



Flyover

Final Project Report, May 2015

UC Berkeley School of Information

Siddharth Agrawal, Ankita Bhosle, Divya Menghani, Sufia Siddiqui

Contents

- Acknowledgements 5**
- 1 Introduction..... 6**
- 2 Needs Assessment 7**
 - 2.1 Literature Review 7
 - 2.2 User Research..... 8
 - 2.2.1 Contextual Inquiries..... 8
 - 2.2.2 Interviews 9
 - 2.2.3 Observations..... 9
 - 2.3 Key Insights 11
 - 2.4 Existing Solutions..... 15
 - 2.5 Summary 16
- 3 Design Process 17**
 - 3.1 Synthesis..... 17
 - 3.2 Personas..... 17
 - 3.3 Interactions..... 17
 - 3.4 Prototyping..... 21
 - 3.4.1 Low Fidelity Prototype 21
 - 3.4.2 High Fidelity Prototype 21
- 4 Usability Testing 22**
 - 4.1 Web Interface..... 22
 - 4.1.1 Test Objectives..... 22
 - 4.1.2 Participants and Test Process..... 22
 - 4.1.3 Key Findings..... 23
 - 4.2 Voice Application 29
 - 4.2.1 Participants and Test Process..... 29
 - 4.2.2 Key findings for synchronous sessions..... 29
 - 4.2.3 Key findings for asynchronous sessions 30
- 5 Implementation Details 31**
 - 5.1 Voice application..... 31
 - 5.1.1 Existing voice application platforms 31
 - 5.1.2 Voice application system architecture 32
 - 5.2 Web Application..... 33
 - 5.3 Integrated Solution..... 34

6 Product Walkthrough	35
6.1 Voice application.....	35
6.2 Web application – Unregistered User	37
6.3 Web application - Registered Users.....	38
7 Security and Privacy Considerations	43
7.1 Overview of India's Privacy Policy	43
7.2 Application of our system to the nine privacy principles.....	43
8 Challenges	46
8.1 Process Challenges.....	46
8.2 Solution Challenges.....	47
9 Next Steps	49
10 Team and Partnerships	51
10.1 Team.....	51
11 Appendix	52
11.1 Personas.....	52
11.2 Balsamiq Prototype	57
11.3 Consent Form.....	57
11.4 Low Fidelity Usability Test.....	57
11.5 High Fidelity Usability Test.....	57
11.6 Interview Question Guide.....	57
11.7 Sample Lessons Recorded for IVR application.....	57
11.8 CCXML IVR Code Sample	58
12 Citations	59

Table of figures

Figure 1. Phase 1 - Enter.....	18
Figure 2. Phase 2 - Engage.....	19
Figure 3. Phase 3 - Educate.....	20
Figure 4. Whiteboard Sketches.....	21
Figure 5. First iteration of Registration Form (multi step form)	23
Figure 6. Second iteration of Registration Form	24
Figure 7. First iteration of Session Feedback Form.....	25
Figure 8. Second iteration of Session Feedback Form	25
Figure 9. Third iteration of Session Feedback Form.....	26
Figure 10. First iteration of Student Details Modal	26
Figure 11. Second iteration of Student Details Modal.....	27
Figure 12. Third iteration of Student Details Modal	27
Figure 13. Voice application architecture.....	32
Figure 14. Final Flyover Integrated Solution.....	34
Figure 15. Landing Page.....	37
Figure 16. Registration Page.....	38
Figure 17. Schedule Page.....	38
Figure 18. Volunteer Profile Page	39
Figure 19. Student Details Modal.....	40
Figure 20. Session Feedback Form	41
Figure 21. Resources Page	41
Figure 22. Admin Dashboard Page.....	42
Figure 23. CCXML IVR Code Sample	58

Acknowledgements

We would like to thank our advisers Professor Tapan Parikh and Professor Kimiko Ryokai for their valuable and critical feedback, guidance and support during the course of this project. We would also like to thank Professor Dierdre Mulligan and Nick Doty for her advice on the privacy considerations applicable to our project.

We would like to thank the team at Big Ideas@Berkeley and Dan Gillette at CITRIS for their time, candid feedback and mentorship.

We would like to thank Swapnil Dixit for his vision and the endless enthusiasm, encouragement and support he brought to this project. None of the research and testing would have been possible without all our participants. We thank Firdaus and children in her school, and Mrs. Aarti for their co-operation and enthusiasm. We would also like to thank Mrs. Mamta Sharma, principal of New Sunbeam Public School, Hardoi for her unending support throughout our testing phase. We want to thank all the students, their parents, and volunteers for participating in our effort and reminding us why our work matters.

Last but certainly not the least, we thank the I School community and our huge network of friends and family for believing in us, talking to us about their experiences, connecting us to the right people, and going above and beyond to help, support and encourage us through our process.

1 Introduction

"I go to school. My uniform is white. My shoes are black. I love to read books."

Wasn't that simple to read and understand? One would think that it is easy for even a 5th grade student to read it. Unfortunately, it is not true in some parts of the world. Arjun, a grade 5 student who goes to a school and works part time polishing shoes under a bridge in New Delhi in India cannot read the above lines. Arjun is not an outlier in the Indian education system. The Annual Survey of Education Report (ASER) found that 52% of grade 5 students in India cannot read the above quote nor can they read grade 2 content in English, let alone comprehend it. Less than half the children in grade 5 can read simple words in English and, of the children who can read words, approximately 40 per cent cannot tell the meaning of those words. These statistics convey the harsh reality of English literacy in India.

Our project is called **Flyover** which is a term colloquially used for bridges and expressways in India. In India, the term "flyover" symbolizes progress, aspiration and dreams. A flyover creates jobs and provides means of income to families in the surroundings. We met a group of children aged 10-14 years under a flyover in New Delhi where they polish shoes for a living and some of them go to school part time like Arjun. These children have dreams and they believe education can help them achieve their dreams. They believe being fluent in English will help them get the jobs they want. It will make them independent and achieve their dreams. English is a language of opportunity in developing countries like India and we want to minimize the barriers to getting a good English education.

Our team intends to address the problem of inadequate English literacy in India and help children like Arjun speak in English with confidence. We plan to build an ecosystem in which we connect trained volunteers from big cities globally with students in satellite towns in India through mobile phones. To recruit volunteers, we plan to target educated and passionate individuals, who can speak the local language of the student. With our solution - Flyover, students living in cities and remote Indian towns will have access to the English content on their phones, and will be able to talk to someone who can speak English fluently. We describe in this report in detail the user centered design process that was followed to build the prototype.

2 Needs Assessment

Our research began with a literature review, followed by contextual inquiries and extensive user interviews with over 70 stakeholders in India. The goal of the research phase was to understand unrecognized, unaddressed and unmet needs of users.

Our research sought to answer the following questions:

- What is the current state of education in India?
- What are the resources available to students?
- How much do they pay for existing resources?
- What are the pain points of students, parents and educators?
- Which course/subject do students need most help with?
- What technologies are students comfortable using?

2.1 Literature Review

Having experienced the Indian education system firsthand, we were aware of some of the gaps and pain points with classroom education in India. To understand the present situation we performed a literature review to understand current needs and efforts in this space. Our goal was to find quantitative insights and evidence about the current state of affairs related to education in India. This would complement our anecdotal knowledge and insights from user research.

UNESCO examined the role of governance in overcoming equality and established that more than half a dozen reforms and billions of dollars of taxpayers' money later, enrollments in schools are at an all-time high of 97%ⁱ. Increasing enrollment has led to an increasing number of schools across the country especially in the case of English medium schools. Data compiled by the National University of Education, Planning and Administration (NUEPA) showed that the number of children studying in English-medium schools has increased by a staggering 274% between 2003 and 2011ⁱⁱ. Schools, parents and policymakers pin enormous hopes on English to help lift individuals, families and communities out of poverty and indignity by providing access to education, employment, opportunity and social mobility. In India, hourly wages are on average 34 per cent higher for men who speak fluent English and 13 per cent higher for men who speak a little English, relative to men who do not speak English.ⁱⁱⁱ

However, all is not well with English learning across India, especially at the primary level where the foundations are supposed to be laid^{iv}. Less than half of grade 5 can read simple words in English and, of the children who can read

words, approximately 40 per cent cannot tell the meaning of those words^v. The quality of education has worsened over the year due to factors such as high student to teacher ratio, frequent absence of teachers, their disengagement with students leading to abysmally low learning levels of students. A World Bank survey found that 25% of government primary school teachers in India are absent from work and of those present, half were disengaged^{vi}. In schools, often one teacher teaches all the subjects in the classroom and is usually not qualified to teach. Only 9% of 730,000 teachers from private and government schools passed a recent national eligibility test^{vii}.

2.2 User Research

To further understand the unrecognized, unaddressed and unmet needs of stakeholders, we used a combination of ethnographic methods such as contextual inquiries and interviews to gather observations and insights. The goal of this research was to narrow down on a specific problem we would could address, determine our target demographic, uncover new insights and challenge previously held assumptions.

2.2.1 Contextual Inquiries

During the winter break, two of our team members travelled to India to conduct contextual inquiries in schools in Mumbai and Basoda. They visited the following schools:

- Ja'afari English High School, Mumbai, Maharashtra (three 5th grade classes - two English, one Math)
- Ramabai Paathshaala, Mumbai, Maharashtra (two 7th grade classes - one English, one Science)
- Girls Higher Secondary School, Ganj Basoda, Madhya Pradesh (5th and 6th grade classes - Hindi, Math)
- Rajiv Memorial Higher Secondary School, Ganj Basoda, Madhya Pradesh (6th and 7th grade classes - English, Sanskrit, Math)



Contextual inquiry in a school in Basoda

2.2.2 Interviews

In addition to observing classroom settings, the team also interviewed parents, teachers and students in these schools. Along with this, we conducted several interviews remotely to seek more targeted opinion and insight about some of the pressing questions we faced.

We interviewed over 70 stakeholders for this process:

- 4 school principals
- 2 independent volunteers who run schools
- 4 field experts in ICTD
- 21 volunteers interested with teaching and NGO experience
- 13 teachers
- 27 children

2.2.3 Observations

Listed below are some of the key observations from our user research:

Classroom environments

Classrooms in Mumbai

- There was a conscious effort to promote English as a medium of communication and instruction in the classroom to make children more confident, and it was very effective.
- Recitation was widely used to help make children internalize the lesson.
- Creative teaching methods were used. Teachers often encouraged students to draw or write what they wanted.
- Teacher quality was good, but classroom infrastructure, especially technology, was very limited.

Classrooms in Basoda

- Motivation is not a major issue
- Clearing children's basics and background knowledge for a class, especially important for laggards, competes with the interest of completing the syllabus
- Children get excited just by seeing a projector in the class, can gauge potential excitement about a model like ours
- There is a greater need for an after-school program rather than a classroom-based one

Home environments

- Parents don't speak to their children in English
- Children who have siblings pick up English faster
- Some households have English dailies and books, others have regional language ones
- Cartoon channels also may be in English or Hindi
- Many households have extra mobile handsets lying around at home which children could use for educational purposes

Students

- Are currently taught through rote learning which reflected in their answers to questions like 'what is a noun?' (answer: Ram Book Hardoi, Ram Book Lucknow)
- Have 'math', 'science', etc. as favorite subjects. Nobody said English.
- Are exposed to English for very less time per week, usually in English period in school. They don't speak to friends, family or even teachers in English otherwise.
- Cannot answer basic questions like 'describe your house', 'describe your school' even at the 5th grade level. They
- Understand questions asked in English and supply one-two word answers with the information instead of using full sentences, stories or any natural manner of talking.
- Get paid after-school tutoring for all or most subjects, where the focus is to get them through their academics, exams, complete homework, etc.
- Are curious and chatty during a Hindi/regional language conversation, but become conscious and reticent when spoken to in English. They start turning to their parents for help/support.
- Are interested and chatty when asked about popular cultural phenomena like cricket, films,
- Are socially aware and pick up English words, expressions, slang etc. from TV, social media
- Are familiar with mobile usage and use the same for games, social media, etc.

Volunteers

- Are Indian and concentrated in major cities in India or based out of India
- Are socially aware and know the state of education in India, have personally experienced it or been in close proximity to those who suffer from it
- Are motivated by the will to give back to society and their country and wish to devote time to it
- Are involved or have been involved in social activity to some capacity before
- Are aware of the socio-economic background of children, and sometimes emotionally affected by their lives and difficulties
- Have lost motivation with remote teaching in the past, as they could not connect with the students and had no mechanism to receive feedback
- Are very observant and can point out nuances of classroom teaching and characteristics of children
- Have pointed out that children can read and write better than they can speak in English and try to avoid the latter as much as possible
- Have observed that children are interested and curious about English, especially when engaged through storytelling, etc. but are under confident and reticent
- Use creative teaching tools and methods as attempts to engage children in learning
- Slightly worried by scheduling and commitment issues in an initiative like ours and have a lot of questions, but are more engaged, excited and encouraging than worried.
- Eager to achieve and see impact

Parents

- Are concerned about and dissatisfied with quality of teaching in schools, willing to shell out more for quality teaching but can't afford private schools
- Rely on private tutoring to take care of children's academics
- Want to be actively involved in children's academics
- Plan to send children to major cities for better higher education
- Validate that children are not competent in spoken English
- Are ready to provide resources like mobile phones to children for educational purposes
- Are divided between encouraging and skeptic when it comes to new and experimental initiatives like ours
- Are aware that spoken English competency is important for good future prospects for children

Teachers

- Are hard to recruit, retain and motivate - not a lucrative career.
- Are often not qualified enough to teach
- Shy away from pitting students against each other competitively for English (e.g. debates, elocutions)
- Don't focus on English speaking and instruction in school as much as they should
- Get caught up trying to complete the syllabus, so have to disregard factors like building rapport with students, using creative tools and techniques to teach, giving personalized attention to students and looking out for laggards, etc.
- Don't use technology in the classroom
- Use rote or memory-based techniques to make children retain

ESL content specialists

- Feel strongly about having conversational content to teach spoken English, rather than formal content or teaching English 'structure'
- Content should be increasingly challenging
- Improve child's learning curve through enthusiasm, innovative ideas like letter exchange between children and volunteers
- Give follow-up content from the call
- Spoken English improves reading
- Ideal volunteer = native English speaker + experience teaching ESL

2.3 Key Insights

Demographic

"Around age 11, children transition from being dependent students to independent students"
- Seema, ESL educator

From literature review, field research and interviews we identified that spoken English was a gap in the education system for children in India in middle school in grade 5 - 8 (i.e. the 10 - 14 year old age group). These students live in satellite towns in India and go to government or small private schools where every week, there are roughly 2 or 3

English classes for 30mins. Thus, their exposure to English is just for 60-90 minutes per week approximately and is confined to their school.

