

When Understanding Follows ‘Experiencing’: A Report from Research in the Field*

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This paper describes two case studies where immersive ‘experiencing’ of a novel concept led to a better understanding of it. This approach helped bridge cultural and academic divides. By having a shared experience, the members of a multi-disciplinary, distributed project aimed at poverty alleviation created shared meaning. The creating and experiencing of prototypes proved to be a transformative experience. These cases suggest the engineering students, who are increasingly working on design projects in developing countries and other culturally unfamiliar situations, would benefit from learning to undertake such immersive experiencing as part of how they approach design. This argument is made in the context of John Dewey’s model of ‘active doing and undergoing’.

Keywords: prototyping; poverty alleviation; multi-disciplinary distributed teams.

INTRODUCTION

THE KOZMETSKY GLOBAL COLLABORATORY (KGC) is an interdisciplinary community of scholars at Stanford University engaged in the research, development and application of interdisciplinary theories and methods, in collaboration with entrepreneurs and communities for accelerating shared global prosperity. KGC’s mission is to engage the humanities and social sciences in interdisciplinary problem solving to accelerate the achievement of shared global prosperity. KGC is a research program situated within the School of Humanities and Sciences and was founded in 2003 by a gift to Stanford University from Ronya and George Kozmetsky.

In 2005, KGC initiated a project called Community Digital Vision and Voice Narrative Enactment (or Co-DiViNE for short). Co-DiViNE is aimed at creating sustainable prosperity in chronically poor, oral communities. The first pilot of the project was started in August 2005 in a village in the south of India and concluded in May 2007. The project was conducted in collaboration with a local rural university that was in close proximity to the chosen village.

The case studies presented here came out of this first prototype of Co-DiViNE. They illustrate that two of the key founding principles of Co-DiViNE are sound; namely, student interns can serve as bridges between the village people and project researchers, and the articulation of community aspirations via community self-reflection is pos-

sible. However, these two cases also illustrate the need to modify details of the pilot’s original design to make the project viable. More specifically they show the need to engender deep understanding of Co-DiViNE’s underlying approach in all of the Project’s participants. In other words, an immersive “experiencing” of the Co-DiViNE approach will be necessary to make the project viable.

BACKGROUND

Studies of communities living in chronic poverty [1, 2] show that most are still predominantly oral [3] in that they do not have an external symbolic system (ESS) [4]. An ESS is seen as one of the main factors in the development of an impersonal exchange system and one of the primary foundations in the advent of institutions that are responsible for economic prosperity in western cultures [5]. Simply put, it is the availability of a suitable medium to externalize existing knowledge such that it can be archived, shared, reflected on and revised that makes modern economies prosperous.

One of the research premises underlying the Co-DiViNE project is that the absence of ESS is a confounding factor that keeps the oral cultures chronically poor. In accordance with this understanding the Co-DiViNE project was conceived to explore approaches for introducing visual literacy as an ESS in oral cultures to accelerate the advancement of an indigenously created, sustainable form of prosperity in chronically poor, rural communities. The success of the Co-DiViNE project would offer a possibility for creating prosperity within a much shorter time as compared to

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the experience with the introduction of traditional literacy, which takes shape over generational time frames and has resulted in brain drain from the oral communities and created mass urbanization.

Co-DiViNE pursues a new solution and a new model of field research for addressing chronic poverty; focusing on the use of visual media to help people in these communities to externalize their knowledge. Since poor communities are predominantly oral, their mode of knowledge transfer is often through verbal and gesture enactments [6]. Furthermore, the research team's visit with a local NGO showed that the use and adoption of video and audio technologies, particularly cell phones, has been relatively easy for these communities. Instead of learning the syntax and semantics of written language, Co-DiViNE is based on the idea that the communities will be able to use visual media which is more akin to their current form of communication and may then evolve/develop their own indigenous 'Visual Literacy'. This form of literacy may lead to the creation of norms and institutions that will be rooted in indigenous cultural values, and will thereby be capable of fostering a more sustainable foundation for the local prosperity [7, 8].

The Co-DiViNE method consists of four steps. These are diagrammatically shown in Fig. 1.

