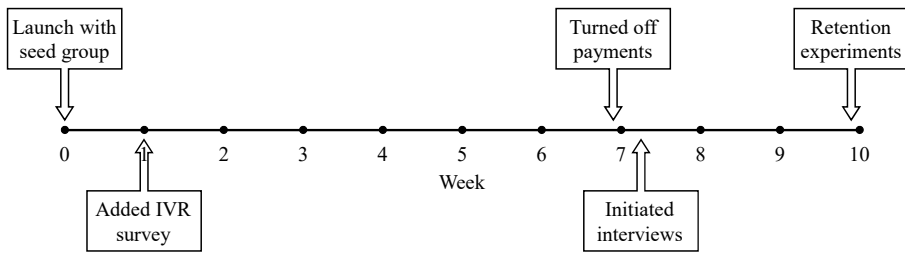
Fig. 4. Timeline of study activities.

We designed the tutorial and quiz to focus on important actionable messages while retaining a natural narrative style. To make the tutorial as engaging as possible, we presented it as a simulated dialogue between two farmers. An example of this dialogue (as well as a sample quiz question) appears in Figure 3; the full text appears in the appendices. All content was recorded in the local language (Hindi).

Seeding uptake. While the system was intended to spread via word of mouth, outreach to initial users required a different strategy. In our pilot, we seeded uptake by advertising the system on CGNet Swara, an existing IVR platform that was already used by indigenous populations [21]. In other contexts, seeding via personal outreach or one-time use of broadcast media (radio, TV, print, etc.) may be necessary.

5 STUDY METHODOLOGY

Our mixed-methods study sought to understand whether Learn2Earn could be a cost-effective way to bolster public awareness campaigns in rural India. We approached this question by observing and analyzing real-world engagement with the system. In particular, we were interested in the following metrics:

(1) **Usage:** How fast and how far did usage spread? Did people pass the quiz?
(2) **Who were the users:** What were the demographics of users? Were forest dwellers included?
(3) **Experience and impact:** What were users' qualitative experiences? Did it impact their life?
(4) **Retention:** Did users retain knowledge over time? Can we retain users for other campaigns?

Each of these metrics led to a corresponding research activity: the Learn2Earn deployment, an IVR survey, qualitative interviews, and retention experiments. These activities are depicted as a timeline in Figure 4 and detailed in the following sections.

5.1 Learn2Earn deployment

We launched Learn2Earn by playing a 1-minute advertisement on CGNet Swara. The advertisement ran for only one day; all users from that point forward were recruited via referrals and word of mouth. Due to budget constraints, we turned off payments for Learn2Earn after 7 weeks (and modified the IVR to emphasize that payments were disabled). We also warned callers in advance of turning off payments to minimize surprises for them (and anyone they might refer). Throughout the deployment, we logged routine call information, including the time and duration of each call, the caller ID, the sequence of keypresses (including answers to quiz questions) and the network of referrals.

5.2 IVR survey

One week after the initial launch, we added an IVR survey as an additional earning opportunity for those who had already passed the quiz. The survey consisted of 20 questions, of which 19 were multiple choice (answered with a keypress) and one was an optional free response (answered by speaking). The multiple-choice questions probed topics such as caller demographics, technology usage, media exposure, and prior awareness of the Forest Rights Act. Some questions were repeated in slightly different ways to check for users' consistency and care with their responses. The free response question offered an opportunity for unstructured feedback. However, in retrospect we did not offer sufficient guidance or examples on how to answer the free-response question; answers were typically very brief or empty, and we did not analyze the contents. Since the survey was longer than the Learn2Earn quiz, we increased payment accordingly to Rs. 50 (about $0.71). A total of 3,838 users completed the survey, of which 2,770 users passed the built-in consistency checks; only the latter cases were analyzed.

5.3 Qualitative interviews

We conducted brief semi-structured phone interviews with 30 users. Of these, the first 20 were randomly selected among users who had passed the quiz, while the last 10 were purposely sampled: seven users who entered large numbers of referrals (as per the system logs) and three users who were blind (snowball sampled from other blind interviewees). Interviews focused on users' experience of Learn2Earn, including how they became aware of it, what they learned, whether the information was relevant to them, who they told about it, whether they had any help, and how the system could be improved. Basic demographic information was collected. In the event that users did not remember using the system (e.g., due to a shared phone), we discussed who else might have used it.

Two of the authors were present for each phone interview: one leading the conversation, and the other listening and providing occasional prompts. Interviews were recorded and lasted 11 minutes on average. Later, the lead interviewer reviewed the recordings (in Hindi) and produced a set of detailed notes (in English). The interviewers collaboratively analyzed and refined the notes into a set of emergent themes.