Our system is designed for children who have a basic foundation in English fundamentals taught at the middle school level and build on top of what they already know to incrementally improve spoken English competency.

Rote memorization of English

The teachers, parents and students acknowledged the fact that English was still taught by rote learning and the passive knowledge of pronunciation, vocabulary, and grammar was not transformed into active knowledge to articulate their ideas and thoughts.

From our interviews with children, we found that they have tacit knowledge of English but are unable to use it. We asked them what their favorite subjects were and not one expressed that they enjoyed English. When asked questions in English, they supplied one to two word answers with the information instead of using full sentences, stories or any natural manner of talking. Many, even at the 5th grade level, could not answer basic questions like 'describe your house in English' or 'describe your school in English' and became conscious and reticent when spoken to in English. They were curious and chatty during a Hindi/regional language conversation but started turn to their parents for help and support when asked the same thing in English.

They were able to demonstrate their passive knowledge of English, for instance, when asked what a noun was they were able to recite the definition of a noun but were unable to give examples or use it in a sentence.

Lack of quality resources to teach English

"The school charges fees but the quality of education is not great. The teachers sometimes teach wrong things and for the children that becomes the truth" (translated from Hindi)

- Parent, Hardoi

When interviewing school principals and teachers, we learnt that most students take private tuitions for Math and Science and that teachers usually have to conduct extra classes to teach children English. Students usually seek the help of their teacher, older sibling or use solution manuals to help practice Math and Science but are unable to use the same resources to improve their performance in English.

The parents we interviewed mentioned that finding a quality educator to improve English skills was hard and was often quite expensive. Parents also expressed that their child's ability to have fluent English literacy skills would have a strong impact on their social and economic outcomes.

Lack of a conducive environment to practice English

"I can read and write, but my spoken English is weak" (translated from Hindi)

- Grade 5 student, Hardoi

During our field research we observed that an English teacher for a class of 45 students was absent from his class while another teacher wanted to teach Math during English class so that he could complete the Math syllabus before upcoming exam. There are roughly 2 or 3 English classes for 30mins at school and exposure to English is usually limited to the confines of the classroom.

At home, students speak the regional language and are more likely to engage in English outside school if they have an older sibling or have family members that live in a more urban environment. Our research suggests that the lack of a conducive environment where children can try to speak in English is a major problem. This is not to say that the parents and students were not motivated to learn English. Quite the opposite, in fact the parents we spoke to, especially those from middle class families, were highly encouraging and ambitious of their child's future. They believe in the power of education and want to see their children be fluent in English at school and future jobs.

Children should be encouraged to speak in a more conversational than formal manner

The ESL educators interviewed felt strongly about encouraging children to speak English that was more conversational in nature rather than formal. When conversing in the ESL class, we asked if these educators used the mother tongue in the classroom. They mentioned that they would try as much as possible to mainly use English in the class but depending on the context they would have to switch to the local language. The National Curriculum Framework Position Paper on English Language Teaching, states that at present, "the mother tongue enters the English class as a surreptitious intruder^{viii}". The paper suggests that "the mother tongue need not be an interloper but a resource and it can occur in tandem with the first language^{ix}". We took this into consideration and realized that as a team we did not want to suppress the mother tongue in any form but use it as a resource to further English learning. With hundreds of languages and regional dialects, language is an important part of India's rich cultural landscape, which we wanted to respect.

Education content should be contextualized

Educators mentioned that language learning should be contextualized, should become increasingly challenging and that follow up content and exercises should be given in order to build upon previously acquired knowledge. We learnt that children tend to be more engaged when content is contextually relevant and that contextualizing content should not just focus on language translation but also on cultural norms and interests of children.

Speaking English improves confidence

Volunteers who had spent time in the classroom often in slums or in rural areas noted that they were aware of the socio-economic background of children and were

sometimes emotionally affected by their lives and difficulties. In the classroom, these volunteers would try to use creative teaching tools and methods as attempts to engage children in learning. We learnt that children were usually curious but often under confident and reticent in the classroom. One way to improve children's confidence was to teach them to speak English. They pointed out that children could read and write better than they can speak in English and try to avoid the latter as much as possible. Research has shown that reading aloud to and with pre-readers is known to promote literacy^x, and could counter the fear of 'unseen' passages for comprehension in tests or examinations^{xi}).

Social awareness of education amongst volunteers

"I volunteered to teach because I wanted to contribute especially in the field of education. I also knew some friends who were doing it. I opted to teach at high school level because I felt that that is the age when children need a friend"

- Volunteer with an education NGO in Pune

In addition to teachers, we interviewed volunteers in India and the United States who currently volunteer or had volunteered in the past with NGOs and other organizations that aim to improve the state of education in India. These volunteers had worked with both large organizations like Teach for India, Make a Difference, Gandhi Foundation and with smaller organizations as well. Volunteers were young socially aware citizens who knew the state of education in India, had personally experienced it or had been in close proximity to those who suffer from it. They were motivated to see things change and many who lived abroad saw it as a way to connect to their hometowns and give back to society.

Lack of a social connection with remote volunteering

Some of the volunteers we interviewed had volunteered their time to teach remotely over Skype but did not continue with it, as they could not connect with the students nor was there any mechanism to receive feedback. When asked about their concerns with regards to volunteering remotely, they mentioned that scheduling, commitment and a loss of motivation due to the lack of social connection tended to be the main issues with such initiatives.

Technology use

"I will give my child a cellphone for educational purpose. As a parent, it will be my contribution for my child's future" (translated from Hindi)

-Parent, Hardoi

We assessed the technologies available to students at school and at home. We noticed that the technology most easily available to students was the mobile phones of their parents. These phones, usually owned by the head of the household, ranged from simple feature phones to smart-phones. Often, there is a spare mobile phone in the house usually with the mothers. We also found that 10-16 year old children were very comfortable in using a phone and features such as taking pictures, using WhatsApp, playing songs are few things.

As per the Telecom Regulatory Authority of India (TRAI), out of the 1.25 billion people in India, only one-fifth of the people use Internet.^{xii} Use of Internet is on the rise in India but it is mainly limited to urban areas and metro cities. However, mobile phones have penetrated into the deep realms of social structures in India and are pervading steadily. The mobile phone's communication facilities offer immediate utility to any user, urban or rural, rich or poor^{xiii}. Research has shown that mobile phones offer the greatest opportunity to facilitate informal learning in out-of-school environments so as to complement formal schooling^{xiv}. Its low power usage and mobility allow it to be the fastest growing technological platform in the developing world, India being its fastest with nearly 6 million additional mobile phone subscriptions per month^{xv}.

Cultural sensitivity

When conducting interviews and speaking to the parents of children, we noticed that if a male volunteer was conducting the interview, the mother of the child would request that we come back or call after their husband had returned home. If parents had a daughter at home, they would prefer that a female was present when being interviewed. (Note: This was the same thing we noticed when lessons were delivered over the phone in the usability-testing phase to female students.) Another finding we revealed was that knowledge of dialect and mother tongue play a huge importance when speaking to the child. A word commonly used in colloquial Hindi has a very different connotation in another Hindi dialect, which we were not aware of.

2.4 Existing Solutions

After identifying the need for English language learning for our target demographic, we examined existing solutions that attempt to improve English literacy skills of children. Current approaches to resolve the education gap are fulfilled mainly by private tuitions that tend to be expensive. Volunteer networks and technology solutions also play a role for certain demographics however these have not been able to scale at a level that would reach a wider demographic due to either technology or human resource limitations.

Private tutoring

In order to make up for the gap between what is taught at school and what is needed for high stakes competitive exams, many children attend private tutoring classes. Private tutoring is fee based educational coaching aimed to provide supplementary instruction to children after school. Tutoring in India operates in parallel with the school system and is not restricted to higher grades, and urban areas. In 2013, 23 percent of children in grade 1 - 5 (primary school) in rural India attended private tutoring, while 26 percent of children in grade 6 - 8 (middle school) in rural India attended private tutoring. Additionally, there is a gender imbalance when it comes to children attending tuition.

Most tuition classes focus on Math and Science and usually not on English. Very few of these classes target children and charge more money for teaching young children. The English speaking classes focus mainly on adults and charge over 4000-5000 INR for teaching basic and intermediate English^{xvi}. They focus more on knowing the English

needed for specific jobs at a call center or a being a driver but not on learning the language to express ideas.

Volunteer Based Networks

Volunteer based networks play a small, yet important role in improving the access of quality education for disadvantaged children and improving accountability of schools and teachers. Most of these networks such as "Teach For India" and "Make A Difference" run initiatives on improving English literacy and rely on the volunteer network to make a positive social impact and create self-sustaining communities. These organizations require volunteers to be full time fellows but there are few who target remote volunteers to work part time.

ICT solutions

Targeting a network of remote volunteers increases the pool of available volunteers who want to teach. The closest implementation we found for a remote volunteer-based teaching solution in India is eVidyaloka^{xvii}. eVidyaloka is a non-profit organization in India that sets up digital classrooms in remote parts of India and taps into a volunteer system to teach children via Skype. Their 2012 annual report highlighted the success, as their ability to scale however key challenges that they addressed with their system was intermittent power, Internet connectivity and local tech support in India^{xviii}.

2.5 Summary

For our target demographic, we believe that the age group of 10-14 years is appropriate since the students already have some passive knowledge of the language, and are comfortable to talk to someone over phone. Our user research suggested that the lack of a conducive environment where these students can even try to speak in English is a major problem.

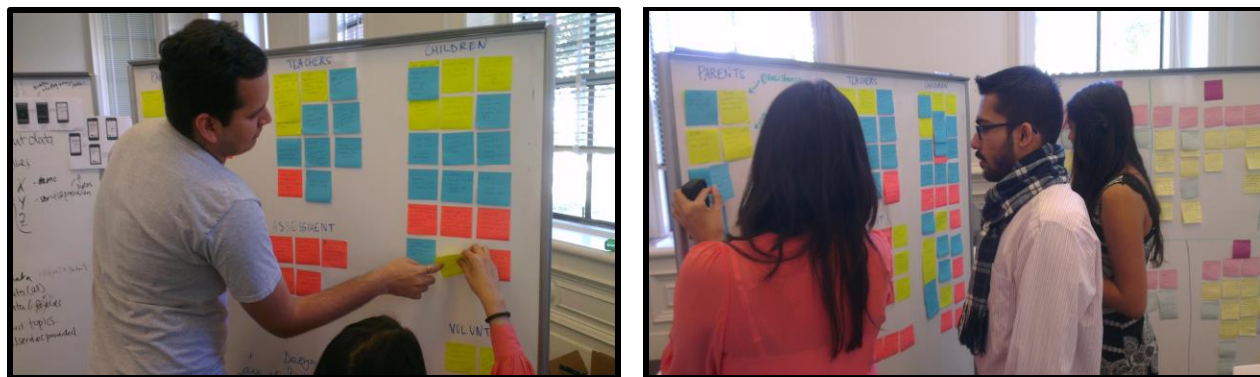
Through our primary research, we concluded that younger individuals and working professionals are passionate to teach students and want to give back to the community. Most of these volunteers were aware of the acute situation of the education in India and specifically English. We found that this group is educated and comfortable with technology related to conducting a class via a mobile phone. One important affordance our solution should afford is that students should be connected with volunteers who can speak the regional language of students and English fluently.

Based on our assessment of the technologies available to students at school and at home, we noticed that the technology most easily available to students was the mobile phones of their parents. We found 10-14 year old children were very comfortable in using a phone and features and often had a spare mobile phone accessible to them at home to use.

3 Design Process

3.1 Synthesis

To interpret the results of the needs assessment, the team coded the interviews and observations and created an affinity diagram to understand major themes emerging in the domain.



Affinity Diagram - Finding insights from observations

A “How might we” exercise was conducted to quickly generate solutions surrounding the categories outlined by the affinity diagramming. The process generated discussion on the following:

1. Reach the students without Internet or smartphone access
2. Leverage the passive knowledge of the students and find ways to make it more active and conversational
3. Involve the parents in the process of learning
4. Find ways to reinforce learning via repetition
5. Connect a fluent English speaker to a student in India. The fluent speaker should also have a sense of context where the student is - e.g. mother tongue, geography etc.
6. Understand privacy and security concerns to ensure students are safe in talking to someone over phone
7. Building the right content suiting Indian competency levels
8. Leveraging contextual knowledge within India and using viral content such as Bollywood, Cricket etc. as part of lessons
9. Building a sustainable network of volunteers
10. Make volunteers, students and parents understand how the platform works

3.2 Personas

Based on our insights we created three personas – volunteer, student and parents. Please refer to the Appendix for further details.