The first step involves teaching the oral communities to use visual technology tools (primarily video cameras) (1). Individual members of the community then use the video cameras to capture their self-narratives (2). These narratives are then shared within the community giving the people the capability to voice their reflections in real-time and discuss the issues that affect the community as a whole (3). The hypothesis was that within the group would be a number of positive deviants [9, 10] who will use these video screenings as a platform to have a meaningful exchange with their fellow community members. These positive ideas could then influence and inspire others in the community and lead to community based and community inspired innovation. Over time, such

discussions would lead to the emergence of community aspirations for creating indigenously rooted solutions to problems that the community has been facing (4), [11, 12] which can then be fulfilled by working with local universities and NGOs. This approach places the responsibility for envisioning the future and the creation of prosperity in the community rather than the outsiders, such as government, donors, academics, intermediaries and other interest groups and organizations.

Since the emphasis of Co-DiViNE was on sustainable change [13, 14, 15], a further literature review was conducted to understand what methods had been tried in the past in Co-DiViNE like initiatives [16, 17, 18]. It was observed that in most cases, these initiatives resulted in progress during the period the research team was present in the field and engaged in working with the oral communities [19]. The research team generally introduced the new ideas, and the village community merely acted on these ideas in response to the visitors (rather than from their intrinsic sense of aspirations and motivations). The villagers had little or no understanding of the projects or resulting ramifications beyond the scope of interactions with research visitors. The ideas, inspiration and aspiration were not rooted in indigenous, local context were hence the community lost momentum once the research teams exited the field.

To avoid this 'novelty' effect in the current Co-DiViNE project, it was decided that a bridge community of student interns would be employed to interface between the research community and the oral community. These interns would be graduates from local universities, with a master's degree in rural development and much experience in working with the local village communities. It was envisioned that these students would live in the village for ten months. A new batch of students would take up this position every year, thereby ensuring a sustained presence in the village.

The research team that participated in Co-DiViNE was multidisciplinary, drawing in experts

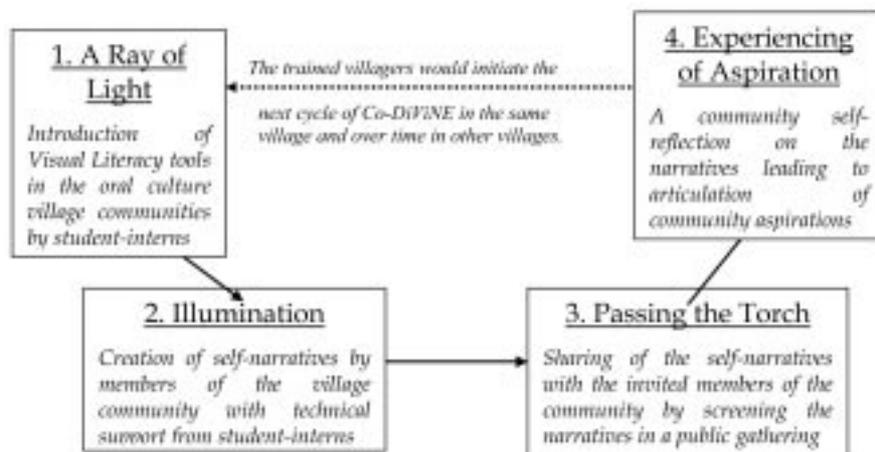


Fig. 1. Co-DiViNE four step methodology.

Table 1. Co-DiViNE team

Senior Researchers —Disciplinary Backgrounds (<i>7 in total</i>): Stanford University
<ul style="list-style-type: none"> • Operations Research • Design Research and Engineering • Communications and HCI • Clinical Psychology
Indian University
<ul style="list-style-type: none"> • Micro Finance and Rural Development • Folk Lore studies
Graduate student (1 student) Stanford University
<ul style="list-style-type: none"> • Ph.D. candidate, Mechanical Engineering
Interns (2/village/year) Indian Universities
<ul style="list-style-type: none"> • Academic qualifications: Completed Master's Degree in Rural Development • Language skills: Proficiency in the local language and dialect, and English • Technical skills: Familiarity with use of a computer to send e-mail messages
Other necessary skills:
<ul style="list-style-type: none"> • Be willing and able to work as part of a team • Be comfortable working in a mixed-gender environment • Be compassionate