5.4 Retention experiments

We explored two aspects of retention. First, we sought to test whether users who passed the quiz retained that knowledge over time. Starting three weeks after payments were turned off, we placed automated calls to a random selection of 1,246 phone numbers that had passed the quiz (and received payment) at any point during the campaign. This implies that there was a 3-10 week gap between passing the quiz and receiving our follow-up call, depending on the user. We placed two calls every five minutes between the hours of 7am to 10pm (boundaries of the most active usage of the platform). The IVR prompt explained the opportunity to earn an additional top-up by completing the same quiz as before. It invited users to either stay on the line to take the quiz immediately, or to call back to take the quiz later. The follow-up quiz was only available to selected callers; users were not eligible for referrals or referral bonuses. The questions asked were identical to the original quiz (though the answer order was randomized as usual).

We also explored another aspect of retention, which is whether prior users were open to completing a tutorial and quiz on a different topic. Our second campaign sought to build awareness about tuberculosis, including its symptoms, diagnosis, and treatment. We used existing audio content—a nationally televised awareness message from a well-known celebrity, about one minute long—as the tutorial. The quiz consisted of a single question: after how many weeks of coughing should one be tested for TB? To explore users' willingness to engage in a second campaign, we initiated
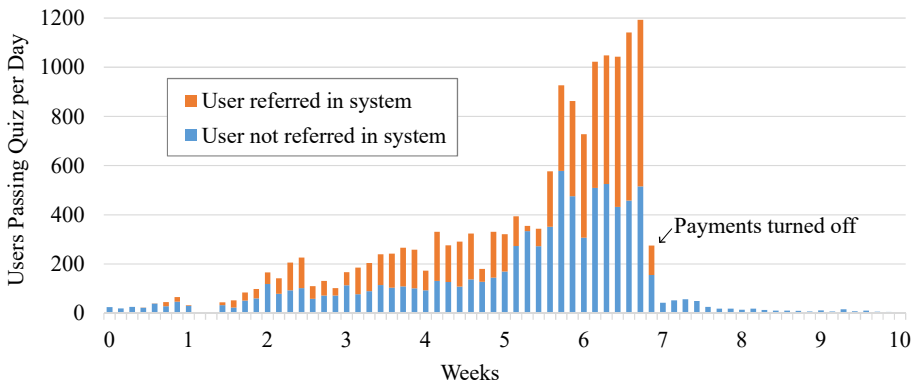
Fig. 5. Number of users passing the quiz each day. A total of 15,325 passed in 7 weeks, and 15,724 in 10 weeks.

automated calls to 1,234 users in a similar manner as described above. We did not invite or reward referrals as part of this experiment.

6 RESULTS

6.1 Usage

In the first 7 weeks, Learn2Earn spread to 17,358 callers, of whom 15,325 passed the quiz. The advertisement for Learn2Earn (on CGNet Swara) was heard by 150 people, of whom 17 eventually passed the Learn2Earn quiz. This implies that 99.9% of those passing the quiz learned about Learn2Earn from one another, as opposed to any broadcast media outlet. Usage of Learn2Earn also far outpaced the usage of CGNet Swara.

Figure 5 illustrates the number of quiz passers over time. A brief outage is visible after one week, due to a technical problem. After 15,000 users passed the quiz (on day 49), we discontinued payments due to budget constraints. This led to a steep decline in usage; by the end of 10 weeks, an additional 724 people had completed the quiz without payment. With a larger budget, Learn2Earn likely could have spread much further.

Usage patterns. Analysis of users' mobile phone numbers suggests[2] that their phones originated from Madhya Pradesh or Chhattisgarh (70%) and Odisha (28%). Usage of Learn2Earn was relatively constant from 7am to 10pm, with a slight decrease in the early afternoon and peak in the evening hours.

Failed attempts. In the first 7 weeks, there were a total of 17,358 users who called the system. Of them, 88% eventually answered the quiz correctly. Of users who did not pass the quiz, 2.4% were stuck on the opening menu (press 1 to continue), 4.8% did not pass question 1 and the remaining 4.8% did not pass question 2 or question 3. Of those who eventually passed the quiz, 83% passed on their first attempt, 12% passed on their second attempt, 3% passed on their third attempt, and 2% passed on four or more attempts (maximum 13 attempts).