3.3 Interactions

We identified the following main interactions.

1. Registering with the platform and matching volunteer-student

2. Scheduling a session
3. Reviewing content before/after class through Interactive Voice Response asynchronously
4. Conducting a session synchronously and providing feedback

Here we describe how Flyover works by taking a scenario of Pia and Shanti. Pia, a recent Berkeley graduate student working in San Francisco, uses the platform to interact and teach Shanti, a 5th grade student in a satellite town in Central India.



Figure 1. Phase 1 - Enter

As shown above in figure 1, the Volunteer and student register with Flyover and complete the onboarding process.

Volunteer - Pia signs up as a volunteer on Flyover's web interface, builds her profile, and provides her availability to teach. She completes the required onboarding training and orientation. This involves attending an existing class conducted by another volunteer. As per our content design, we expect a 1-2 hour commitment from volunteers on a weekly basis.

Student - Shanti calls on a hotline 1800-FLYOVER from her parent's phone. An admin picks up the phone, talks to Shanti and gets her details about her school, her interests, and her availability for lessons. Once profile information is collected, the admin orally administers a level 0 assessment. The assessment will be standardized and predefined as per Common European Framework.



Figure 2. Phase 2 - Engage

As shown in above figure 2, Volunteer and student access the platform to prepare for the upcoming class.

Volunteer - Based on Pia's and Shanti's availability and preferences, Flyover assigns Pia as Shanti's tutor for her upcoming English lesson. This allows Pia to find out more about Shanti's interests, her Level 0 assessment score and other information that was collected when Shanti registered with Flyover in the previous phase. Before the class, Pia selects the content that she wants to deliver. We plan to build the content within the team with the help of language experts. This content is aimed to move Shanti from level A1 to level A2 as per the CEFR framework. Pia will deliver predefined lessons of 30mins each which she can customize to Shanti's level.

Student - Shanti receives a notification once Pia is assigned to her. Shanti then receives a text notification for the upcoming class. Shanti can review the content asynchronously prior to the class using the IVR system. She can use the same IVR to also listen recorded content after the class.



Figure 3. Phase 3 - Educate

As shown in above Figure 3, Volunteer and student participate in English language lesson and both complete feedback.

Volunteer - At a scheduled time, Pia receives the call and Shanti is on the line ready to engage in a lesson with her. During the lesson, Pia engages Shanti in a fun way and delivers the lesson creatively. This encourages Shanti to build a rapport with Pia necessary to sustain Shanti's interest and trust. Once the lesson is complete, Pia evaluates Shanti on predefined metrics testing English reading competencies such as range, accuracy, fluency, interaction, coherence aligned with the CEFR. This determines Shanti's ongoing progress and when the content level can be increased. The progress report is also sent to Shanti's parents over phone.

Student - At a scheduled time, Shanti receives a phone call to engage with Pia. Shanti completes the assessment administered orally by Pia. Additionally, she can also complete the assessment available on the IVR. Once the session is over, she provides the feedback for Pia using her keypad. Responses provided by Shanti on the IVR are also visible to Pia in the web app.

3.4 Prototyping

3.4.1 Low Fidelity Prototype

Our prototyping process began with a few low-fidelity paper and whiteboard sketches. These sketches helped us quickly visualize the basic tasks our tool would support and helped us better understand our interaction flows. We then moved to using Balsamiq, a wireframing software. Balsamiq allowed us to rapidly iterate on our designs and allowed for the development of some basic interactive functionality that could be tested on users. We created flows for three basic tasks: registering with the system, scheduling a class, conducting a session.

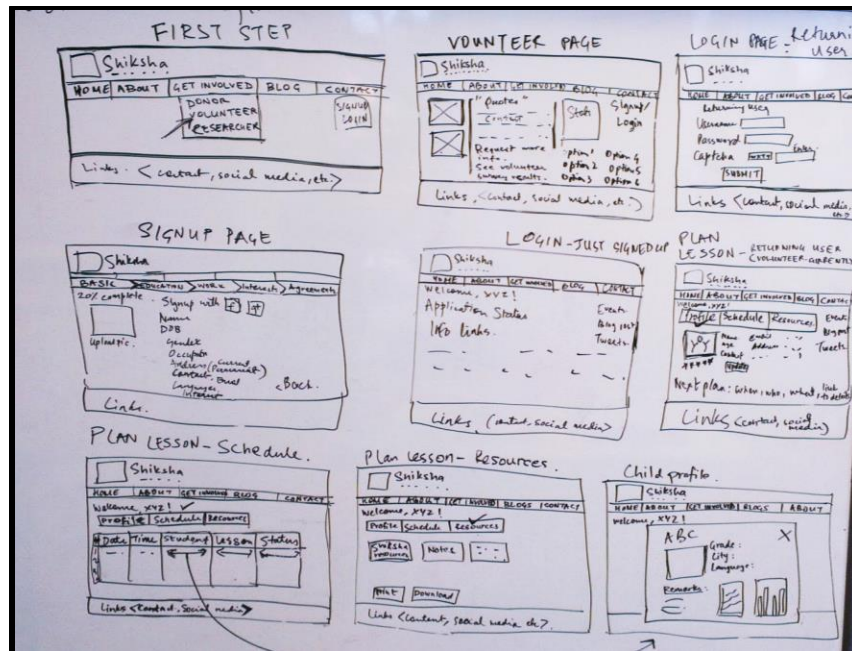


Figure 4. Whiteboard Sketches

Our final Balsamiq prototype can be referred in the appendix.

3.4.2 High Fidelity Prototype

Once we received feedback from our users about the Balsamiq prototypes, we incorporated the feedback in the next version of prototype. We proceeded to build a high fidelity functional prototype with Meteor framework. We built all the screens and they can be referred in Product Walkthrough section below.

4 Usability Testing

4.1 Web Interface

4.1.1 Test Objectives

We conducted two rounds of user tests, one on a low fidelity prototype and the other on a high fidelity interactive prototype of our web interface. Each test required the user to go through a set of tasks in order and to think aloud during the process. This was to evaluate the intuitiveness and the ease of use of the interface. Qualitative interviews were conducted after the usability test to get a deeper understanding of how useful and effective the interface was while teaching. We wanted to use the interview to probe further into their motivation level, hesitations and their experience on our platform.

The purpose of usability test was to check:

- Whether the overall architecture, navigation and workflow patterns were easy to use and effective?
- Whether a volunteer understood why certain items were displayed on a page, its interactivity and its use?
- Whether the messaging was clear and easy to understand?
- If volunteers could understand why certain data was being captured and whether they thought capturing it was necessary in order to engage with the system?
- To understand what other information or screens would the volunteer find useful when they conduct their next session over the phone

The qualitative interviews were aimed to get an understanding of the following:

- What users liked or disliked about our platform and whether it was a useful tool when teaching a child over the phone?
- How could the interface be used to create an environment that is more fun and engaging for the volunteer?

The complete script for the usability test and the qualitative interview is provided in the Appendix.

4.1.2 Participants and Test Process

Eight participants were selected who matched the persona for volunteer as described in the Appendix. These professionals are 25 - 45 years of age, are comfortable using technology and have a strong desire to connect with and contribute to their home country.

We conducted the first round of testing on a low fidelity prototype where we mocked up the screens in Balsamiq to test the workflow and the main interactions on our interface. The findings from this test were used to inform the design of our high fidelity prototype.

The second round of testing was conducted on the high fidelity prototype to help us iterate and improve the interface architecture and aesthetics of the screens.

We used a combination of in person and remote testing. Remote tests were conducted using Google Hangouts where the screen was shared and the clicks and think aloud activity was recorded. Screen activity and audio was recorded using QuickTime Player.

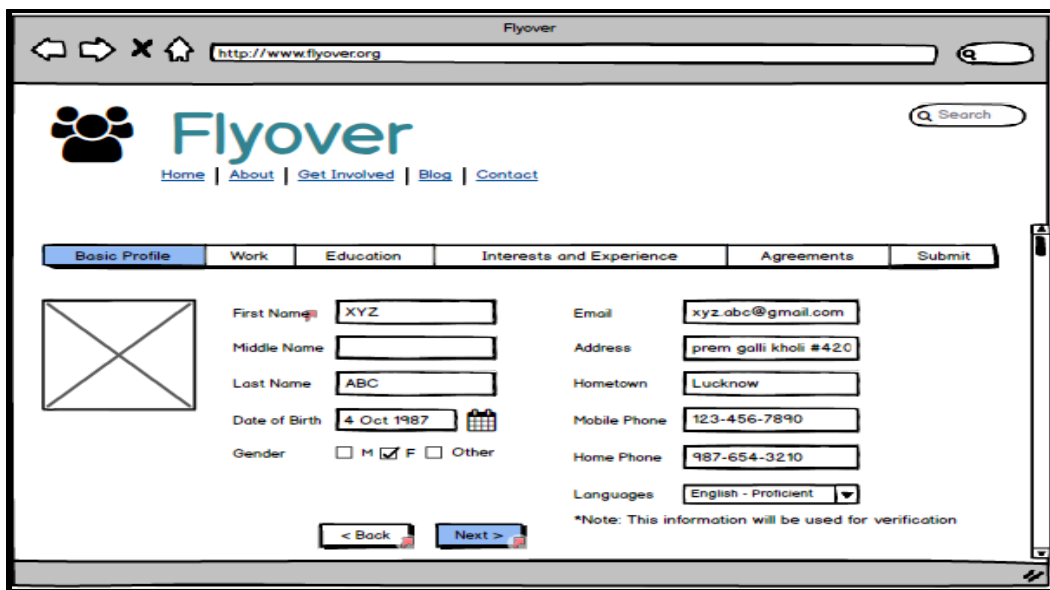
4.1.3 Key Findings

1. Usability Tests

Usability tests helped us identify problems and issues with our web interface and interactions. This feedback helped us iterate on our design and the key findings are summarized below:

Registration Form - Multi Step Form vs. Simple Form

Insight: During our first round of testing, we mocked a multi-step form shown below with a progress bar in order to justify the information that we were collecting from the volunteer and comprehensive.



The screenshot shows a web browser window titled "Flyover" with the URL "http://www.flyover.org". The page features the Flyover logo and navigation links: Home, About, Get Involved, Blog, and Contact. A search bar is located in the top right corner. Below the navigation is a progress bar with six steps: Basic Profile, Work, Education, Interests and Experience, Agreements, and Submit. The "Basic Profile" step is currently active. The form includes a placeholder for a profile picture, followed by input fields for First Name (XYZ), Middle Name, Last Name (ABC), Date of Birth (4 Oct 1987), and Gender (M, F, Other). To the right, there are input fields for Email (xyz.abc@gmail.com), Address (prem galli kholi #420), Hometown (Lucknow), Mobile Phone (123-456-7890), Home Phone (987-654-3210), and Languages (English - Proficient). A note at the bottom states: "*Note: This information will be used for verification". Navigation buttons for "< Back" and "Next >" are located at the bottom of the form.

Figure 5. First iteration of Registration Form (multi step form)

During the usability tests we found that users were overwhelmed by the form and had many questions regarding why certain points were being asked of them. Volunteers mentioned that they were excited by the idea of signing up to teach children but were not clear of the time commitment that was required from them. The registration form looked long and cumbersome which made them uncomfortable when signing up.

Action: As a result, we changed the form as shown below to be a simple form which volunteers were more used to seeing, minimized the data collected from the form and communicated why we were capturing data from certain fields.

The image shows a registration form titled "Create an Account" with a background of faint educational icons. The form contains the following fields and options:

- Email:** A text input field.
- Password:** A text input field.
- Password (again):** A text input field.
- Name:** A text input field with the placeholder "Please enter your name".
- Gender:** Radio buttons for "Male" and "Female". A note states: "Gender (This helps match students to you -- children are more comfortable speaking to the same gender)".
- Year of Birth:** A text input field with the placeholder "Please enter your year of birth - volunteers must be over 18 to teach".
- Mobile Phone Number:** A text input field with the placeholder "Please enter your number so our system can call you when you have to teach".
- Hometown:** A text input field with the placeholder "Please enter your hometown - this helps when matching students to you".
- Current City:** A text input field with the placeholder "Please enter your current city - this helps know where our volunteers are coming from!".
- Current TimeZone:** A dropdown menu with "Select an Option".
- Highest Degree Received:** A dropdown menu with "Select an Option".
- Besides English - what regional language do you speak?:** A text input field with the placeholder "This helps us match volunteers and students who speak the same local language".
- Level of Proficiency:** A dropdown menu with "Select an Option".
- Any other regional language you speak? (Optional):** A text input field with the placeholder "This helps us match volunteers and students who speak the same local language".
- Level of Proficiency:** A dropdown menu with "Select an Option".

At the bottom of the form is a dark blue "Register" button and a link: "If you already have an account [sign in](#)".

Figure 6. Second iteration of Registration Form

Volunteer Profile Page - Session Feedback Form screen

Insight: The Session Feedback Form screen is opened when a volunteer is conducting an English language lesson with a student. The mockup as designed below in the first iteration was meant to allow the volunteer to see the lesson plan, assess the student's progress and record feedback during a class. The idea of having one screen to refer to when teaching a class was appealing to the user but the title and layout of the screen was extremely confusing.