Table 2. Jallipatti Village details

Village details:
<ul style="list-style-type: none"> • Conditions of Chronic Poverty • Population—150 to 175 households • Mixed households—presence of different castes and occupations • Situated in a remote rural area • Predominantly agro based but poor top soil conditions

from Engineering, Economics and Rural Development, amongst others. These researchers all joined the project because the mission of Co-DiViNE was consistent with their own research interests. The Co-DiViNE team therefore consisted of senior scholars (professors from different academic fields) from Stanford University and the partnering universities in India, a graduate student from Stanford University and the interns from the Indian universities. The basic approach of Co-DiViNE (as represented in Fig. 1) was developed at Stanford University.

Table 1 provides a summary of the research team involved in designing and implementing Co-DiViNE. Table 2 provides a brief selection criteria for the village in which the pilot was run.

Co-DiViNE was launched in August 2005 with a workshop attended by all the senior researchers (held in Hyderabad, India). A primary goal of this workshop was to build consensus amongst the senior researchers and the graduate student regarding Co-DiViNE's goals and milestones. The review of the basic approach of Co-DiViNE was the focus of the workshop. A consensus among the senior scholars on a common approach was expected to result from the workshop deliberations. However, only preliminary and tentative shared understanding on the principles and research goals of the Co-DiViNE was reached at the workshop. As such a common approach rooted in each scholar's own research agenda was not feasible.

The Research team decided to proceed with the fieldwork and in October 2005; two interns were selected in accordance with the criteria listed in Table 1 above to become the interface of Co-DiViNE at the field site. A training session for the interns was conducted from November 2005 to January 2006. Then the first prototype of Co-DiViNE (Steps 1 through 4) was implemented in November 2006. A timeline of the Co-DiViNE Project is shown in Fig. 2.

Below two cases coming out of the Co-DiViNE work between September 2005 and January 2007 are reported. Case Study 1 describes intern training, and the extent to which the planned approach had to be modified in order to be successful. Case Study 2 reports on the prototype of Co-DiViNE methodology. As the reader will soon discover, the primary aim of the prototype was not to test the underlying concepts of Co-DiViNE, but rather to familiarize the entire research team with Co-DiViNE's underlying principles. As such, no formalized assessment of Co-DiViNE was undertaken; rather researchers' informal notes and video recordings of the prototype in the village form the basis of what is reported here. A formal assessment of Co-DiViNE has yet to be undertaken.

Case Study 1: Training of student-interns

The training of the interns commenced in November of 2005, and was designed and lead by the first author. Although the community interns had been trained to work in village communities, their knowledge about the Co-DiViNE methodology was very limited. These interns, themselves came from rural communities and were hence not conversant with the use of video cameras or video-

	Aug-05	Dec-05	Apr-06	Aug-06	Dec-06	Apr-07	May-07
Co-DiViNE Project Starts							
Intern Training Period							
Co-DiViNE Prototype (in the field)							
Co-DiViNE Pilot Completed							

Fig. 2. Co-DiViNE timeline.

editing software (visual literacy tools). A training program was hence started to familiarize the interns with the main theoretical premise of the project, the four-step method and their roles and responsibilities. In addition they were given some basic training on how to use visual literacy tools.

The training was broadly divided into three broad categories:

- *Visual Literacy Tools*: the first step was to ensure that the interns themselves felt comfortable with the visual literacy tools. Once the interns were comfortable handling the tools by themselves, with practice, a certain level of expertise would emerge. At that point, the training would shift to how to introduce the tools to a predominantly oral community. It was this last part where the interns were expected to contribute from their own experiences in the field.
- *Theoretical understanding of the methodology*: since the interns would be implementing the methodology, which in turn, would affect the data and the final outcomes, it was imperative that they have a thorough understanding of the research design, motivation and points of departure. In short, it was deemed necessary that they have a basic understanding of why and how the method had been created. For this purpose a concise yet rigorous literature review was made part of the training program.
- *Ethics*: It was important for the student-interns to believe that the learning in this project would be a two-way process. Being a research project, the aim was to learn from the oral communities while sharing what we knew about prosperity with them. It was imperative that they do not create any hierarchies in the village. Also, since the local university did not have any human subject protocols of their own, it was critical that all members and especially the interns be fully familiar with the Stanford-Human Subject protocol and its requirements.