Referrals. The IVR survey asked how users learned about the Learn2Earn. As illustrated in Figure 6, most of respondents (69%) learned about the service from an in-person interaction with another user, and this user was most commonly (79% of the time) a friend. Less common ways of learning

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[2]In India, one can infer the telecom circle where a phone number was originally procured based on the first four digits of the number [22]. However, recent changes in number portability enable users to migrate their number to other states and carriers. Thus, while we can infer states in which phones originated, we are unable to verify the current locations of users.
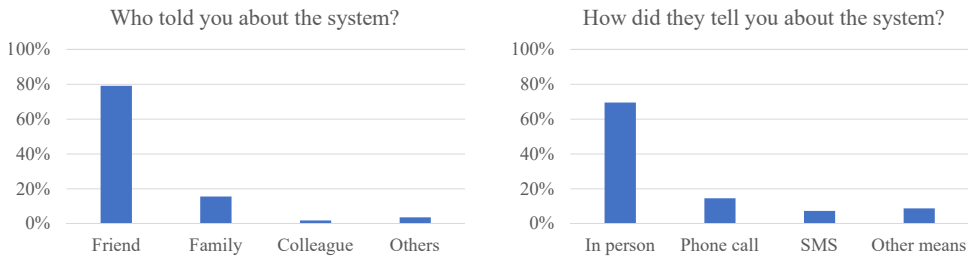
Fig. 6. How users learned about Learn2Earn (as reported in our IVR survey with 2,770 respondents).
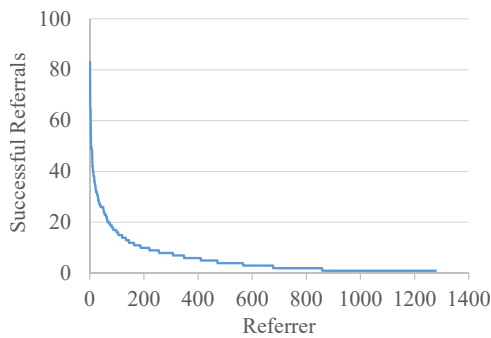

Fig. 7. Number of successful referrals (entered in the system who went on to pass the quiz) for each referrer.

about the service include via a phone call (15%), SMS (7%) or other means (9%), from sources that include family members (15%), colleagues (2%) and others (4%).

While these survey results confirm that almost everyone was personally "referred" to Learn2Earn, less than half (48%) of users who passed the quiz were entered as a referral in the IVR. Likewise, only 35% of people who were entered as a referral eventually went on to call the system, and a smaller fraction (28%) of referrals went on to pass the quiz. Figure 7 illustrates the number of successful referrals (those who went on to complete the quiz) by each referrer. There were a total of 1,278 people who made at least one successful referral. Of these, the average number of successful referrals was 5.8, the median was 3, and the maximum was 83. The longest chain of successful referrals was 7 people long. (It deserves emphasis that these statistics are drawn only from the IVR referral logs; the graph of in-person referrals may have been more extensive.)

Summary and interpretation. Overall, we interpret these results as positive evidence that Learn2Earn can spread efficiently through social networks, providing a useful alternative to other forms of outreach. A large number of people were reached in a short period of time, and usage trends suggest that even greater growth was achievable with additional funding. That 88% of callers eventually passed the quiz reflects positively on the clarity of the content and the usability of the system. The prevalent use of the referral feature suggests that referral bonuses may have played a role in incentivizing spread. At the same time, survey data suggests that in-person meetings were more important than electronic communications (messages or calls between users) for spreading uptake. There may be room to better recognize and reward such in-person referrals in the future.
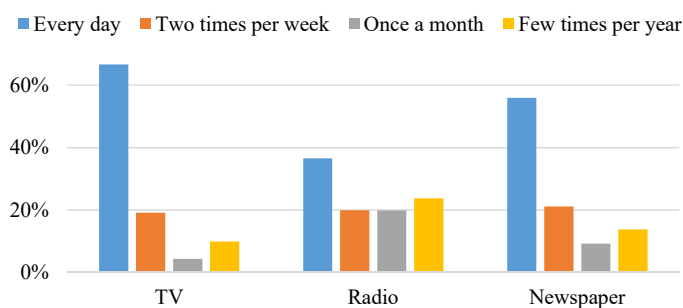
Fig. 8. Users' exposure to other forms of media (as reported in our IVR survey with 2,770 respondents).

6.2 Who are the users

For the usage described in the last section to have real-world impact, the system needs to reach the people who stand to benefit it. We used the IVR survey as a tool to understand whether usage was inclusive of the targeted population.

Relation to target group. We sought to reach people who have a connection to forest land and would benefit from taking the tutorial. Results showed that 31% of respondents indicated a connection to forest land and 72% of respondents said that they directly benefited from the tutorial. Just over half (53%) of respondents said that they were not aware of the Forest Rights Act before taking the tutorial, and a larger fraction (70%) said that they would not have passed the quiz without the tutorial.

