

The Social Complexities of User-Centered Design in ICTD: Experiences from Four Schools in India's Villages and Slums

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Abstract—Low levels of education remain a barrier to economic empowerment in the developing world. In our work on English language learning among underserved communities in India since 2004, we have observed differences between school communities in terms of their access to educational opportunities outside school, access to ICTs including cellphones and digital gaming, enthusiasm for visitors, and the relationships between students. We report on these observations and argue that they call for the greater use of a comparative approach in constructing models of the micro-cultures at various schools, so that user-centered design processes and methods can better account for the unique differences across communities.

Index Terms—Developing Countries, Educational Technology, User-Centered Design

I. INTRODUCTION

Low levels of education and literacy remain a barrier to economic empowerment in the developing world. Despite possible skepticisms about the benefits of ICT for education in developing regions, however, this idea is not far-fetched. At least two non-government organizations (NGOs), Pratham and the Azim Premji Foundation, have incorporated educational computer games into their initiatives for children in the urban slums and rural areas of India respectively. Most importantly, a randomized longitudinal experiment over more than two years with over 10,000 urban slums children, undertaken as a collaboration between Pratham and development economists from MIT, showed significant gains on mathematics test scores when children played computer games that target mathematics learning on a twice-weekly basis [1].

User-centered design (UCD) is a broad term that denotes

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the design philosophy in which users are involved in some way in the design process [2]. UCD has led to products that are more effective, efficient, safer, and better adopted by users [3]. But as Heeks [4] and Raiti [5] have commented, the field of ICTD currently suffers from the problem where the ICT literature is not wholly integrated with the literature in development. In particular, while UCD is a methodology that has evolved out of the ICT community, it is less clear how UCD can be applied effectively in the specific context of ICT for education in the developing world.

We argue that the existing development literature provides little directions for UCD in the educational domain. High-level survey papers such as [6] and similar work at the macro-level suffer from the tendency to obscure individual differences that are crucial to technology designers. Conversely, rich accounts of ground conditions, such as Sainath's award-winning work that covers rural education and other domains in India [7], do not include ICTs in the equation. We feel that this shortcoming is problematic given our view of culture as a phenomenon that is mutually co-constituted and co-constructed by various actors using the technological tools at their disposal, such that the introduction of ICTs facilitates profound changes in culture.

Similarly, among the projects in ICT for education in the developing world, those that have entailed some sort of UCD processes (e.g. [8]-[10]) have not focused on the contextual differences between communities of learners as the object of investigation. We argue that these variations are as important to the technology designer as are the commonalities across use settings.

This paper aims to address this gap in the literature. We first present background information on an ongoing project which we started in 2004 to address the demand for English language learning among underserved learner communities in India. We then describe four schools in India's villages and slums where we have worked in throughout the project's lifecycle. We next report on our findings from our baseline assessments, efforts in building relationships with learners and technology trials to show the differences between the four school communities in terms of access to educational opportunities outside school, access to ICTs including cellphones and videogaming devices, enthusiasm for visitors,

and the relationships between students. We conclude by proposing that these observations call for a greater use of comparative approaches in creating models of micro-cultures at various schools, so that UCD processes can better account for the differences across communities.

II. PROJECT BACKGROUND

Economic opportunities are often closed to those who are literate only in a regional language. India for example has 22 regional and 2 national languages Hindi and English. English is the language of opportunity [11]-[13]. It is the language of instruction in private schools, government and corporations. The value of English is widely recognized by ordinary Indians, and it is the poorest who are lobbying most strongly to expand English teaching. Owing to teachers in rural schools who are not able to speak the language, however, English teaching in public schools is not succeeding and is often out of reach of children who cannot attend school regularly due to their need to work for their families in the fields or households [14].

At the same time, cellphones are being used by Indians at all economic levels, creating an opportunity for mobile games that target English learning in out-of-school settings, at places and times that are more convenient than school. We also believe that our work will transfer to other languages and places. Since this project started in 2004, we had completed six field studies with children from the urban slums and rural areas of India. Our total time in the field was six months. In the more recent studies, we had designed and piloted a set of English learning games on cellphones. Local researchers participated to lend a deeper understanding of the local cultural context.