Figure 7. First iteration of Session Feedback Form

When testing the second iteration of the screen, volunteers mentioned that the items on the page were useful but disorganized as they didn't know what parts of the screen were meant to be referred to and what parts required action from their end.

Figure 8. Second iteration of Session Feedback Form

Action: We split the Session Feedback Form screen into two parts. On the left was the read only screen that volunteers would refer to and on the right were fields that the user would need to take actions on. We also aligned the objects on the page into columns to create a visual hierarchy of the information, improve recall of the UI and to reduce cognitive overload.

Figure 9. Third iteration of Session Feedback Form

Volunteer Profile Page - Student Details Modal

Insight: The student details screen allows the volunteer to view details of the child they are assigned to teach. In the first iteration of the screen as shown below, volunteers wanted to see more qualitative information about the child and did not want to be exposed to personal details of the child.

Figure 10. First iteration of Student Details Modal

Iterating on the feedback from the lo-fi prototype, we minimized the information of the child and added a short narrative of the child to give the volunteer some more context of who they will be teaching. When testing this iteration of the screen, volunteers expressed that they really like this feature but that they wanted more details on the child's progress in the system and would like to see what was taught in the previous class.



Figure 11. Second iteration of Student Details Modal

Action: We changed the student details page and added more detail of a child's progress within the system. We displayed statistics of the student's use with IVR platform so that volunteers could see the effect the live speaking lessons were having on the children and use it as a point of inquiry. Additionally we added feedback and details of what was taught in the previous teaching session.



Figure 12. Third iteration of Student Details Modal

2. Qualitative Interviews

Interviews provided valuable feedback into the preferences of users using the Flyover platform and most importantly it helped highlight information needs of the volunteers. Our key findings are synthesized below:

Child to remain the central focus on the platform

"I would like children to be the main focus of the platform"

- Volunteer

Insight: Users wanted the children that they taught to be the main focus on the platform. They didn't like the notion of receiving badges or awards for using the platform but stated that they would rather receive feedback from the child or hear about experiences of other volunteers. Users mentioned that they wanted the platform to comfort and guide them through the teaching process not convince them that they had to teach.

Action: We removed the badges awarded to the volunteer from the screen, highlighted the details of the children the volunteers were assigned to teach and provided a detailed lesson plan for each teaching session.

Concerns with quantifying the progress of a child

Insight: Volunteers mentioned that although they wanted to see how a child was progressing within the system, they did not approve of the notion of awarding a star or a quantitative measure to the child.

Action: We added more qualitative aspects to the feedback form and provided more narrative information about the child to the volunteer. Statistics on the child's progress were shown however majority of these statistics focused on the scores children achieved when they used the offline IVR system not when the volunteer was teaching the child. We also added more details around previous classes taken by the students on the system as volunteers expressed that this would be an important data point for them when teaching.

Privacy and security concerns

Insight: Although volunteers wanted details of the child they wanted to teach, they expressed their concerns with being exposed to too much information about the child. They also didn't want personal information such as their address or their phone number being exposed to the child or their parents.

Action: We immediately minimized the information revealed to the volunteer about the child and provided more qualitative information about the child instead. Only first name of the child was provided to the volunteer and to give the volunteer a little more context we only exposed the volunteer to the city and state the child was from not their current address. Our system places the phone call to the child and the volunteer during the session so neither party are aware of each other's phone number.

4.2 Voice Application

The purpose of conducting usability test for voice application was to validate our design decisions about the voice application flows. It was also meant to gauge the students' enthusiasm and engagement with the system. We also conducted brief qualitative interviews with students after the usability test to get a understanding of how effective the flow was while using the interactive voice response system. We wanted to use the interview to understand their hesitations and their experience on our platform.

Here, the purpose of usability test was to check:

1. Whether the overall navigation and workflow patterns were easy to use and effective?
2. Whether a student understood the format of the content, which included instructions, lesson prompt, questions and options?
3. Whether the voice instructions were clear and easy to understand?

4.2.1 Participants and Test Process

Four volunteers and four students were selected as they matched our personas as described in appendix in detail. In order to test both synchronous and asynchronous medium, we first conducted 2 synchronous sessions for each pair, followed by one asynchronous session for each student, followed by second synchronous session.

4.2.2 Key findings for synchronous sessions

Phone network issues

Our first iteration informed us of one of the major foundations of our system which is its dependence on phone network. During our testing there were instances of dropped calls and unreachable calls. We realized that sometimes these situations confused students about whether they were going to receive a call back from the voice application.

Hardware issues

During our testing we encountered some instances where sound from student's end was unclear. In order to improve voice quality, we recommended student to use earphones. But this led to echo in voice reception. We had to ask the student not to use earphones to avoid this issue. This made us realize that our application was prone to hardware issues and it was very difficult for us to deal with these issues remotely.

Need of reinforcement

Qualitative interviews with students after the live teaching sessions made us realize the need of reinforcement of English lessons for students. Some students expressed the desire to repeat the lessons. We could provide this repeated access to content in two ways - synchronous and asynchronous. To avoid issues with scalability we decided to opt for asynchronous model. This approach not only addressed this problem but also validated the need for asynchronous model.

Need of building rapport

After observing multiple volunteers and students we realized that it was very important for students to be comfortable with volunteers. Therefore while designing our lessons, we decided to devote initial lessons focused around building the rapport. It also included knowing students' likes and dislikes. Once students were comfortable with volunteers, they could be engaged in teaching.

Need of contextualized content

Based on our observations of synchronous sessions, we realized that students felt more engaged when volunteers talked to them about their interests, for example, movies, sports etc. This made us realize that we need to design our lessons keeping in mind students' interests to keep them engaged.

4.2.3 Key findings for asynchronous sessions

Need for training

Our first iteration informed us of the key issues with our recorded instructions which were meant to guide students through the system. We realized that these recorded instructions had to be recorded in both local language and English. Moreover, they had to be in Indian accent for better understanding. One of the instructions required participants to press the pound key after a number. Participants made errors in the first run where they could not understand what "Pound" key was. This made us realize that we needed to provide training to these students before making them use our IVR platform.

Varying levels of content

During our testing we realized that students had varying levels of English literacy skills based on their exposure. For our first round of testing we had recorded few lessons based on our assumptions of the levels of the students. But, after our first trial, we had to bring down the level of these lessons to accommodate students with not so good English literacy skills. This made us aware of the fact that we need to have content with varying levels on our system. Moreover, we need to provide students with the flexibility to switch levels of lessons based on their own pace and without any intervention of volunteer.

5 Implementation Details

5.1 Voice Application

There are lots of voice-based tools available for developers, some free, some open-source, some cloud-based. Before starting the development of our application we evaluated multiple platforms available in the market. Here are some of the platforms we evaluated.

5.1.1 Existing Voice Application Platforms

1. **Awaaz.De**^{xxix} is a relatively new open source voice message board. It allows people to call to a number, leave voice messages and listen to others' messages. They provide a hosted-service in India. The system was built on top of IBM tools (Spoken Web, WebSphere Voice Server), requiring not only access to proprietary commercial software, but also a skilled team that can develop the application on top of it. This platform mainly allows only asynchronous delivery that is broadcasting of recorded content. In our case, we wanted to support both synchronous and asynchronous delivery; therefore we decided not to use this platform.
2. **Asterisk**^{xx} and **Freeswitch**^{xxi} are 2 great open source projects with incredible communities and support. Both are similar in features, and provide PBX capabilities. Almost anything-voice can be built on top of Asterisk or Freeswitch but the issue is that both require a highly specialized programming knowledge and are far from simple to deploy, configure, use and maintain. Based on the available resources and time, we decided not to use these platforms.
3. **Twilio**^{xxii} and **Plivo**^{xxiii} - These platforms allow software developers to programmatically make and receive phone calls and send and receive text messages using their web service APIs. Their services are accessed over HTTP and are billed based on usage. We mainly avoided these platforms because of their limited functionality for India and monetary reasons.
4. **Verboice**^{xxiv} - Verboice is a set of free and open source tools that allows organizations and communities to build their own Interactive Voice Response (IVR) applications using the infrastructure and skills they have available. Phone numbers can be setup using Skype and IPKall which are used in the Verboice to route calls. We avoided this platform because of its restrictive graphical user interface functionalities and its interfacing with other platforms such as Skype.
5. **Voxeo**^{xxv} - It is a development platforms for unified customer experience (self-service) and unified communications (real time communications) applications. It provides Interactive Voice Response (IVR) platform called Prophecy. Upon registering it provides multiple ways to access the application for free. These access numbers include USA domestic number for voice and SMS, iNum number, USA toll free PIN access, Skype VoIP, SIP VoIP, Phono number and SMS botkey. Applications can be developed using VoiceXML, CallXML or CCXML. Customer service team for this platform is very responsive and resolves the issues very

quickly. There is also a forum for developers where most of the questions are already answered.

After evaluating all the options and based on the recommendations from other developers, we decided to use Voxeo to develop our application because of the flexibility to write our own code and test it using the provided US number.

5.1.2 Voice Application System Architecture

We used CCXML (Call Control XML) as the language to develop our application. CCXML provides a complete telephony service application, comprised of Web server CGI compliant application logic, one or more CCXML documents to declare and perform call control actions, and to control one or more dialog applications that perform user media interactions. CCXML provides support for multi-party conferencing, with advanced conference and audio control. A conferencing application involves multiple participants, and is dependent upon call control to establish relationships between those participants.

The architecture of telephony implementation consists of four primary components

- A caller (along with the telephone network),
- A dialog system (e.g. a VoiceXML implementation),
- A conference server used to mix media streams,
- CCXML implementation, which manages the connections between the caller and the dialog system.

As shown in the diagram below, a caller calls the number for telephony web application, which in this case is our hotline number. Call request passes through a conference server. This conference server mixes the media streams and then passes the events to CCXML interpreter. This interpreter parses the CCXML scripts for the telephony web application and takes the required action. For example, in our case, it will play instructions or lessons based on the keys, which are pressed by users.

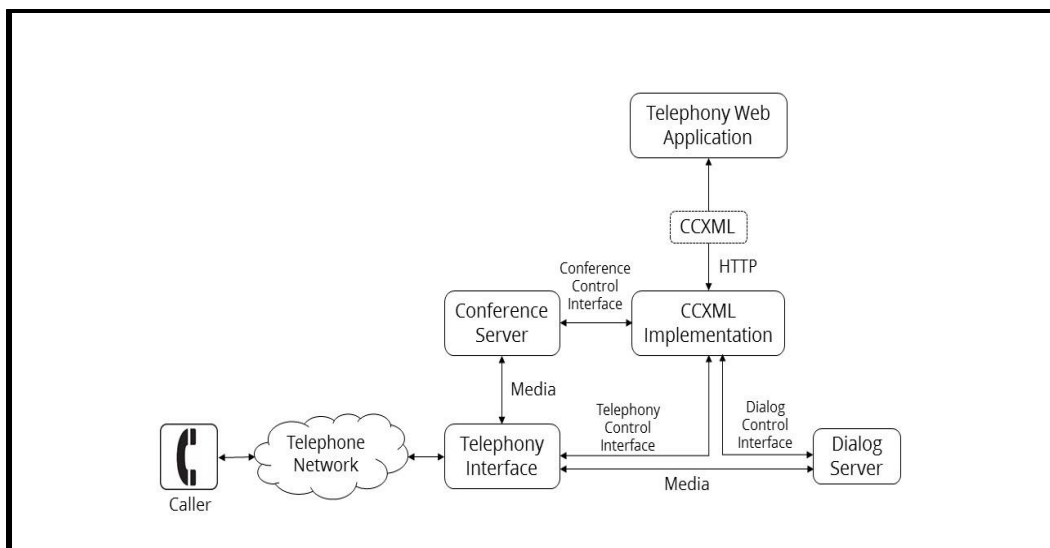


Figure 13. Voice application architecture

5.2 Web Application

Meteor is a complete open source platform for building web and mobile apps in pure JavaScript. We considered multiple frameworks such as Angular, Meteor etc. before implementing the web application. Meteor has the few advantages over other frameworks.

- Reactivity is built throughout the stack between client and server. Application is realtime.
- Integrates seamlessly with MongoDB
- JavaScript is the only language throughout the application
- Availability of web packages such as calendar etc. increasing code development

With these factors in mind, we designed our functional prototype using Meteor^{xxvi} JavaScript framework. For implementing a full working system, we recommend using a web framework such as PHP etc. to avoid the scalability and performance issues Meteor potentially causes.