Demographics. Users were predominantly young males: 94% were men, and the most common age group was 18-25 years (54%), followed by <18 years (31%), 25-45 years (13%) and above 45 years (2%). The most common occupation was students (64%), followed by agricultural labor (22%), working elsewhere (7%) or not working (7%). Respondents who were students were relatively well-educated, with 23% enrolled in or having completed college; 33% in 11th or 12th grade; 31% in 7th to 10th grade, and the remaining 13% in 6th grade or below. Those working in agriculture had lesser education, with only 8% having started or completed college; 25% completing 11th or 12th grade; 43% completing 7th to 10th grade; and 24% completing 6th grade or below. The most common income reported by agricultural workers was $71-$143 per month (42% of respondents), which aligns with the per-capita GDP in these states; other agricultural workers reported incomes of $14-$71 per month (24% of respondents), <$14 per month (18% of respondents) and above $143 per month (16% of respondents).

Technology use. Only 42% of respondents had a smart phone (as indicated by a touch screen). However, 68% of respondents had a feature phone or better (as indicated by a camera). Slightly less than half of respondents had sent SMS (43%) or used Facebook (45%).

Media exposure. Figure 8 illustrates respondents' exposure to other forms of media. Results show that broadcast media are commonly accessible to Learn2Earn users, with 67% reporting daily access to TV, 56% reporting daily access to newspapers, and 36% reporting daily access to radio. However, there remain challenges in utilizing such channels for building awareness of rural issues. Apart from being expensive for advertisers, the content on such channels is often restricted to urban issues. In addition, such channels don't reach everyone: there is a significant fraction of users that has only yearly or monthly exposure to each.

Summary and interpretation. The overlap between the actual users and our intended targets surpassed our expectations. Users sampled were often young men, many of them students in secondary or tertiary institutions, or agricultural workers with incomes representative of the area. Respondents stated a connection to forest land, a lack of prior knowledge of the Forest Rights Act, and a benefit from hearing the tutorial—themes that are further explored and validated in our qualitative interviews. More than half of users did not use smart phones, SMS, or Facebook, which confirms the importance of a voice-based IVR solution to reach such users. While forms of broadcast media were also accessible to users, they have inherent limitations relative to Learn2Earn.

6.3 Experience and impact

As indicated previously, we conducted semi-structured phone interviews with 30 users who passed the quiz: 20 sampled randomly and 10 sampled purposefully. Of the latter group, seven were selected for their enthusiastic usage, as indicated by their referral behavior. These users entered a large number of referrals in the system (min=89, max=200, avg=131) that often, but not always, led to successful quiz results (min=8, max=83, avg=48).

The demographics of interview participants were similar to those reported in the IVR survey. All participants were male, from rural areas of Madhya Pradesh and Odisha. They were predominantly young (17-20 years old), though there were older participants as well (up to 45 years old). Most participants were students (from 11th grade to pursuing their Bachelor's degrees). Most belonged to smallholder farmer families that either owned land (less than 2 acres) or where parents worked as farm laborers on other people's farms. Some participants' parents worked as construction workers, or worked at or ran other small businesses (shops, motor parts). Household income was consistent with that reported on the IVR survey ($114 to $286 per month). An outlier participant owned 50 acres of land and had a household income of roughly $800 per month.

Our analysis of interview data led to four emergent themes, which we highlight in the following paragraphs.

Impact on participants and their families. Though participants had relatively advanced levels of education, they often had direct ties to ancestral lands through their families. This is exactly the group that we sought to reach with the campaign.

For one participant, a proposed highway was coming up through his family's forest lands. He said:

> The compensation (for the land) from the government will most likely be minimal, inadequate. I had heard about the Forest Rights Act earlier, but did not know the details, that by making an application, one can protect our land. I got to know this from the service. It is very beneficial, especially when the information spreads. It is great that it's available on the phone.

Several participants could clearly recount the key messages from the campaign. For example, an honors B.Com. student, whose father was a construction worker, summarized the content as follows: "Personal land can be protected from companies trying to capture it, by submitting an application at the local panchayat." He read newspapers regularly and used Facebook on his phone. His relatives owned forest land near a national park in Madhya Pradesh. He told them about Learn2Earn.

Another participant, a student whose father worked as a mason, said that their family's forest land was currently under litigation with the forest department. He got to know about the Forest Rights Act from Learn2Earn and was going to take follow-up action (submitting an application). He thought what he learned from Learn2Earn would help other people in his village who owned land in the forest.