The training was conducted through e-mails and phone-calls between the student-interns and the trainer (who was located in California). A regular schedule of two calls a week and three e-mail exchanges were agreed upon. The calls were akin to remote seminars with all parties agreeing to read a set of papers and discussing them. This training format was put into effect in November 2005. (References for all papers sent to student interns are in Appendix A)

Challenges in training

The training began to fail very early. Within the first week, it became apparent that the interns were finding the readings very difficult to follow since English was not their first language. Further their interaction with technology (internet) was very different than the trainer. The community-interns due to limited access checked e-mail only once a day. Since the time difference between India and California is 12.5 hrs, one round of e-mail com-

munication took two days. Even when after two weeks, when an uninterrupted Internet connection was provided, the behavior did not change, indicating that the problem was not with availability of technology. Rather, it was rooted in how technology was viewed and its normative use.

However, the slow temporality of communications was nearly as challenging as the content of the communications. Most of the e-mail messages and phone-call discussions were focused on negotiating the meanings of words from the various disciplines to which the interns had no prior exposure. Finding analogies and metaphors that could generate shared understanding was another preoccupation of the exchanges. These challenges made progress towards collective understanding of the project very slow and most discussions started confused and ended the same way.

Solution and insights

In December 2005, there was an opportunity for the lead trainer to visit India for five days and provide on-site training. This was a breakthrough since the community-interns and senior researchers were eager to begin work in the villages but were frustrated by the lack of progress in the past two months. The training goals of this on-site training were the same as those listed above. It was hoped, however, that face-to-face interaction might speed things up.

The on-site training started with a literature overview in a very conventional classroom setting and failed to move beyond the words. Since there were only five working days available, a new approach was tried. To gain some common context, the interns were asked to undergo the experiencing of the Co-DiViNE methods themselves. (This decision was made by the trainer, in consultation with the Stanford research team and was based on the belief that by going through each step the interns would have a better understanding of what the implementation would feel like. The literature could then be used and explained as the reasons for the sequencing of the steps and other such details.)

The interns accepted an immersive 'experiencing' as part of their training. The trainer took up the role that the interns would play in the village, and explained and instructed them in the use of visual literacy tools. Having gained some proficiency and confidence in handling the video camera, the two interns then took turns to individually create their own self-narratives. In the evening of that same day, the two narratives were screened before an audience comprised of the senior researchers from the local university, the trainer and the two community interns. Thus the interns subjectively experienced the 4-step method. Both the interns 'shifted' as they were *experiencing* the method. The following marked changes were observed:

- A shift from instruction seeking behavior to collaborative behavior: previously, most of the questions from the student-interns had been to

get step-by-step instructions on how to conduct the project. The interns might have asked questions such as: 'How should we explain the concept of zooming to the village?' or 'Should we teach zooming on the first day itself?'. This line of questioning was replaced by an articulation of their imagination on how the communities would receive the method and what alterations would improve the method. Their rhetoric was now more like, 'Maybe we can have them walk towards the tree and see how it grows bigger on the screen and then have them stand in one place and use the zoom button. . . .'

- Confidence in the method and its effectiveness: having gone through the experiencing of the method personally, the community-interns could feel an embodied and internalized sense of concepts that were inherent in the methodology. Consequently they had a direct experience and felt sense [20] of the challenges in speaking to a camera and also the anxiety in sharing it with a larger community. The responsibility of the task of implementing this method in the field and subjecting the village community to it became very apparent.
- Experience precedes learning: the student-interns used their experience to understand the literature. They were using the concepts and vocabulary to explain their experiences to themselves. Their access to the embodied sense of experiencing became the shared context and the anchor through which the different concepts could be understood.