5.3 Integrated Solution

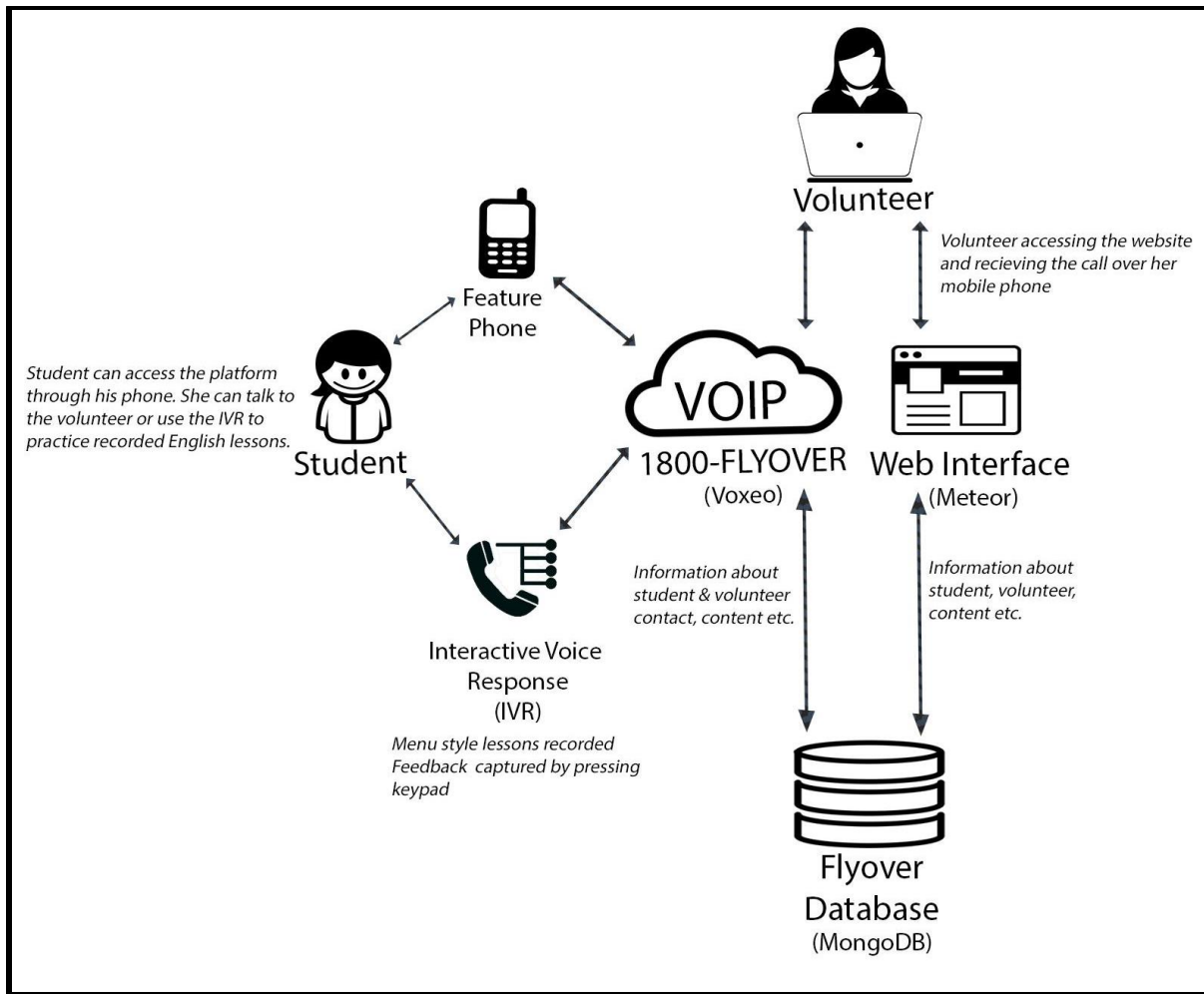
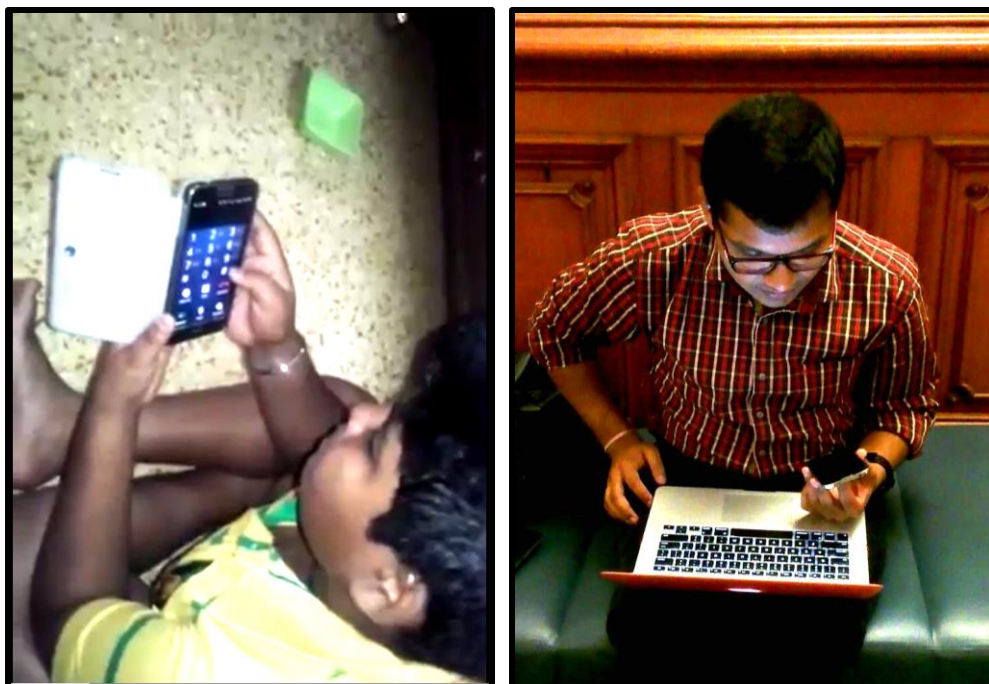


Figure 14. Final Flyover Integrated Solution

The final integrated solution will be a complete end-to-end system that supports voice, web and SMS interactions connected by a common database. The system will include a fully functional IVR system using the Voxeo, which will input and retrieve information from a MongoDB database. The website will operate on the same database and provide the most current information to the users. The volunteer can use his phone and web interface together while teaching the student. The student will also have access to the IVR system in which she can practice with recorded lesson.

6 Product Walkthrough



Images from voice application and web interface testing

6.1 Voice Application

There are mainly 3 scenarios for our voice application.

1. **Registration** - The main purpose of first call is to register the student and perform their level 0 assessment for English literacy skills. When a student calls for the first time on our toll free number their details such as phone number and time of call are recorded on the system. Application plays a welcome message in both Hindi and English, which greets them and informs them that they will get a call back on their number. The main reason to design it this way was to avoid waiting time on caller's part. In future, with enough resources to handle the incoming calls, we would prefer to attend their calls instantly rather than calling them back.

2. **Synchronous sessions** - After registration with the system, live teaching sessions between student and volunteer are scheduled by our application. At a scheduled time both the parties call on the toll free number and enter 1 followed by # key. In the backend, the pre-assigned conference ID which is same for both the parties. After the synchronous session gets over, details of the calls such as time and duration are recorded in the system. We also plan to send SMS to the parents of the student in future using our system to keep them updated with student's progress.

3. Asynchronous sessions - After the synchronous session is conducted, students have the option to listen to recorded lessons over the phone. To practice these lessons and complete the exercises, students can call on our toll free number and press 2 followed by # key to listen to the recorded lessons. After that students enter the lesson number to listen to a particular lesson. We recorded these lessons in both Hindi and English keeping in mind students' level. As the students make progress they are presented with harder lessons. After listening to a lesson, they are presented with the questions and answer choices. For every question, four possible choices are presented. To answer those questions they press the key for correct option number. Their responses are recorded in the system to assess their performance. In future, our aim is to record these responses in the database and present them to teaching volunteers for effective teaching.

Here are sample logs for three different scenarios for our voice application developed in Voxeo.

- Joining the conference

```
00100 1fab 03:51:12 AM matched transition at line 93 (, getConfID, ) @ eventhandler (, state_0)
00101 1fab 03:51:12 AM log: *** callerID: (XXXXXXXXXX) ***
00102 1fab 03:51:12 AM log: *** callerName: [Siddharth] ***
00103 1fab 03:51:12 AM log: *** Caller is registered with the system ***
00104 1fab 03:51:12 AM action: DIALOGSTART _linenumber="109" conferenceid="" undefined" connectionid="3d912cb9b52c69f882d50588f0bb4c79" dialogid="" getConfID_Dlg" enctype="application/x-www-form-urlencoded"
hints="" method="get" parameters="" preparedialogid="" src="audio/AsyncL1/intro_gyaan.mp3?termidigits=%23&maxtime=90000&text=Hello Siddharth Enter your conference I D followed by the pound
key. Enter 2 as conference I D for completing your English lessons." type="application/x-fetchdigits" namelist=""
```

- Listening to lessons and questions

```
00126 1fab 03:51:51 AM matched transition at line 274 (playLesson, dialog.exit, ) @ eventhandler (, state_0)
00127 1fab 03:51:51 AM log: *** USER PRESSED: [1] ***
00128 1fab 03:51:51 AM log: *** USER CHOSE LESSON 1 ***
00129 1fab 03:51:51 AM action: SEND _linenumber="278" delay="0s" hints="" name="playLesson1" sendid="" target="09c16498f3800065f0292434b9131fab" targettype="ccxml" namelist=""
(sendid=c880586cb6d830fd74302858a3e639f9)
```

- Disconnecting the conference

```
00146 1fab 03:52:10 AM matched transition at line 76 (, connection.disconnected, ) @ eventhandler (, state_0)
00147 1fab 03:52:10 AM log: *** CALL DISCONNECTED ***
00148 1fab 03:52:10 AM action: EXIT _linenumber="78" expr="" undefined" namelist=""
00150 1fab 03:52:10 AM SESSION_END: sessionStartTime=1431057014473756 sessionEndTime=1431057130204924 sessionLength=115731
appID=502391
```

Currently, our main focus was to test the IVR as the medium. For testing purposes, we created and recorded lessons that were used to test the medium. In future, we would like to include more features as mentioned above and test the robustness of the system with more users and more recorded content. Further details about our future scope have been described the “Next Steps” section.

6.2 Web Application – Unregistered User

Landing Page

The landing page has been intentionally kept simple, visual and vibrant with clear messaging to compel volunteers to sign up using the conspicuous Register button on the navigation bar.

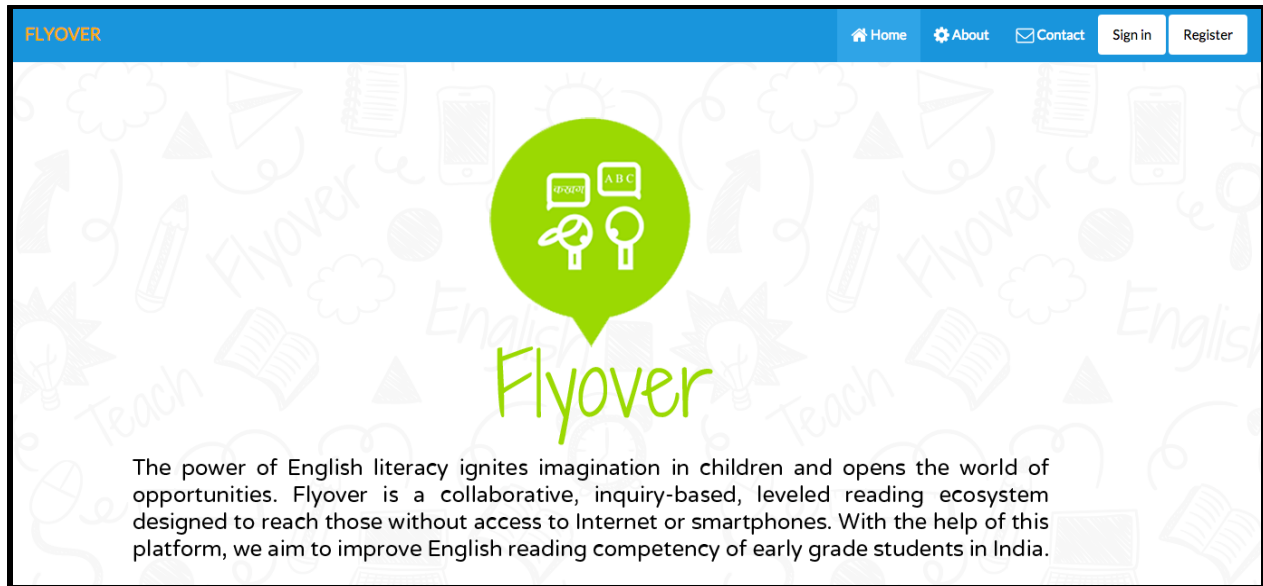


Figure 15. Landing Page

Registration

Upon clicking 'Register' the volunteer will see a form asking for basic details, while omitting highly sensitive information like complete birth date and address. Notably, the volunteer is asked about hometown and regional languages he can speak along with the proficiency. This helps us to better match volunteers to students based on affinities like common regional languages spoken so that the volunteer can use the mother tongue as an aid to teach English. Upon successful registration, we envision that the volunteer will land in the onboarding and training section, which he would complete before proceeding. However, as of now, the volunteer directly lands at the next logical page - the Schedule.

FLYOVER Home About Contact Sign In Register

Create an Account

Email

Password

Password (again)

Name

Gender (This helps match students to you – children are more comfortable speaking to the same gender)
 Male
 Female

Year of Birth

Mobile Phone Number

Hometown

Current City

Current TimeZone

Highest Degree Received

Besides English - what regional language do you speak?

Level of Proficiency

Any other regional language you speak? (Optional)

Level of Proficiency

Register

[If you already have an account: sign in](#)

Figure 16. Registration Page

6.3 Web Application - Registered Users

Scheduling

A volunteer - whether newly registered or already part of the system - can use this page to pick students to teach according to his availability. The slots on the calendar represent students available to learn at that time every week for a fixed period of time, for example, 3 months. A volunteer is expected to be responsible for the same student for such an extended period of time so that both the parties can develop a rapport and have a successful teaching/learning experience. The volunteers will already have this information during onboarding where expectations will be set.

FLYOVER Home Profile Schedule Resources

Schedule

Below calendar shows the students you will be teaching. Each event on the calendar is one class. To drop a class, click on the event and press Delete.
 To add a new student to your calendar, please click [here](#).