Passionate use by the visually impaired. We interviewed four blind participants. Consistent with prior work on voice forums in rural India[31, 38, 39], blind users were particularly enthusiastic about the system, not only as participants but also as contributors who could further expand and strengthen the community that engaged with the platform. One blind participant was so enthusiastic about the interview that he started to sing an Alaap (a form of melodic improvisation drawn from Hindustani classical singing) and urged the interviewer to sing along.

The person who entered the largest number of referrals was blind. However, his approach was far from customary:

> I made up these numbers from my own mind. If the numbers are right the calls will go through, if they're not, the calls won't.

Of the 200 numbers referred by this user, eight went on to pass the quiz. While one might construe such referrals as an attempt to "cheat" the system, we attribute it only to his enthusiasm about the platform. We did not anticipate such behavior, and future systems could potentially discourage it. On the other hand, this experience also shows that unsolicited SMS advertisements can successfully convert a fraction of unknown contacts into users who pass the quiz. Such "cold calls" have also been explored to seed usage of other IVR systems in India, though without much success [30]. Perhaps cold seeding via SMS could warrant further exploration.

Proxy quiz taking by friends, family and acquaintances. We found that 7 of 30 participants could not describe the content on Learn2Earn because they had not taken the quiz themselves. Instead, it was typically a friend, family member or acquaintance who listened to the tutorial and took the quiz on their behalf. In some cases the participant retained control of the phone but was told what buttons to press in order to pass the quiz.

One participant said, "I did not hear the conversation. My brother took my phone and called." When asked about whether he got to know about the contents of the call from his brother, he said, "You have to keep your land documents safe." Such directions, however, were not part of our campaign.

Another person who worked as a mason said that he only "faintly remembered" what was said on the call. The boy who informed him about the service was telling him what to press when answering the questions. According to him, "Because I'm not educated very much, I can't understand. Others more educated are able to". He had dropped out of school in the 7th grade.

A shopkeeper from Odisha said that he took the quiz from the phones of 4-5 customers when they came to his shop, "They gave me their phones. I answered all questions for them". He was happy that his customers were pleased (to get mobile talk time). He told his customers afterwards that the service was about "preventing mining companies from taking over personal forest land".

Suggestions for improving the service. Participants had various suggestions for improving the Learn2Earn service. One participant, who had completed his graduation and owned a motor parts business, suggested popularizing the service on All India Radio, as well as via newspapers and posters. Another participant, who was a blind student aspiring to become a civil servant (IAS officer), suggested going into more depth about the Forest Rights Act and asking more detailed questions of users.

Summary and interpretation. Our qualitative interviews, though relatively modest in scope, revealed important insights about users' experience of the system. Even in a small random sample of users, there were several cases where the campaign was directly relevant to problems faced by participants and their families, and the knowledge gained could potentially have a real impact on their community. Many users were able to clearly recall key messages from the campaign, even though they were not familiar with the Forest Rights Act previously. Blind users were particularly
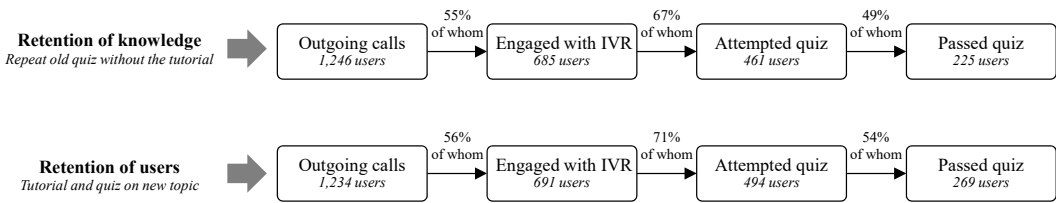
Fig. 9. Results of retention experiments.

passionate about the system and could potentially be engaged more deeply in future campaigns. The practice of taking the quiz on others' behalf is important to understand and address, and something that we revisit in the discussion.

6.4 Retention

The results of our retention experiments are summarized in Figure 9 and detailed below.

Retention of knowledge on the same topic. As described previously, we initiated outgoing calls to 1,246 users who had passed the quiz 3-10 weeks ago to test if they could pass the same quiz again (without repeating the tutorial). Of users who connected the call and attempted the quiz, 49% passed the quiz (and thus received payment). While this is lower than the 83% of users who passed the quiz (on the first try) in the original campaign, it is higher than we might expect of an untrained user. That said, only a fraction of users we sought to reach attempted the follow-up quiz. Of the users called, 55% eventually connected with the IVR (either by picking up or calling back) and of those who connected, 67% attempted the quiz. While users had a large variation (3-10 weeks) in the time between the original quiz and the follow-up quiz, this gap was not significantly different for users who passed the follow-up quiz (4.91 weeks on average) versus those who connected the call but did not go on to pass the quiz (also 4.91 weeks on average).