Case Study 2: Prototyping Co-DiViNE to create shared understanding among senior researchers

From the inception of the project in September 2005, through conference calls and e-mail messages, the team of senior researchers worked to arrive at a shared understanding of the goals and methodology of Co-DiViNE. These discussions however continued to stay very theoretical, with every expert unwilling to step out of his or her areas of expertise. The problem of poverty alleviation is non-trivial and the Co-DiViNE methodology was novel and untested, amounting to much ambiguity and resulting in much discomfort amongst the experts. There was no shared context to anchor the discussions and much of the discussion was often ineffective because of semantic confusion. The interns had for months been practicing and improving the method. The senior scholars however were unable to converge at shared understanding even after one year's worth of discussion that included face-to-face meetings at Stanford and in India; and with scholars from both locations during the visits of the Stanford scholars to India.

A Solution

In an attempt to accelerate the creation of a context for shared understanding, the learning from the experience with the training of community-interns was used to create a similar experience

for the senior researchers. The research team at Stanford made the decision to create the opportunity for 'experiencing of the Co-DiViNE methodology' for the senior scholars based on the success of the approach from the training of the interns. In the case of the community-interns, it had been found that 'experiencing' the methodology and seeing it unfold for them had proved as a catalyst in their broader understanding of the literature, the vision and their roles and responsibilities. This same approach might work with the senior researchers in order to facilitate the development of a shared understanding, upon which to launch Co-DiViNE in earnest. However, it was decided that the 'experiencing' scenario created for the senior research staff should be unlike the training created for the interns (which involved their role playing as villagers). It should involve rapid prototyping of the Co-DiViNE approach, with the interns, researchers and villages playing their actual roles. It was rapid, in that the scenario would only last 12 days (whereas the full implementation of Co-DiViNE is more on the scale of years).

The rapid prototype was conducted in 12 days (10 to 22 December 2006) in Jallipatti Village. The interns trained over 20 persons from the village in the use of visual technology and a total of five self-narratives were collected. These were then shown to the community in a self-reflection session that lasted four hours.

A senior scholar from the local university attended this self-reflection session. Before the session she had voiced scepticism that the self-reflection session would not result in any discussion amongst the community members. Her previous experience suggested that chronically poor communities typically needed mediation to get a conversation going.

The entire Co-DiViNE Team (everyone listed in Tables 1 and 2) met in person in January 2007 to view the videotapes from the self-reflection session and discuss the outcomes of the prototype in Jallipatti village.

The most compelling video was of the community-reflection session. The audience comprised mainly of the village women and children and one elderly man. They watched the five visual self-narratives mostly in silence with some minor remarks about the colors or locations. Below are the details from one of the last narratives that sparked off a discussion among the community members.

The last narrative was by a woman who complained that she and her family especially her young children often fell ill and that this was something she was very worried and sad about. At the end of that narrative, many of the other women present there, asked this woman (who was also in the audience) why she fell sick so frequently. She replied that there was stagnant water close to her house and mosquitoes and other germs grew there. This led a third woman to jump in to ask why she allowed water to stagnate. At this quite

a few women started talking together about how this was the basics of good health and hygiene and some went on to get aggressive and abusive in their annoyance with the narrator.

The narrator meekly responded that the community tap was close to her house and that in their eagerness to get to the water, someone had broken the tap and that water kept trickling and hence was constantly stagnant next to her house and there was very little she could do about it. At this point a cacophony broke out with cries of shame and outrage that the community could not even take care of their own tap and how an innocent woman and her family were getting so badly affected by it.

The elderly man stood up to calm the women down and in a soothing tone asked what the women were going to do to address the problem. At this point one forceful woman stood up and said that she was willing to start a collection to buy a new tap and install it. There were many voices of support and encouragement for this action. Suddenly being aware that there were three people who were outsiders (the senior scholar and the two community-interns) this woman turned to the senior scholar and said 'Madam, when you next come and visit the village, we will take you to see our new tap'. This announcement was followed by much cheer and applause.