May 4 – 10 2015 month week day

	Mon 5/4	Tue 5/5	Wed 5/6	Thu 5/7	Fri 5/8	Sat 5/9	Sun 5/10
8am							
9am				9:00 - 10:00 Devarshree			
10am			10:00 - 11:00 Sita			10:00 - 11:00 Karan	
11am					11:00 - 12:00 Bushra		
12pm							

Figure 17. Schedule Page

Volunteer Profile

This will be the landing page for existing users after signing in. New users can navigate to this page after picking a class schedule from the Schedule page. This page, then, reflects the basic details of students who the volunteer will be teaching. The volunteer can use the links to view more details about any student. Below the student information is a table of upcoming class sessions that are scheduled for the volunteer. The volunteer can view the basic details of any session by looking at the respective row in this table. He can also search the table using the text bar above, order entries by any column and control the number of sessions displayed in the table. He can also click on a row to view the details of the session.

The screenshot displays the 'Volunteer Profile' page. At the top, there is a blue navigation bar with 'FLYOVER' on the left and 'Home', 'Profile', 'Schedule', and 'Resources' on the right. The main heading is 'Volunteer Profile'. Below it, a message states: 'Below are the students that you will be teaching. Click to view their details and see their progress. Upcoming classes that you have taught or are about to teach are in the table below'. There are four student cards, each with a person icon, name, grade, and city, and a 'More Details' link. The students are Sita (Grade: 6, City: Pune, Maharashtra), Devarshree (Grade: 6, City: Rampur, Bihar), Karan (Grade: 6, City: Rajasthan, Rajasthan), and Bushra (Grade: 6, City: Sevan - Village Laheji, Bihar). Below the student cards is a 'Sessions' section with a message: 'Upcoming classes that you have taught or are about to teach are listed in the table below. Click the row to view the lesson plan and record feedback for a session.' There is a 'Show: 10 entries' dropdown and a search bar. The sessions table has columns: Date, Time, Lesson, Student, and Status. The first row is highlighted in blue: April 2, 2015, 10am PST, Module 0 First day: Building a rapport with the child, Devarshree, Not Started. The second row is: April 5, 2015, 10am PST, Module 2: Review and Expanding Upon Introductions, Sita, Completed. At the bottom left of the table, it says 'Showing 1 to 2 of 2 entries'. At the bottom right, there are 'Previous', '1', and 'Next' buttons.

Figure 18. Volunteer Profile Page

Student Details

Volunteer can click on 'More Details' under a student on the Volunteer Profile page to view comprehensive details about the student and his learning progress. These include:

- Description about the student including interests (as captured during the first onboarding call with student)
- Notes from previous sessions for the student
- Visualizations of assessment scores from both live as well as recorded sessions, depicting progress of the student.

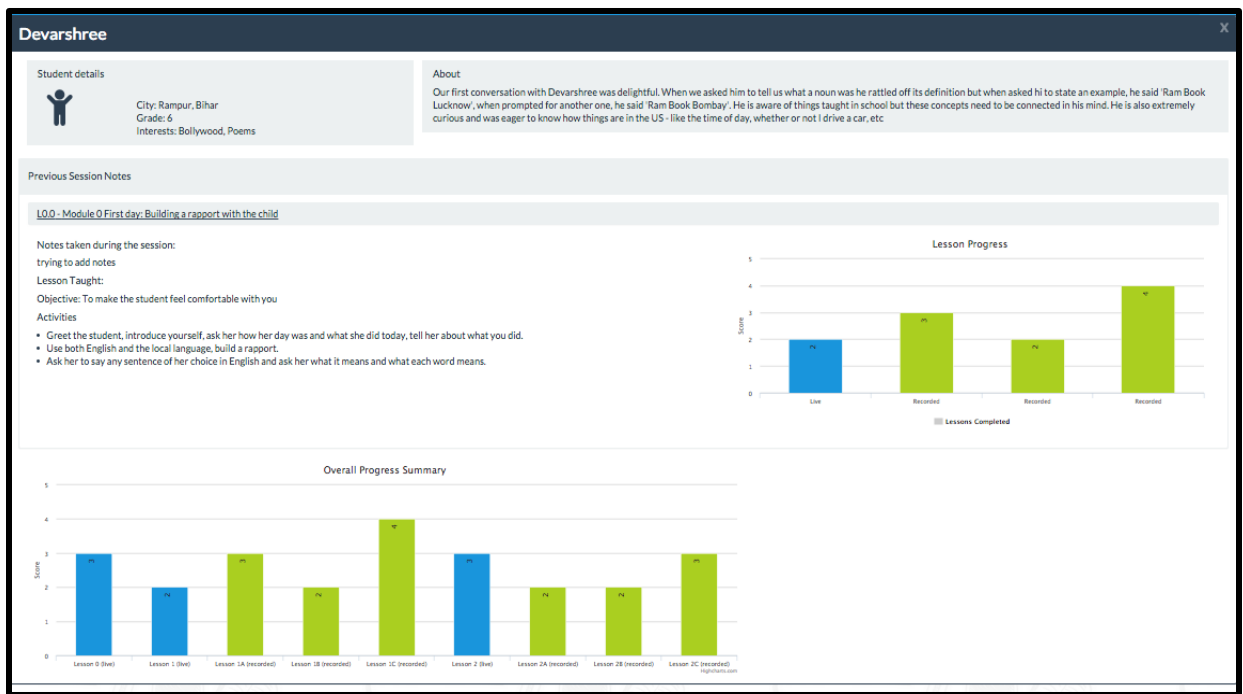


Figure 19. Student Details Modal

Color has been used strategically to differentiate between the live and recorded lessons. This is meant to serve as the roadmap of the student's progress, thus lending some context to the volunteer. We hope that this combination of qualitative and quantitative factors would be a successful indicator of progress and point to the teaching effectiveness.

Session Feedback

This screen is meant to have all the information that a volunteer would need before and while conducting a live teaching session. It has the student's details, notes from the previous session, plan for the current session and links to resources. Additionally, volunteer is required to enter comments (to be sent to parents occasionally) and notes (to self or other volunteers), conduct and check off assessment items and request to repeat the this lesson again if deemed necessary.

Session Feedback Form

<div style="background-color: #d9ead3; padding: 5px; border: 1px solid #ccc;"> Student details Devarshree Rampur, Bihar Grade 6 Likes Bollywood, Poems </div>	<div style="background-color: #d9ead3; padding: 5px; border: 1px solid #ccc;"> Previous Session Notes sita's notes </div>	<div style="background-color: #d9ead3; padding: 5px; border: 1px solid #ccc;"> Current Session Notes (Notes for self and future volunteers) <input style="width: 100%; height: 20px;" type="text"/> </div> <div style="background-color: #d9ead3; padding: 5px; border: 1px solid #ccc; margin-top: 10px;"> Assessment <input type="checkbox"/> No assessment for this lesson </div> <div style="background-color: #d9ead3; padding: 5px; border: 1px solid #ccc; margin-top: 10px;"> Comments (Comments to be sent to the student's parents periodically) <input style="width: 100%; height: 20px;" type="text"/> </div> <div style="background-color: #d9ead3; padding: 5px; border: 1px solid #ccc; margin-top: 10px;"> <input type="checkbox"/> Repeat this Lesson </div>
---	---	---

Lesson: Module 0 First day - Building a rapport with the child

Objective: To make the student feel comfortable with you

The first interaction with the child is important to help build a rapport and get the child excited about you and about learning to speak English over the phone. Have a conversation with the child -- you can use both English and Hindi. When the child gets more comfortable, switch to using English and Hindi. Speak slowly in English and translate that in Hindi for them. Ensure that the following things are communicated: 1) Explain that the goal will be to improve her English by learning and practicing together. Sound excited and upbeat and keep telling them how fun it will be. 2) Say bye on a happy note, and remind her you will call back soon. Ask them to practice her sentence with others.

Resources

Resource1

Figure 20. Session Feedback Form

Resources

This screen allows the volunteers to access resources that they can use to help them prepare for a lesson that they will conduct.

FLYOVER

[Home](#)
[Profile](#)
[Schedule](#)
[Resources](#)

Resources

Lesson Plan

FAQs

Training Videos

Assessment Reports

We have created a comprehensive collection of resources for you to refer to. Please click on the icon to access the files belonging to a particular category. If you find anything missing then feel free to contact us .

Figure 21. Resources Page

Admin Dashboard

This screen allows the website administrator to access the usage details and monitor the progress of the server. At the top, it shows 4 main statistics of the system - registered students, registered volunteers, number of synchronous sessions and number of asynchronous sessions. Below that, it shows the progress for these 4 metrics over time. In future iterations, we would like to implement notification panel as shown in the right lower panel.

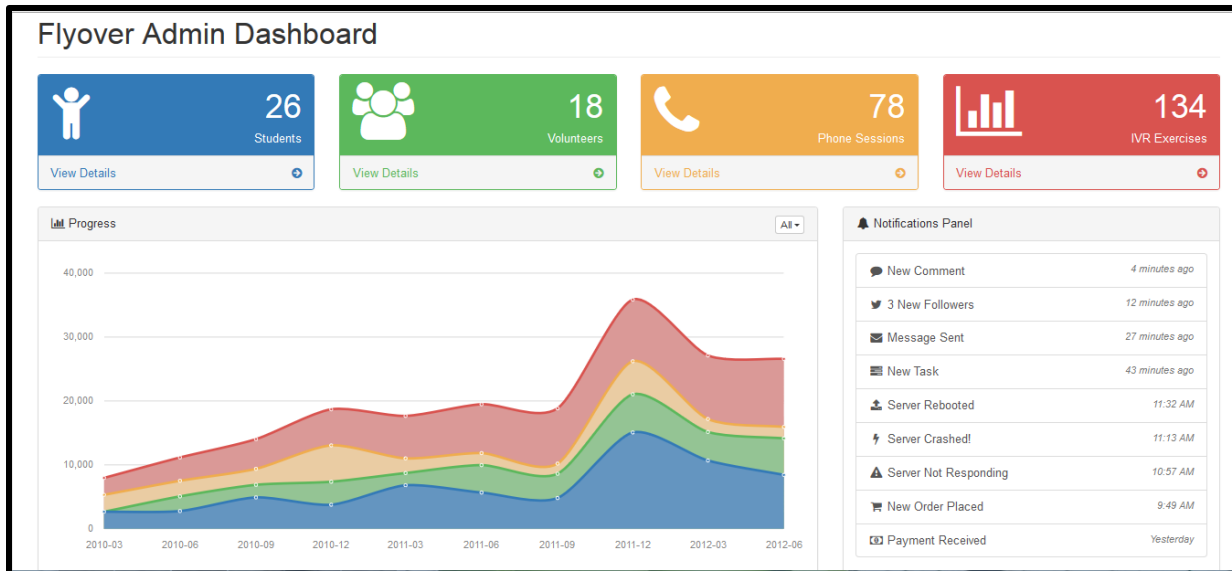


Figure 22. Admin Dashboard Page

7 Security and Privacy Considerations

Since our system will be connecting volunteers with children we wanted to consider security and privacy implications that our system should have. To do so, we assessed our system against India's *national legal privacy framework* to highlight security and privacy considerations that would arise if our solution is to be built in a production environment. Conducting a privacy assessment for our system is a good start to approaching privacy by design and promoting privacy and data protection from the start rather than an afterthought. Our pilot project has been able to adopt some of the principles in its design but further consideration would be needed when we consider growing our project beyond a pilot.

7.1 Overview of India's Privacy Policy

India's most comprehensive legal provisions on Internet privacy were passed in the Information Technology Act (ITA) in 2000. As a response to that law, a group of committee experts created a set of recommendations for a privacy framework and to be in compliance with the legislation^{xxvii}. The Report recognizes privacy as a right of an individual and defines nine National Privacy Principles applicable to legal parties storing personal information.

One thing to note is that though the National Privacy Principles in India were made to be in line with global standards including EU, OECD and APEC privacy principles and are the strongest the country has ever had, the EU does not recognize these principles, as they don't meet their standards of "data secure"^{xxviii} and gaps still exist. Additionally India does not have an equivalent of the US online children privacy law, COPPA.

7.2 Application of our System to the Nine Privacy Principles

Principle 1 - Notice and Principle 2 - Choice and Consent

These two principles require a notice before collecting any PII and it is only after consent has been given, that the PII of the individual can be recorded. Individuals must be given the option to opt in or opt out with regard to providing their data.

In the case of our project, one of the user groups providing consent to use our system is the parents of the children who in our case, tend to be illiterate or of a poor reading level. The Principles do not take the different literacy levels into account but simply state notice and consent. The Group of Experts on Privacy Report however does recognize that "from an Indian context, integration of illiterate and poor residents in the overall privacy design especially in the implementation of user centric principles is a major challenge^{xxix}".

Currently, when we reach out to parents of the students to help test our pilot system, we explain the goals of our system, how it will work and what information we would need from their child to the parent. This process can be formalized and once we have the parents' consent, we can connect the parent to our hotline and give them the option to opt in or opt out of our system by interacting with the IVR. On the backend, we

ensure that our system only makes calls to those students for whom this consent has been taken for. This takes account the literacy level of the consenting parent and confirmation of their consent, which could be revoked by calling our system's hotline.

Principle 3 - Collection Limitation and Principle 4 - Purpose Limitation

In our initial low fidelity prototype we mocked up the web interface and when testing the interface with the volunteers we received feedback about the data being collected. Test users asked questions about the data being asked off of them and stated what level of information they would need to know about the student in order to teach. Using this feedback we removed details from our pages and added tool tips to communicate why certain information was being collected from the volunteer. In the table below we map out what data is collected by our system.