Retention of users on a different topic. We also initiated calls to 1,234 users who passed the original quiz with an opportunity to learn about a different topic (tuberculosis) and take a new quiz. Users' overall engagement with this opportunity was very similar to the first retention experiment. Users who progressed as far as the quiz passed it 54% of the time. However, only a fraction of users progressed that far: 56% of those we called eventually connected with our IVR, of whom 71% eventually attempted the quiz. The number of elapsed days between the original quiz and second quiz was not significantly different between those who passed and didn't pass the second quiz.

Limitations. There are some biases inherent in these experiments. On the one hand, there may be a self-selection bias whereby more confident users are more likely to complete the quiz, leading us to overestimate the actual learning retained. On the other hand, our interviews showed that the person who answered the phone was sometimes different than the person who took the quiz, which would lead to underestimating the learning gains. The challenges observed in successfully engaging users with automated outbound calls is well-known [18] and attributable to various factors, including the likelihood of interrupting other tasks and calling with an unrecognized number and/or voice.

Summary and interpretation. Roughly half of users who attempted a follow-up quiz successfully passed it—whether repeating a prior topic without a refresher tutorial, or introducing a new topic and tutorial. Our data are insufficient to quantify any learning gains, since we did not administer a baseline quiz before the first tutorials. However, our qualitative interviews suggest that baseline knowledge of forest rights was quite low, which leads us to interpret the results favorably.

Item	Price per Unit	# of Units	Total Cost
Phone calls	$0.0043 / min	5,392 hours	$1,387
Mobile top-ups (passing quiz)	$0.14 / quiz passed	15,325	$2,189
Mobile top-ups (referral bonus)	$0.14 / successful referral	7,408	$1,058
TOTAL			$4,634

Table 1. Marginal costs of scaling up the campaign (not counting payments for the IVR survey).

7 COST ANALYSIS

After modest one-time setup costs, the primary costs incurred from scaling up the campaign were the cost of phone calls and mobile top-ups, with the latter disbursed both as quiz payments and referral bonuses. As illustrated in Table 1, these costs sum to $4,634 for the entire campaign, with approximately 30% spent on phone calls, 47% spent on quiz payments, and 23% spent on referral bonuses. Dividing by the total number of people who passed the quiz (15,325), this yields a marginal cost of $0.30 per person. This represents a large cost savings compared to the campaigns quoted in the introduction, which costed several dollars per person even under impossibly optimistic assumptions (that every resident of the countries were impacted).

8 DISCUSSION

Our initial experience with Learn2Earn was quite encouraging. The system witnessed dramatic growth, from a seed group of 17 users to a group of 15,325 users who took and passed the quiz within 7 weeks. Most people (88%) who called the system eventually passed the quiz. The system successfully reached those who had a connection to forest lands, and the campaign positively impacted communities facing challenges with forest rights. The system drew enthusiastic participation from blind people, who are often marginalized by other platforms. It demonstrated good results with respect to retaining knowledge, and retaining users, over time. Finally, the approach promises to be cost-effective relative to current best practices. For all of these reasons, we are actively working on expanding Learn2Earn to other contexts.

At the same time, there are several open questions that deserve further attention if Learn2Earn is to thrive at greater scale. We touch on some of them below.

Preventing misuse of the platform. Whenever financial incentives are involved, it is inevitable that some people will look for shortcuts to receive the maximum payment with minimal effort. Our qualitative interviews revealed that the most common behavior in this category was for users to take the quiz on behalf of others. Other potential behaviors (that we did not observe directly) could be for users to blindly guess the answers until they received payment; to keep track of which guesses were correct (and repeat them on future attempts) without understanding the questions; to convey the answers to friends who would not pay attention to the full tutorial; or to use multiple personal phones (or SIM cards) to receive duplicate top-ups. At face value, all of these behaviors are undesirable because they trigger payments without achieving commensurate learning gains.