In the following section, we provide some background on the schools and the conditions in which we conducted UCD, so as to contextualize the observations that we will next report.¹

III. SCHOOLS

We observed that the school settings where we performed UCD varied along multiple dimensions, including management (government-run vs. privately-run), location (rural vs. urban), infrastructure and access to ICT, and availability (were our sessions conducted during or after school hours?). Although we have visited eight other schools – three public rural schools and a private school for slums students run by a charitable trust in North India, as well as a private rural school administered by a charitable trust and three public rural schools in South India – we settled on the following four schools to conduct our feasibility studies. Our overriding concern was that the local community, from the

NGO partner to the teaching staff, had to be supportive of our work, since such relationships were key to successful fieldwork in developing regions.

We conducted our third field study in July 2005 at a rural government school in Lucknow (Uttar Pradesh, North India). It is located in a very remote rural area and we had to travel 75 km (1½ hours) each way from Lucknow's city center to reach it. It has about 250 Hindi-speaking students (grades 1-8) and classes are housed in over five classrooms in two single-story buildings. There are 5 teachers who taught regular classes in the mornings in Hindi as the medium of instruction. It also has a computing center with 3 computers. Although students have weekly computer classes, these lessons are often cancelled or revert from hands-on training sessions to lectures because of frequent electricity shortage. Our sessions took place over two weeks in the afternoons to avoid disrupting morning classes. Every session lasted 3 hours. In total, 12 children (grades 4-8, ages 10-16) participated in the study. There were 10 girls and 2 boys.

Our fourth study took place in August 2006 at an afternoon school founded and directed by one of our non-government organization (NGO) partners. The school premises are located right in Lucknow. This private program targets girls from the neighboring slums who would otherwise not have the chance to receive schooling. Classes are free-of-charge, are conducted using Hindi as the medium of instruction, and last 3½ hours every afternoon since students have household duties in the mornings. Computer lessons are part of the curriculum and are conducted twice per week. Electricity access is more reliable here in the state capital city compared to the villages. Students join the afternoon school program when parents hear about it from word-of-mouth or when teachers make home visits to convince parents about the value of formal schooling for their daughters. In all, we worked with 14 kindergarten and 1st grade students (ages 4-6) as well as 11 6th-grade students (ages 11-15). Every session lasted about two hours in the morning, when we could obtain permission from parents to excuse their daughters from household chores for the duration of our study.

Our fieldwork in January 2007 and June to July 2007 was conducted at a rural government school in Mysore (Karnataka, South India). It is in a remote village that is seldom visited by outsiders. The school has about 60 Kannada-speaking students and three teachers. In comparison with the above government rural school in Lucknow, there are only two classrooms at this school. Similarly, there is one donated computer in the school premises but it is only used infrequently due to power outages. We worked with all 47 students from grades 2-5 (ages 7-10). Since classes run from the mid-morning until late afternoon, our NGO partner suggested that our sessions take place in the mornings when students are most energetic. This schedule was acceptable to the teachers when we restricted each student's participation to an hour per day, on average.

We conducted a field study in August 2007 at a private rural school in Lucknow (Uttar Pradesh, North India). It is located in a fertile agricultural area where inhabitants grow

¹ Even though our project aims to complement school-based learning by promoting learning in out-of-school settings, for logistical reasons such as having an accessible location where children could easily congregate to participate in our studies, especially after school hours, we found it necessary to hold our studies at their school premises after some consultation with our non-government organizations partners.

cash crops such as mangoes. It is conveniently located off a highway and it takes less than an hour one-way from Lucknow's city center to reach it. It has about 200 students (grades 1-10) and classes are housed in classrooms in a double-story building. Classes run from the mornings to the early afternoon using English as the medium of instruction. It also has a computing and audio-visual center backed up by a power generator, which makes regular computer lessons possible. Our sessions took place in the afternoons in order to avoid disrupting morning classes. Every session lasted about two hours. 35 children (grades 1-6) took part in the study in total.

For brevity, in the rest of this paper, we refer to the above schools as LUCKNOWPUBLIC, LUCKNOWSLUMS, MYSORE and LUCKNOWPRIVATE respectively. This combination of private and government-run schools, where we ran our studies during school hours or after-school hours, allows us to juxtapose our experiences from vastly different contexts.