From the informal analysis of the videos by the senior researchers, it was clear from the quality of the visual self-narratives created (sound quality, brightness, effects like zooming in and out) that the community-interns had managed to communicate the use of visual literacy tools effectively to the village community. The overall quality of the self-narrative produced by the five villagers was also a testament to the trust the interns had developed with the community. The interns had a tough time initially, in building rapport with the community. It had taken them almost ten days before they were invited into the village to talk about the project with the elders in the village.

The interns did make some mistakes, like interrupting while a visual self-narrative was being taped. They had been given explicit instruction not to impose their views and ideas on the community, as it would interfere with the efficacy of data. They also forgot to use a projector to screen the

videos and had to settle for screening the narratives on a laptop. However, the interns learned about their mistakes through the prototyping exercise and acknowledged the mistakes they realized they had committed.

Insights

The senior scholar in the January 2007 meeting spoke of her own 'shift'. She had not believed that the community would even begin discussing any relevant issue. What she saw was that without any external influence, oblivious to her presence, the community had a long (4hrs) discussion on very relevant topics. Not only was a problem acknowledged, so many different perspectives on the same were offered. The community collectively arrived a solution and even went the extra step to develop and commit to an action item. Such commitment to action usually takes much longer. In fact mobilizing a community to take notice of their surroundings from a health and hygiene perspective is not an easy task. The senior scholar, being an expert in the field of rural development and extension work (extension is the activity of conducting field research with the aim of rural development) felt that the progress in the village was real and had happened very fast. Experiencing the method unfold caused her to understand and appreciate the details of the Co-DiViNE method and its potential in advancing approaches for indigenous innovation for local problem solving emerging from an indigenous sense of inspiration and aspiration.

The prototyping of the self-reflection session by the senior researcher turned out to be the proof of concept required by the entire senior research team. Figure 3 shows how the prototype validated the Co-DiViNE method.

The prototyping of Co-DiViNE reported in this case was undertaken to build a shared experience among the senior research staff, an experience that would enable conversations about the design, implementation and potential of the Co-DiViNE to reach new level. Though not an aim of this prototyping, another outcome was it serving as a

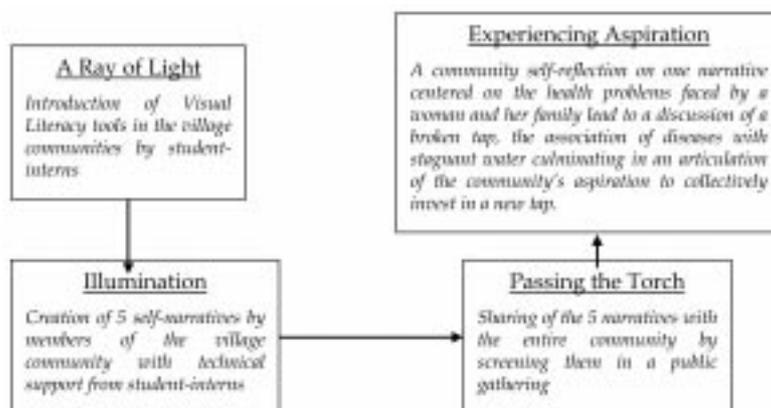


Fig. 3. The unfolding of the Co-DiViNE prototype in Jallipatti village.

pilot or prototype of the Co-DiViNE concept itself. Because it was not undertaken for this purpose, no formal assessment data were collected. However, we can report that the entire Co-DiViNE team felt confident that the method could work and held great potential towards creating community aspirations.

SUMMARY AND IMPLICATIONS FOR EDUCATION

On one level, the takeaways from the two cases are that it is possible to effectively train the community interns to be able to build rapport and work with a village community in chronic poverty to help them use visual literacy tools; the interns are conceived of as a critical bridge between the village and research communities. Furthermore the concept of Co-DiViNE seems to work to affect community engagement, though much more rigorous next steps to further develop and test the prototype in the field setting are needed.