It will be important to explore various ways to prevent such behaviors. For example, the system could decouple the tutorial from the quiz, initiating the quiz via an automated call after an unpredictable delay (say, sometime the next day) after listening to the tutorial. This practice would likely prevent users such as the shopkeeper from assisting his customers with the quiz, but might pose less barriers to close colleagues or family members who are often co-located with the phone owner. It could also make the quiz more difficult for honest users, since the tutorial would have been heard longer in the past. An additional deterrent to repeating answers across different phones (either by the same or different people) could be to draw questions at random from a large question

bank, such that each user hears only a small subset of the possible questions, and also hears them in an unpredictable order. For users who are referred by someone else, the system could ensure that different questions are played for each person in the chain of referrals. Decreasing or eliminating the referral bonus may reduce the desire to help a referred person to pass the quiz. Simply stating that such behaviors are not allowed (a statement conspicuously missing from our pilot campaign) could also help to ameliorate any problems.

These points notwithstanding, one could also argue that some users taking the quiz on behalf of others may help to strengthen the sustained usage and impact of the platform. Such "power users" likely gain social capital from helping earn top-ups for others, and may be especially motivated to seek out new learning opportunities in the future. The repeated exposure of such users to the quiz questions may help to cement their understanding of the content. Their likely position as influencers in the household or community may further amplify their ability to put that knowledge into action. While we still recommend pursuing measures to reduce this behavior when possible, it might not be absolutely necessary to eliminate it completely, at least not without further study.

Improving inclusivity. While our system sought to be inclusive of many low-income users, in practice its reach was constrained to specific demographic groups—specifically, those who were phone savvy and able to navigate the complexity of a new IVR (and optional SMS) interface. It is known that access to, and use of, mobile phones is mediated by several factors, including a stark gender gap and rural/urban gap in India [14]. It is also known that in-person training is needed to enable non-tech savvy users to successfully utilize IVR [16, 18] and that rural women users face particular challenges in use [6]. Consistent with these trends, we find that 94% of users surveyed were male and 64% were students. Most had relatively high levels of education. While these users could potentially provide an indirect channel for impacting broader groups (such as their families) living in rural areas, it is also incumbent upon us to directly engage with a broader swath of society, in particular women and the elderly.

Targeting special groups. While Learn2Earn naturally attracts lower-income participants by virtue of paying only a small amount, once the phone number for Learn2Earn is in circulation, it could hypothetically be accessed by anyone, including some who may not directly benefit from the content provided. For example, if we sought to propagate a message to new or expecting mothers (say, regarding breastfeeding, or the Zika virus), it would be desirable to have some way of verifying that the user is a member of this group. Future research could explore how to attempt such identification, for example, to refer to printed materials that group members have (health cards, ration cards, etc.), other unique identifiers they are given (medical record number, national ID number, etc.) or questions that they might know the answer to ("on what day was the state-wide meeting", etc.) Such targeting needs to be customized to each campaign.

Revisiting referrals. Though almost everyone who used the system learned about it via word of mouth, only half of new users were claimed as referrals by a prior user of the system. This suggests that many users are either unable, unwilling, or uninterested to use the referral feature as currently implemented. We are currently exploring simpler ways of capturing referrals. For example, each referrer could receive a personal referral code, valid for a fixed period of time, that is set (by default) to the last few digits of the referrer's phone number. Any referred person who enters this code would give credit to the referrer. We also seek to explore the tradeoff between referral bonuses and quiz payments. What fraction of funds (if any) should be devoted to referrals? Should referral bonuses be held constant for all users, or are there benefits in varying the payout depending on the characteristics and connectivity of the referrer?

Increasing the pass rate. While it is encouraging that 88% of users eventually passed the quiz, there is still room for improvement. In particular, we have limited understanding of the underlying factors that caused some users to hang up the call prematurely or to answer incorrectly. Some users may have just been exploring the system, or guessing randomly for the chance of a payment. Others may have been earnestly trying to pass the quiz, but facing challenges in understanding the content, the questions, the interface, or facing challenges with connectivity. In the future, it could be valuable to interview a sample of people who did not pass the quiz in order to understand these factors better. To the extent that we can detect users who make a genuine attempt to engage, it could be possible to offer them some payment even if they do not pass the quiz.

Leveraging alternate technologies. While this paper focused on implementing Learn2Earn using IVR, the same concepts could be applicable to a broad range of technologies and media formats. When broadcast media is available, it could be used to deliver the tutorial; only the quiz requires a personal, interactive interface such as a phone. Quizzes could be administered via a variety of channels, from SMS communications to smart phone applications. We are also interested in exploring alternate forms of payment, especially non-monetary incentives such as value-added services (songs, jokes, horoscopes, etc.) or other tokens (coupons, badges, points, etc.)

9 CONCLUSIONS

Running an awareness campaign in rural, low-resource areas has traditionally been costly, labor intensive, and difficult to evaluate. Learn2Earn represents a new approach in which funding for the campaign is re-appropriated into direct incentives for beneficiaries. The recent proliferation of mobile phones offers a new opportunity to automatically administer quizzes, transfer payments, track referrals, and monitor the real-time spread of a campaign. The technology underlying Learn2Earn is simple, scalable, and affordable, and can hypothetically scale to nationwide deployments in a short period of time.