IV. BASELINE ASSESSMENT

UCD begins with the fundamental question: "Who are the users?" Of particular importance is the baseline of the target learners in terms of their English competency and familiarity with ICTs, which influences the complexity of the cellphone games that we design for them. We used our initial exploratory studies to learn about our participants in an ad-hoc manner, and these findings in turn led us to assemble a more structured questionnaire that we could use when conducting standardized "demographics interviews." The survey included questions on parental occupations, cellphone ownership and usage in the family, possible tuition attendance outside school, the child's aspirations and activities that the child engage in after school.

However, it was only during the summer of 2007 that we had enough time in the field to conduct these interviews. The results in this section therefore applied only to MYSORE and LUCKNOWPRIVATE. In all, we found interesting consumption patterns for private tuition, even as access to cellphones and videogames were higher than we originally anticipated.

A. English Competency

We were not surprised that children at LUCKNOWPRIVATE were more proficient in English relative to the students at MYSORE, since the former's English teachers could converse fairly well in English compared to their counterparts at rural government schools. While the students at MYSORE (and also LUCKNOWPUBLIC and LUCKNOWSLUMS) had a vocabulary that was restricted to a handful of spoken English words, students at LUCKNOWPRIVATE had a more comprehensive knowledge of the English language in terms of vocabulary and grammar that seemed "bookish." We believed that this was the result of them acquiring English mostly from textbooks, as opposed to interactions with English speakers outside school. We also learned that textbooks used at LUCKNOWPRIVATE were issued by a national examination board whereas other schools where we conducted fieldwork at made use of

textbooks from state-level boards (exams administered by a national board was perceived to have higher credentialing value throughout India).

What was more surprising was that only 6% of students at LUCKNOWPRIVATE attended English tuition outside school, as opposed to 50% of the students at MYSORE. To be more exact, tuition attendance at LUCKNOWPRIVATE was reportedly higher during the summer holidays, but parents would stop sending their children to tuition classes once the semester is underway. A plausible reason was that school fees at LUCKNOWPRIVATE were comparable to those at a typical semi-urban school even though LUCKNOWPRIVATE was located in a rural region. As such, parents presumably felt that there was no need to incur additional costs with tuition lessons in the regular semester, especially when LUCKNOWPRIVATE offered classes that were taught by relatively well qualified teachers. On the other hand, parents at MYSORE had no choice but to continue with tuition classes due to the poor quality of English instruction at their children's school.

B. Familiarity with ICTs

The demographics interviews conducted at MYSORE and LUCKNOWPRIVATE brought out a number of differences which reflected the variations in the economic and social status of the families residing there. Of the students at LUCKNOWPRIVATE who participated in the demographics interviews, 97% of their families owned cellphones, as opposed to 60% at MYSORE. Subsequently, 67% of our respondents at LUCKNOWPRIVATE had used cellphones previously for playing games or making calls to relatives. On the contrary, only 43% of the respondents at MYSORE had used cellphones before. Furthermore, their use of cellphones were restricted to mobile games and not making calls, since we understand that airtime were expensive to them.

We believe these differences could be attributed to parental occupations. The parents of the students at LUCKNOWPRIVATE were primarily doctors, local shop owners or land-owners who cultivate cash crops such as mangoes. These professions were higher paid compared to teachers or factory workers, as was the case at MYSORE.

Although none of the children at LUCKNOWPRIVATE or MYSORE owned home computers, we were surprised to learn about the access to videogames among the former group. Four of them reported that they owned handheld game consoles. These devices are inexpensive (about US\$5-8 each), but suffer from limitations such as the lack of a color display, the lack of support for polyphonic sounds (which is essential for teaching conversational English) and already come pre-programmed. One of them added that his parents will be buying him a game console that could be connected to a television output display. On the higher end of the scale, two more respondents had prior experience with Atari cassette videogames. However, only one respondent owned a device, namely, a Nintendo console, at the highest end of the scale. Nonetheless, we distinguish between ownership and access by noting that several children were familiar with videogames on the

Nintendo because its owner was generous in allowing them to play it at his home.

In contrast, the only videogames that students at MYSORE had been exposed to were simple games such as Snake on their parents' cellphones. These differences in access to videogames and cellphones turned out to make a difference in terms of how fast the students familiarized themselves with the games that we had designed for them to learn English.

V. RELATIONSHIP BUILDING

It is understood that relationship building is crucial to the success of the UCD lifecycle; the term "relationship building" has become mainstream in the development rhetoric. But *how* can technology designers working on ICT-based solutions for education in developing regions build strong relationships with users? We aim to provide a starting point for addressing this question by describing how our experiences differed across the above schools.