However, we now discuss what we consider as an equally important takeaway from the two cases. Both cases illustrate that that when dealing with a concept that is novel and requires imagination, an immersive experience can act as a catalyst to understanding. Projects like Co-DiViNE that are trying to solve complex problems and are distributed over different continents do not remain within the domain of any one discipline or one culture. Trying to integrate different academic and cultural perspectives in the traditional way (literature review followed by detailed discussions) alone may be insufficient to provide the necessary context for shared understanding. As more and more projects become multi-disciplinary and multi-cultural strategies for creating connections and integration of perspectives will be critical.

The work on Co-DiViNE discussed in this paper, illustrates one possible way of navigating unknown terrains of academia and world cultures; 'Experiencing' before understanding. As shown by the two case studies, understanding can be illusive especially when faced with so much ambiguity and not enough time to create deep trust before starting a project. Shared embodied experiences provide a common context which then lead to common metaphors and imagery and hence help in overcoming semantic confusion. The shared experience can also be a moving experience and provide a common sense of aesthetic to all the team members for accelerating the trust building [25, 26].

We find that prototyping is very useful in not only understanding a concept but also communicating and collaborating in multi-disciplinary and multi-cultural teams. Especially with project courses in the area of service learning, it is imperative, the educators prepare the engineering student in not only sound engineering skills but also help students come to terms with notions of chronic

poverty. People living in chronic poverty are amongst the most vulnerable groups in society and therefore any project course involving such communities should be considered from a long-term perspective. The student should therefore also be taught to understand the long-term implications of their design.

CONCLUDING THOUGHTS

Since the project was in pilot phase, no rigorous data were collected. The hypothesis that 'understanding follows experiencing' was in itself an emergence. It was an unintended consequence, which provided much food for thought.

The idea of experiencing is not new and has been explored in the work of John Dewey. He suggests that learning should have two components: active doing and undergoing. 'Active doing' implies creating or doing an action. About 'undergoing' Dewey wrote, 'the esthetic or undergoing phase of experience is receptive. It involves surrender'. [27]

So what are the implications for education? When designers prototype, or build, they fulfil the 'action doing' component part of Dewey's vision. The other part is however seldom done or studied. Students are at least trained in prototyping. As long as the action (design prototyping) is happening in a predictable environment, the impact of the prototype on the designer may pass unnoticed. As we move into the unknown world of chronic poverty, student designers will be affected by the vulnerability of the people. They will realize that their actions and prototypes will affect the people and their reaction in turn will affect the student designer. They must therefore be encouraged to give themselves the freedom to be affected by the prototypes they build and create.

This reciprocal relationship has not been investigated much in the design context. In addition to teaching students how to gather information about other cultures, its needs and requirements, design education provides them with tools to innovate in these cultures. It would be remarkable if the students could also be taught how to surrender to their creations and truly experience their prototypes in action in the context of the culture they are working in and with.

Allowing the designer to create and act on a prototype and in return allow the prototype to act on the designer is the skill required to navigate the developing world. Such an encounter leads to tacit capacity building in the designer. This in turn manifests as an ability to learn from embodied experiences and an ability to truly collaborate within the deeper and richer context imbued with a shared sense of aesthetics. The two case studies above show how the designer can be acted upon by the design and how they change as a result of it. Introducing this component into design curricula will help create designers who can not only appreciate the diversity of this world but through

experiencing, also rise beyond it and create an undivided world through collaborations [28].

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APPENDIX A: PAPERS READ BY THE INTERNS DURING THE TRAINING PROGRAM

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Sheri D. Sheppard is a professor at Stanford University in the Design Group of Mechanical Engineering. She began her Stanford academic career in 1986. Besides teaching both undergraduate and graduate design related classes she conducts research on weld fatigue and impact failures, fracture mechanics and applied finite element analysis. She is particularly concerned with the development of accessible engineering tools that allow designers to make more informed decisions regarding structural integrity. Sheppard also conducts research on the education of engineers, investigating questions regarding engineering thinking, how individuals learn to undertake engineering work, and how to increase the attractiveness of engineering careers to underserved populations. She also serves as a Senior Scholar at the Carnegie Foundation for the Advancement of Teaching. Before coming to Stanford she held several positions in the automotive industry, including senior research engineer at Ford Motor Company Scientific Research Lab. Her graduate work was done at the University of Michigan (1985).