In this exploratory study, we sought to validate the feasibility of Learn2Earn for a pilot campaign in rural India. Our findings illustrated some strengths and weaknesses of the approach. Learn2Earn spread relatively quickly without any centralized communications outside of the initial seed group. Participants were able to learn the content and pass the quiz, were enthusiastic in referring others, and conveyed positive stories regarding the potential impact of the campaign on their community. Our study also identifies some opportunities for improvement, such as broadening participation beyond a narrow demographic (young men, many of them students) and preventing users from taking the quiz on behalf of others. We are actively refining the system in response to the study's findings and are further exploring its potential in new and ongoing deployments.

10 ACKNOWLEDGMENTS

A   TUTORIAL ON FOREST RIGHTS ACT

The following dialogue is presented in English for readability. It was authored and recorded in Hindi.

Narrator: Listen to a conversation between Bajju Shyam and Arvind Netam in the village on how to use the Forest Rights Act and claim your rights. Arvind just heard about a notice from the government to take away his land in order to set up a mining company for the state. He is disheartened about this and begins to talk to his friend Bajju.

Bajju: Hey Arvind! How are you?

Arvind: I am not doing well. A mining company is trying to occupy our forest lands. You know I go to the forest every day to collect food and other produce which I sell in the market. I could loose all of that. Besides, the water in our streams and rivers could get polluted and we may not be able to use them again for farming. I don't know what to do!

Bajju: Well... there may be a way the law could help us. Have you heard of the Forest Rights Act?

Arvind: No Bajju ji. What is the Forest Rights Act?

Bajju: Let me explain. The Forest Rights Act is a law that was passed in 2006 to help us claim legal rights to our forest lands and community forest resources. Using this law, we can claim from four to ten acres of land and use it for cultivating crops like mandiya, sanquery, and barquery. We could also use such land for building our own water storage and check dams for crops. So, what this means is that the land will be just ours to use.

Arvind: So you mean... using the Forest Rights Act, we can prevent mining companies from taking control of forests where we live?

Bajju: Yes, that's right. We can use the legal provisions in Forest Rights Act and make sure the land belongs to us and the mining company cannot take it from us.

Arvind: That sounds great Bajju ji! So are we protected automatically by this law? Or do we have to do something?

Bajju: To use this law, we need to submit a claim request to the Forest Rights Committee (FRC) of the village. Every village has a Forest Rights Committee, which takes a claim and submits it to the Gram Sabha. When the Gram Sabha receives the claim, they can give the final approval.

Arvind: Okay, so I need to submit a claim request. What documents do I need to submit?

Bajju: Along with the claim form, you need to provide two things: a) Proof of residence such as voter card, ration card, etc. and b) Proof of dependence—that is, proof that you that you and your ancestors have always lived off these lands.

Arvind: This is good Bajju ji, I will claim my forest lands now. I am also wondering what happens to our rivers, trees and so on... does the Forest Rights Act offer any protection over community resources such as water bodies, timber and saal trees? Or does it only protect my individual land?

Bajju: Arvind, so far we have been talking about protection of individual land. However, there is another section of the Forest Rights Act that protects community resources, such as water bodies, timber, Saal trees, Laak, Bamboo trees, and fishing bodies. You can learn more by talking to your village's Forest Rights Committee.

B QUIZ ON FOREST RIGHTS ACT

The following questions are presented in English for readability. They were authored and recorded in Hindi. Answers 1 and 2 were presented in a random order for every question. Once the user responded, the system announced and explained the correct answer before moving on to the next question.

(1) Using the Forest Rights Act, can Arvind prevent mining companies from taking control of forests where he lives?
   - If you think that the Forest Rights Act can protect Arvind's forests against mining companies, press 1.
   - If you think that the Forest Rights Act can NOT protect Arvind's forests against mining companies, press 2.
   - To hear the question again, press 3 or just wait.

(2) In order for Arvind's lands to be protected, does he have to file a claim request? Or is he protected automatically?
   - If you think he has to file a claim request, press 1.
   - If you think he is protected automatically, press 2.
   - To hear this question again, press 3 or just wait.

(3) Does the Forest Rights Act offer protection for community resources such as water bodies and saal trees? Or does it only protect your individual land?
   - If you think that community resources can also be protected, press 1.
   - If you think that only individual lands are protected, press 2.
   - To hear this question again, press 3 or just wait.

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