Although we have done user testing, it was not for the specific purpose for implementing privacy by design. The European Union considers user testing to be good practice and welcomes "the explicit inclusion of a stakeholder consultation process as part of the internal procedures needed to support the execution of a PIA" (Art 29 WP, 2011)^{xxx}. PIA is a tool designed to promote 'privacy by design', better information to individuals as well as transparency and dialogue with competent authorities (Art 29 WP, 2011)^{xxxi}. The Group of Experts on Privacy Report only talks of user centricity with regards to Principle 1 and 2 but not in terms of Principle 3 and 4. Including stakeholders in the design process is considered to be best practice and can be adopted if future iterations of our prototype will be made.

Consideration	Student	Volunteer
What data is collected? (Synchronous Content Delivery—systems calls student and volunteer)	<ul style="list-style-type: none"> • First name only • Gender • Grade • Name of school and the state it's in • Local language • Mobile phone number of their parents • Likes/Dislikes • Information about their progress and difficulty in school 	<ul style="list-style-type: none"> • First and Last Name • Gender • Year of Birth • Mobile phone number • Hometown • Current city and timezone • Highest degree received • Language proficiency
What data is collected? (Asynchronous content accessed via IVR)	<ul style="list-style-type: none"> • Phone number used to call the system to track progress and interactions with IVR interface • Time of call • Scores of the quizzes and activities interacted with 	<ul style="list-style-type: none"> • N/A
Why is it collected?	<ul style="list-style-type: none"> • To build a general profile of a particular student so that a volunteer has some context prior to when they teach. • Gender of the student is captured to allow our system to handle some of the cultural context within which 	<ul style="list-style-type: none"> • To assess the skills of the volunteer to teach • To match the availability of the volunteer with the child. • The information on gender is collected so that volunteers can

	<p>this interaction takes place. Parents are more comfortable when volunteers of the same sex teach their children.</p> <ul style="list-style-type: none"> • The parent's phone number of the parent is in our system which allows us to connect to the volunteer to the child at an assigned time. • The phone number is also collected so that a student's usage and progress of recorded asynchronous content can be recorded 	<p>be matched to students of the same gender.</p>
--	--	---

Principle 5 - Access and Correction

Our interface should allow a volunteer to edit the details that they have provided to our system via the web interface. The use of the hotline can also be used by the parents of the students to access and correct details pertaining to their child.

Principle 6 - Disclosure of Information

Personal information would not be disclosed to third parties.

Principle 7- Security

Although we can take measures to secure the data stored in our system, a lot of the information that is exchanged between our users is verbally over the phone. One of the other weaknesses of our system is the verification of the volunteer. We can use a volunteer's LinkedIn profile to try and confirm the professional identity of a candidate but that does not provide any information of the integrity of the person itself. Volunteers from any part of the world can teach students over the phone but background checks differ from country and country and may not be feasible for us to do.

Principle 8 - Openness

This principle ensures that privacy policies are made transparent and accessible and that information is provided in multiple languages. When we reach out to parents to enroll their students into our system, we only reach out to them if we have a native or bilingual fluency in that regional language or dialect. This would allow us to converse with both the parent and child and explain what our system is doing thus in principle adhering to this standard.

Principle 9 - Accountability

Currently for our pilot we have no accountability measures in place for privacy but that would be a consideration if we expand the scope of our project beyond the initial pilot.

8 Challenges

8.1 Process Challenges

Below are the challenges we faced while working on this project.

Remote operation

Operating out of Berkeley while working on a project based on India posed challenges at every step of our process like user research needs assessment and usability testing. We addressed this by making reliable connections in India with schools and social workers that have access to children and also leveraged our personal network to assist us through the process. We had to deal with the difference in time zones by working nights. Some of our volunteers were located in other parts of the US, while the children were located in India, so we had to deal with as many as three time zones at a time. We always made sure to carry out any research and testing activities during reasonable hours according to Indian Standard Time that would work for children.

Constraints posed by the tech stack

For our web application, we used Meteor - a framework to create responsive, real time web applications entirely in Javascript. While we chose the framework for these features and the speed with which we could develop, the stack posed some unique challenges. One of these was the database. Meteor comes with MongoDB, an unstructured document-oriented database that stores data in the form of JSON objects. This makes it very difficult to write complex queries involving large number of joins between tables. One workaround was to create a single large nested fractal data structure containing all the data. This would have been an attractive option if we had just a few tables, which was not the case. The large and complex hierarchical structure of our database required us to normalize it, which was not particularly suitable for modeling relationships between the various tables. Other challenges included difficulty in finding and using packages for various UI elements and functionalities, which would work with Meteor. This especially affected the visual design of our app as we had limited options of templates that would work well with Meteor. We eventually used a Twitter Bootstrap template for Meteor and customized it, which was highly time consuming.

Difficulties in implementing Voice Application

As per Telecom Regulatory Authority of India (TRAI) rules, currently in India, it is legal to use VoIP, but it is illegal to have VoIP gateways inside India^{xxxii}. This was a big challenge from the development perspective. We had to evaluate multiple options for VOIP gateways based in US. These platforms provide a free US based number for incoming calls and messages. Since we had to test our platform with users in India, we had to follow a workaround and call our users and IVR number in conference. This allowed us to test our system with users but they could not call our hotline number directly without avoiding international calling charges.

Content

For the purpose of testing, we had to create custom engaging content, for both synchronous and asynchronous modes. While we interviewed some ESL content specialists and received guidance, we struggled to manage the level of difficulty in the content. We were aware that students had varying levels of passive knowledge of the language and a one-size-fits-all approach to creating content would be ineffective. We had to experiment with difficulty levels and iterate over the sample content several times.

8.2 Solution Challenges

Below are the challenges we anticipate if we further pilot and implement our platform.

Awareness

The success of our system depends heavily on awareness among both students and volunteers. On the students' side, we plan to build awareness by forming strategic partnerships with schools and other relevant organizations such as Teach For India, Akanksha Foundation, etc. On the volunteers' side, we will use our personal networks and leverage social media to expand our reach. We will also partner with for-profit organizations interested in CSR initiatives and activities to gain access to larger volunteer pools. Indian diaspora communities scattered around the world will also serve as sources of more volunteers.

Motivation

All actors in the system have expressed strong interest. However, we realize that our system's success depends largely on the motivation of all the actors involved - volunteers, students and their parents. Lack of motivation might result in attrition. This in turn will propagate into the system, reducing its effectiveness in the absence of enough volunteers or students. To overcome this challenge, there will be a dedicated effort to engage users through orientations, meetups, and incentives and reward programs. We will use loss-aversion in our messaging to keep motivation levels up for both students and volunteers. We will also incorporate the feedback mechanism to find the root cause of attrition.

Parents were largely comfortable in letting their children talk on the phone to a stranger. However, we noticed some reservations with parents of a girl child about this. We have decided to mitigate such reservations by assigning girl children to female volunteers. This will ensure girls don't hesitate from talking to volunteers and parents are more comfortable in the process. We will also do affinity-based matching in other areas like language, region, background to ensure comfort and motivation of all actors.

Resources

Resource unavailability and/or misuse will be detrimental to the success of our solution. We will distribute feature phones with SIM cards to children who do not have access to phones at home. Ensuring the intended use of these phones would also be a major challenge. To mitigate this risk, we plan to collect a refundable deposit from parents for

these phones. This will act as a financial responsibility on the part of parents and will ensure proper handling of phones.

Safety

We realize that our system involves interaction with vulnerable subjects such as children. To mitigate any risks, we will be extra sensitive to protect their identity and information. We plan to anonymize the data at all stages, scramble phone numbers, and maintain system logs. We will also ensure that their interactions with volunteers are completely safe. Volunteers will be required to undergo a background check and comprehensive training process before they start teaching. We will also obtain consent of all actors, comply with all relevant laws and obtain the required security clearances. Clear policies will be outlined for all actors. We had an unpleasant experience during one of our usability tests, wherein a child was being prompted by somebody in the background to ask questions of a personal nature to the volunteer. While this is a rare phenomenon and we cannot control for each and every edge case, the training program will also include rights of volunteers and guidelines to deal with all possible conceivable situations. Additionally, we will implement feedback mechanism to address the grievances and educate all users to make their experience completely safe.

Quality

We realize that the quality of our system depends on the teaching competency of volunteers. While we impart training to all volunteers during onboarding, we also need to account for differences in teaching styles and ensure that consistency and quality is maintained. This is especially important since the content itself is static. A fine balance has to be maintained between customizing the experience to every child and effectively achieving the learning goals. Flexibility and personalization are built into our solution itself since volunteers are instructed to adapt and personalize the lessons to match the student's abilities while still adhering to the lesson plan and guidelines, to maintain consistency. We will also cap the number of students a volunteer is responsible for to maintain quality standards.

9 Next Steps

Content

Building engaging content will define the success of our system to a large extent. Our user research has proved that culturally and contextually relevant viral content like Bollywood, cricket, etc. crosses all socio-economic barriers and opens children up to the learning process. Building such contextualized content and ensuring compliance with CEFR standards will require deep ESL subject matter expertise and experience with building such locally relevant content. We have a contact (of Indian origin) at Harvard Graduate School of Education who will advise us on this matter.

IVR in India

Currently, our IVR system is hosted on Voxeo's staging environment, which is meant to be for development and testing purposes. In production environment, we aim to host the IVR system in India so that our users can call on our hotline without being worried about the calling charges. Voxeo allows buying the numbers in India too but there are other platforms based in India too such as Kookoo^{xxxxiii} which we can be evaluated.

Data pipeline between web app and IVR

One part of our solution is to capture students' scores on the asynchronous recorded audio lessons and make them available to volunteers who could monitor overall progress of these students and build on past knowledge. Currently, our web application and IVR application work independently since they are hosted on 2 different platforms. But in future, we would have to send these recorded responses from Voxeo application to our web application developed on Meteor using a secured channel.

Affinity based matching of students-volunteers

We plan to match volunteers to students based on a number of affinities like gender (especially for girl children), language and region. However, we still wish to give volunteers flexibility with their schedule. To handle this, we will do one level of filtering based on the information the volunteer provides during registration and only place the pool of students that match the volunteer's characteristics on his calendar. The volunteer can then pick students in the time slots that suit him. This matching algorithm is still to be developed and will be one of our immediate next steps.

Notifications and Feedback

We plan to send text notifications to children on their mobile phones about upcoming classes and changes to schedule if any. We will also send timely updates and feedback to parents about students' progress and milestones achieved, to keep them involved in the learning process. Based on insights from our user research, we plan to frame the feedback positively and emphasize achievements rather than adopting a formal assessment and reporting model. No information about scores will be shared with parents.

Onboarding and training program

We plan to develop a comprehensive onboarding and training program for both students and volunteers and a secondary process for parents. Students who have expressed interest by calling the Flyover toll-free number will be contacted via phone call and their personal information and availability will be recorded. We will also perform a Level 0 assessment of their English competency, while remaining sensitive and making them comfortable in this first conversation. A dialogue will also be established with their parents during this call. Both parties will be asked for consent and receive directions about further steps. Volunteers will register through the website and complete the training process (guideline documents, videos, FAQs, case scenarios, etc.) before they can proceed any further. Orientations and meetups will be conducted for both volunteers, students and parents.

Privacy, security, legal issues and compliance

We plan to seek expert advice on Indian laws and best practices related to storing information of children. We will also establish a procedure to conduct background checks for volunteers. This operation will be outsourced. Additionally, we will require volunteers to provide references during the registration process. We will also establish terms and conditions of use and obtain informed consent from all users. Lastly, we will comply with any government regulations that apply to the solution and obtain any required clearances.

10 Team and Partnerships

10.1 Team

All four team members are Master of Information Management and Systems students at UC Berkeley's School of Information. As such, we not only have access to professors and mentors at the I School who, relevantly, are experts in technologies for learning, ICT4D, and text processing, but we are also uniquely positioned to consider such issues of technology in society as privacy. Additionally, since four members are from India, the country in which we will pilot our idea, we have the cultural and subject knowledge to design for our target users.

Siddharth Agrawal is a skilled IT professional, passionate about designing, creating and guiding products from conception to launch. Prior to Master's program, he has worked with Cisco as a software developer and possesses strong knowledge about networking and telecommunication domain. For the past year, he has been working on *Dhang Se Padhai*, a non-profit initiative aimed at delivering quality education to over 100 million children through volunteerism in India. As a technical architect and product developer in this project, he plans to carry forward his passion to serve underprivileged children in India.

Ankita Bhosle completed her undergraduate studies in Computer Science from the University of Pune, India. She has three years of startup experience, designing and engineering several software products. Recently, she was a BI Analyst Intern at Symantec. Her focus at the I School is Product Management. She cares about gender and cultural inclusion and using technology as an enabler in education. She will be involved with research and design, as well as managing communication with various stakeholders in India.


Divyakumar Menghani graduated from Mumbai University in 2009 with a degree in Computer Science. He worked as a Management Consultant at Deloitte for over four years, where he served several Fortune 100 companies. He also led multiple corporate social responsibility initiatives at Deloitte and collaborated with Teach for India, Umang. Recently, he was a Data Science intern at LinkedIn. In this project, he will play the role of product developer and build the technical components of the entire solution.

Sufia Siddiqui has five years of experience as an Operations Strategy consultant at Accenture, where she implemented projects with governments and corporations in the U.S. and with a large international humanitarian organization in Haiti. She will manage the scope of the project and ensure that needs of various stakeholders are managed and get translated into technical requirements.