The situation that we faced at MYSORE was different from the other three schools, in that it was the only site where we required Kannada-speaking interpreters; we did not need that many interpreters at the other schools since the local members in our team were Hindi native-speakers. However, since it was not possible to fit every researcher and interpreter into our hired vehicle at the same time, the researchers waited at the school in the morning before our sessions began and again in the afternoon after our sessions had ended, when the vehicle was used to transport the interpreters to the school and back to their homes. We had initially perceived this waiting time as a negative impact on our productivity, but on hindsight, came to appreciate it as valuable time for social bonding with students.

More specifically, since the waiting times were also breaks from classes for the children, they would play outdoor games with one another on these occasions. In addition, they almost always invited us to join them in their games when they saw that we were available. Most important, several of them knew that we had brought digital cameras. They would pester us to take their photographs ("Uncle, photo please?"), after which they would exclaim in delight when we showed them the photographs on the camera's LCD preview screen.

Similarly, some of the children at LUCKNOWPRIVATE stayed back after the sessions had ended. It seemed that they did not feel comfortable enough with us to let us know why they were loitering around until we asked, whereupon they revealed that they wanted us to take their photographs. Since none of them owned a camera (according to our demographic interviews), it appeared that photo-taking was a good social bonding activity.

However, while the children at MYSORE grew closer to us as a consequence of us engaging in the above activities together, there seemed to remain a distance between the regular students at LUCKNOWPRIVATE and us. We understand from the teachers and our NGO partner at MYSORE that the students there were excited to have us around since their village was so remotely located that they hardly had any outside visitors. As such, they enjoyed our presence.

Similarly, students at LUCKNOWSLUMS knew that we arrived early every morning to setup equipment in preparation for the sessions. Hence, many of them soon turned up every morning before the sessions commenced to interact with us, presumably because they were excited to have us as visitors and wanted to learn more about us. In contrast, LUCKNOWPRIVATE was frequented occasionally by visitors, since it was a test-bed for other ongoing projects between our NGO partner and other collaborators.

It therefore appeared that relationship building with child participants was a mixture of social bonding with appropriate play activities coupled with the excitement at seeing visitors. We recommend that technology designers keep the latter in mind as a variable when choosing learner communities to perform UCD with, even as they should invest time to interact and build rapport with learners outside the research sessions.

In particular, we found that the students were very eager to show us around their communities. For instance, the students at LUCKNOWSLUMS were excited when we wanted to visit their homes to meet with their parents and learn more about their everyday lives. Similarly, children at MYSORE wanted to take us to see the main temple in their village. They became crossed when we initially turned them down since we were waiting for our vehicle to arrive and transport us back. Their unhappiness did not diminish even after subsequent days and affected our test sessions with the mobile games. For example, a girl lost her enthusiasm for the mobile games and handed the cellphone back to a researcher only after a few minutes. However, after we had agreed to visit the temple, every child – including this girl – was only more than happy to take us there. We were also greeted by several villagers on our way. On further reflection, we believe that such small gestures go a long way in building a healthy rapport with the students and adult villagers. At the least, it is one step that we could take to assure the community that we do not look down upon them in any way and that we are there with an open attitude to learn.

However, when engaging a segment of the community, it is equally important not to alienate other segments. Tensions within a community and divisions along social fault-lines such as caste remain commonplace. For instance, while we were on our way to the above temple, our child guides insisted that we skirt around a part of the village that was inhabited by some of their classmates who are "dalits" (i.e. "untouchables" caste). In order to maintain an inclusive environment in our sessions for all strata of society, we followed our guides when we were walking to the temple. But when walking back, we deliberately passed through the homes of the dalits, so as to cheer up the students from the dalit caste who were upset that other children wanted us to avoid their residences.

VI. TECHNOLOGY TRIALS

Further cultural differences between the schools manifested themselves when we field tested our prototypes with students.