11 Appendix

11.1 Personas

Persona for Volunteer

Pia	
Age	26
Education	Graduate/PhD from US University
Distinguishing Characteristics	<ul style="list-style-type: none"> - Person of Indian origin in US/UK etc. - Millennial, mid 20s and above - Can speak one of the Indian local languages - Hindi, Marathi, etc. and English fluently - Desire and passion to contribute to the community and home country - Acutely aware of state of education system in India - Comfortable with use of technology and can be trained for teaching online - Upbeat/Chatty with children, engaging and conversational in nature - Teaching/Volunteer experience preferred but not necessary
Motivation	<ul style="list-style-type: none"> - Interested in helping and giving back to the community
Goals	<ul style="list-style-type: none"> - Be able to provide his availability in the system so he can conduct classes - Conduct classes via phone - Quickly review the content to be used in class - View student profile to know English competency - Provide feedback to students about their progress
Frustrations/ Challenges	<ul style="list-style-type: none"> - Doesn't know or not confident about teaching - Not sure about where to start - Not necessarily fluent in the local language to translate concepts back and forth - Can't devote too much time due to busy schedule
Quotes	<p>"I am willing to spend time and help someone"</p> <p>"I have time for something like this..."</p>
Activities and interests	<ul style="list-style-type: none"> - Often busy at work but still passionate towards education and the need in India - Participating in CSR activities often


Questions	<ul style="list-style-type: none"> - How will the system work? - How do I know when to teach? - Will I be trained? - What happens if a student doesn't show up? - Will there be content predetermined? - How to conduct assessment on the phone? - Will I get to interact with the student beyond the phone?
Comfort with Technology	<ul style="list-style-type: none"> - Comfortable with using Internet and basic apps such as email, calendar etc. - Comfortable with social media
Scenarios	<ul style="list-style-type: none"> - Registration and Onboarding - Reviewing content before conducting class - Providing his schedule and matching with student - Conducting a class - Conducting assessment, providing feedback

Persona for student

Shanti	
Age	12
Education	Grade 5 in a government school
Distinguishing Characteristics	<ul style="list-style-type: none"> - Lives in a satellite town in India - Comfortable in Hindi or another regional language - Speaks local language at home - Uses local language to learn English and translate back and forth - Uses local language to ask questions in all classes including English - Limited exposure to English(3x30mins = 90mins/week) + No one speaks English at home etc. leading to almost no environment to speak English - English competency: <ul style="list-style-type: none"> - Can read/write basic English learnt by rote learning in school - Limited knowledge of basic grammar/spelling/pronunciation/vocabulary - Cannot speak fluently - Limited conversational skills - Struggle in connecting sentences to make a coherent story in English, comfortable in local language to make stories
Motivation	<ul style="list-style-type: none"> - Aspires to learn English and be able to speak more fluently without losing self-confidence - Fascinated and curious to talk to someone new (the volunteer) in this case and know more about them, how they live etc.
Goals	<ul style="list-style-type: none"> - Be able to convert the passive knowledge of English to active knowledge - Be able to converse in basic English and express their thoughts - Able to build fluency, coherence in constructing sentences
Frustrations/ Challenges	<ul style="list-style-type: none"> - Not having enough awareness of resources related to English - Not having the resources to help them learn English on their own - Shyness in speaking in front of others - Scared about being put in the spot, observed and judged - Fear of saying something wrong in English leading to embarrassment
Quotes	<p><i>"Main Angrezi bolne mein kamzor hoon, padhna likhna aata hai phir bhi" ["I am weak in speaking English but can still read and write"]</i></p>
Activities and	<ul style="list-style-type: none"> - Plays sports such as Cricket, listens to commentary and can understand scores etc.

interests	<ul style="list-style-type: none"> - Watch Bollywood movies/songs which have some English words and dialogues very often - Few of students like to read
Questions	<ul style="list-style-type: none"> - Who will talk to me? - What do I do in the call? - Will I get the call or receive the call? - Will I have homework? - Can I be friends with the volunteer? - Can I ask the volunteer some questions around what they do etc.?
Comfort with Technology	<ul style="list-style-type: none"> - Comfortable with mobile phones - can dial, use camera, apps such as WhatsApp, Games etc.
Scenarios	<ul style="list-style-type: none"> - Registration - Joining a class and talk to volunteer for their lesson - Reviewing content on the phone

Persona for Parent – Secondary actor in case of Flyover

Ram	
Age	36
Education	Basic school education until Grade 10, few completed undergraduate degree
Distinguishing Characteristics	<ul style="list-style-type: none"> - Lower middle class upbringing and socio-economic background, often a migrant from a village to the town - Lives in a satellite town working in a shop or a small organization - Living paycheck to paycheck usually with limited savings - Understand the importance of education - Ambitious about their child's education - Aware of the education system in India and their child's school - Willing to pay more money if the quality of education can be improved in school/tuition - Knows how to use a phone and willing to give the phone to the student if it is for a good purpose and their education - Willing to send the child to English speaking classes to gain the skill if needed - Frustrated from the quality of teaching at school
Motivation	<ul style="list-style-type: none"> - Interested to help and willing to do anything that helps their child's education - Improve support to their child's English
Goals	<ul style="list-style-type: none"> - Help their child in learning the language by providing more resources - Internet, books, newspapers etc. - Support the child and encouraging them
Frustrations/ Challenges	<ul style="list-style-type: none"> - Worried about their child being left out due to inadequate quality of school/teacher - Frustrating to work with limited resources in the small town - no good Internet, lack of good schools/teachers - Increasing cost of providing a good education to school but still not getting enough quality
Quotes	<p><i>"Zaroor phone denge bacche ko, agar uske padhai ke liye hai toh"</i> ["Will certainly give the phone to my child if it helps him in his education"]</p> <p><i>"Angrezi ki zaroorat toh hai aage jaake"</i> ["English is necessary as the child moves ahead"]</p>
Activities and interests	<ul style="list-style-type: none"> - Usually work between 9am to 5pm including weekends sometimes - Willing to spend time with their child around topics related to education

	- Have attended parent-teacher meetings and raised their concerns
Questions	- How do I trust the volunteer/system? - Can I talk to the volunteer and get some feedback and build some rapport?
Comfort with Technology	- Limited technology exposure, know basic usage of phone, but not as advanced as their students often
Scenarios	- Know about the progress of their child - Participate in a lesson or exercise with their child

11.2 Balsamiq Prototype

Link: <http://bit.ly/1EUbnO3>

11.3 Consent Form

Link: <http://bit.ly/1bCk9FT>

11.4 Low Fidelity Usability Test

Test Script: <http://bit.ly/1Jva2hL>

Test Tasks: <http://bit.ly/1Jva2hL>

11.5 High Fidelity Usability Test

Tasks: <http://bit.ly/1Pu18CM>

11.6 Interview Question Guide

Link: <http://bit.ly/1DVMcXE>

11.7 Sample Lessons Recorded for IVR application

Link: <http://bit.ly/1zIlyFj>

11.8 CCXML IVR Code Sample

Below code shows the joining event. If student and volunteer are not registered, they listen to the welcome message. If they are registered and enter 1, they are placed in conference for synchronous session.

```
<transition event="getConfID">
  <assign name="state_0" expr="'getConfID'"/>
  <assign name="callerName" expr="getNameFrom(callerID)"/>
  <log expr="*** callerID: [' + callerID + '] ***"/>
  <log expr="*** callerName: [' + callerName + '] ***"/>
  <if cond="callerName == 'undefined'">
    <log expr="*** Caller is NOT registered with the system ***"/>
    <dialogstart src="audioPath + 'playMessage.wav?text=Hello, thank you for calling us.
    Looks like you have not registered with us. We will call you on this number to
    get your details. Have a great day. Goodbye.'"
      type="audio/wav"
      dialogid="playMessage_Dlg"
      connectionid="call_0"/>
  <else/>
    <log expr="*** Caller is registered with the system ***"/>
    <dialogstart src="audioPath + 'AsyncL1/intro_flyover.mp3?termdigits=%23&
    maxtime=90000&text=Hello ' + callerName + ' Enter your conference I D
    followed by the pound key. Enter 2 as conference I D for completing your
    English lessons.'"
      type="application/x-fetchdigits"
      dialogid="getConfID_Dlg"
      connectionid="call_0"/>
  </if>
</transition>

<transition event="joinTheConf">
  <assign name="state_0" expr="'joinTheConf'"/>
  <dialogstart src="audioPath + 'joinTheConference.wav?text=You will now join
  the conference. Press the pound key to exit without disconnecting.'"
    type="audio/wav"
    dialogid="joinTheConf_Dlg"
    connectionid="call_0"/>
</transition>
```

Figure 23. CCXML IVR Code Sample

12 Citations

- i UNESCO (2009). Education For All Global Monitoring Report - Page 14. Available online http://www.unesco.org/education/gmr2009/press/efagmr2009_Summary.pdf
- ii Rahman, Maseeh. 'Language Exodus Reshapes India's Schools'. the Guardian. N.p., 2012. Web. 1 Mar. 2015.
- iii British Council (2009). Project English.
- iv English Impact Report: Investigating English Language Learning Outcomes at the Primary School Level in Rural India
Available at
http://www.britishcouncil.in/sites/britishcouncil.in2/files/english_impact_report_2013.pdf
- v Pratham (2012) Annual Status of Education Report (ASER). Available online at www.asecentre.org/education/India/status/p/143.html
- vi Web.worldbank.org,. 'South Asia - Teachers Skipping Work'. N.p., 2015. Web. 1 Mar. 2015.
- vii Rahman, Maseeh. 'Language Exodus Reshapes India's Schools'. the Guardian. N.p., 2012. Web. 1 Mar. 2015.
- viii indiaelt,. 'Multilingualism As A Resource In An English Classroom In A Non-Native Context'. N.p., 2015. Web. 2 Mar. 2015.
- ix indiaelt,. 'Multilingualism As A Resource In An English Classroom In A Non-Native Context'. N.p., 2015. Web. 2 Mar. 2015.
- x Adams, MA (1990) Beginning to read: thinking and learning about print. Cambridge, MA: MIT Press.
- xi Berry, V (2013) Investigating English Language Learning Outcomes at the Primary School Level in Rural India. British Council
- xii Lee, Dayoung, and Seema Jayachandran. *The impact of mobile phones on the status of women in India*. MobileActive, 2009.
- xiii Parikh, T. (2005) Using Mobile Phones for Secure, Distributed Document Processing in the Developing World. IEEE Pervasive Computing. Vol 4(2): 74-81.
- xiv Kumar, Anuj, et al. "An exploratory study of unsupervised mobile learning in rural India." *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2010.
- xv Lee, D., & Jayachandran, S. (2009). The impact of mobile phones on the status of women in India. MobileActive, Retrieved from http://economics.stanford.edu/files/Honors_Theses/Theses_2009/Lee,%20D.%202009.pdf
- xvi The Economic Times,. 'English Speaking Courses A Hit With The Masses; Training Institutes See Huge Opportunities'. N.p., 2013. Web. 26 Jan. 2015.
- xvii Evidyaloka.org,. N.p., 2015. Web. 10 Feb. 2015.
- xviii Annual Report on eVidyaloka Operations - http://www.evidyaloka.org/static/uploads/careers_files/Annual_Report_AY_12-13.pdf
- xix Awaaz.de,. 'Awaaz.De | Mobile Solutions For Social Impact'. N.p., 2015. Web. 7 May 2015.
- xx Asterisk.org,. 'Asterisk.Org'. N.p., 2015. Web. 7 May 2015.
- xxi Freeswitch.org,. 'Freeswitch.Org | Communication Consolidation'. N.p., 2015. Web. 7 May 2015.
- xxii Twilio.com,. 'Twilio - Apis For Text Messaging, Voip & Voice In The Cloud'. N.p., 2015. Web. 7 May 2015.
- xxiii Plivo.com,. N.p., 2015. Web. 7 May 2015.
- xxiv Verboice.instedd.org,. 'Verboice'. N.p., 2015. Web. 7 May 2015.

-
- xxv Evolution.voxeo.com., 'Voicexml And CCXML Developer Site'. N.p., 2015. Web. 7 May 2015.
- xxvi Meteor. (n.d.). Retrieved May 4, 2015, from <https://www.meteor.com/>
- xxvii Report of the Group of Experts on Privacy. Available at:http://planningcommission.nic.in/reports/genrep/rep_privacy.pdf
- xxviii Business Standard. Data secure status for India is vital: Sharma on the FTA with EU. September 3rd 2013. Available at: http://www.business-standard.com/article/economy-policy/data-secure-status-for-india-is-vital-sharma-on-fta-with-eu-113090300889_1.html
- xxix Page 23, Report of the Group of Experts on Privacy. Available at:http://planningcommission.nic.in/reports/genrep/rep_privacy.
- xxx Article 29 Data Protection Working Party (2011). Opinion 9/2011 on the revised Industry Proposal for a Privacy and Data Protection Impact Assessment Framework for RFID Applications, Brussels, Adopted on 11 February 2011. Available at:
- xxxi Article 29 Data Protection Working Party (2011). Opinion 9/2011 on the revised Industry Proposal for a Privacy and Data Protection Impact Assessment Framework for RFID Applications, Brussels, Adopted on 11 February 2011. Available at:
- xxxii <https://web.archive.org/web/20141006100940/http://www.trai.gov.in/WriteReaddata/ConsultationPaper/Document/cpaper12may08.pdf>
- xxxiii Kookoo.in., 'IVR Applications Through Web, Cloud IVR, Automatically Answer Calls'. N.p., 2015. Web. 6 May 2015.