A. Peer Dynamics

Even though some of our mobile games were designed with

individual play in mind, we observed that the extent to which a competitive atmosphere existed in the school community had a corresponding impact on how participants played these games. In particular, the atmosphere at LUCKNOWPRIVATE was highly competitive to the degree that children belittle or put others down when the latter fail to achieve. For instance, whenever a child won a game, he or she would walk across the classroom to a peer to show off: “See! I have won. What level are you on?” The former, independent of gender, would initiate a discussion with other nearby children on their respective game achievements. This behavior had the effect of demoralizing other children who were still struggling with the game. We later learned that some students at this school were labeled as failures by their peers and/or teachers. As such, students at this school tended to be much more goal-oriented in playing mobile games, compared to children at the other schools. For example, in a Frogger game where the goal was to help selected animals cross several road lanes while avoiding oncoming traffic and to guide these animals to collect mangoes on the other side of the road, users at LUCKNOWPRIVATE were very focused on the mangoes. When we asked which features made an impression, the mangoes would crop up inevitably and very early on in the interview.

In contrast, although we also observed a competitive streak among the children at MYSORE, the atmosphere was more supportive. For instance, players who did not complete a game would nonetheless exhibit delight for their peers who made it to the end, and they would eventually reach the end themselves anyway. There was an element of competition at MYSORE, but we did not observe that children who did well had to belittle the laggards. Similarly, LUCKNOWSLUMS students who could not keep up with their counterparts became demoralized and stopped playing after others had begun to complete the game. But the victors never taunted the laggards.

B. Relationship between Junior and Senior Students

We also observed a noticeable difference in the relationship between junior and senior students across the schools. One of the mobile games that we deployed involved peer teaching, such that the cellphone had to be shared between two users, one of whom is usually more senior (and thus knowledgeable) than the other. The game provides the more senior user with questions to pose to his or her junior counterpart in English, and the former is responsible for providing an explanation to the latter whenever he or she is incorrect.

This game was deployed at both LUCKNOWPRIVATE and MYSORE. On the whole, we observed that cooperative learning took place more effectively at MYSORE. For example, senior students at MYSORE were more conscientious in repeating each new word to his or her junior, as well as giving its explanation in Kannada. Conversely, junior students were more attentive in listening and learning from their seniors. Such group learning dynamics are particularly significant in ICTD because the lack of educational resources is highly likely to necessitate the sharing of these resources, as the work

by Pawar et al. [9] on multiple mice for computers in impoverished schools show.

We believe that this positive relationship could have existed at MYSORE because their teachers had established a precedent whereby the brightest students among the most senior students routinely help the teachers to teach their juniors. As such, the younger students at MYSORE were presumably accustomed to learning from their seniors. It appeared that this arrangement was necessitated by low teacher-student ratios and multi-grade teaching, i.e. a teacher having to teach students from multiple grades at the same time within the same classroom. Moreover, according to our interpreters, the younger children look up to their seniors because the latter help them in their chores, such as washing up their dishes after the mid-day meal in school. Despite the above incident related to caste, we emphasize that this social dynamics applied at MYSORE because the school monitor was from the dalit caste and the junior students were similarly expected to learn from him.

On the other hand, the senior-junior relationship appeared to break down at LUCKNOWPRIVATE because it was common for students in any class to have older students as their classmates, either when the latter were enrolled late or were transferred from other schools and lacked the academic preparations to be placed in the same class as their peers of the same age.

VII. CONCLUSION AND FUTURE WORK

Our experiences in performing UCD in India at the above schools have made us more keenly aware of the social norms and micro-cultures that are peculiar to – and more importantly, can possibly exist at – each school. We have found that there are marked differences between learner communities in terms of access to educational opportunities outside school, access to ICTs including cellphones and digital gaming, enthusiasm for visitors from outside, and the relationships between students.

Where do we go from here for UCD in ICTD? We argue that the rich descriptions that we have provided in this paper suggest that a comparative approach that examines differences between various communities offers a promising direction for UCD in the ICTD context.

UCD has been broadening its scope from its focus on the “task” [15] to encompass the more social dimensions of human activity [16]. In the same direction, we propose to capture the diversity across intended contexts of use by drawing on field observations to make comparisons across communities and to delineate the differences between user groups. While Hofstede [18] offers dimensions for national culture, we argue that what UCD needs are models of micro-cultures that allow technology designers to capture, express and reflect on the uniqueness of each context of use. It is not clear how exactly we can define the elements in a micro-culture, but Cole’s [19] synthesis of cultural psychology offers a starting point in this direction.

In all, we hope that our descriptions will serve as a starting

point that enable technology designers to think more deeply about differences that can exist across schools in developing regions and to account for these variations when employing UCD processes and methods. Only then can the educational technologies that they design scale by being more applicable to a wider range of schools and other learning contexts.

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