

# PERMACULTURE + EDUCATION

AALTO SCHOOL OF ARTS, DESIGN AND ARCHITECTURE



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MASTER'S THESIS

**Title:** Permaeduculture: Towards Sustainable Learning Environment

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## ABSTRACT

*Keywords: Ecosystem of knowledge, sustainable learning environments, sustainability, ethnography, mesh network, permaculture, education, learning environments, Permaeduculture.*

Sustainable development has become a key concern of our generation considering the various implications the mankind has had over its environment. The balance between consumption and production is an important factor that needs to be observed, in order to achieve sustainability in any given system. Application of sustainable principle has spread across disciplines ranging from service systems to product design. Especially in the field of educational services, there are many scopes of applying sustainable design principles to derive an educational model that rely on learning through thoughtful observation rather than thoughtless labor. Eventually, iterating the prevalent system into one that sustains itself organically in the course of time.

This thesis attempts to understand sustainability in learning ecosystems in regards to consumption of information over production of knowledge in the prevalent learning environments. The model of education termed as “Permaeduculture” is conceived as an abstract idea derived from the parallels between natural ecosystems and ecosystem of knowledge, studied under this project. The context of this thesis is set in rural India where the community is advancing rapidly from a self-sustaining livelihood to a modern consumer economy. Focusing on a specific rural field site in the state of Himachal Pradesh, this project identifies various challenges faced by the prevalent education system, through the medium of participatory workshops, ethnographic research and grassroots innovation. Moreover, the study examines the role played by digital media in Indian education system and how rural communities are affected by it. The outcome of this project is a digital infrastructure proposed for the model of “Permaeduculture” in the form of a decentralized Mesh network.

# ACKNOWLEDGEMENT

*This thesis is a culmination of many years of adventure, dialogue and hands-on involvement with a community that I chanced upon 6yrs ago. The list of people I have crossed paths with during this journey is never ending and I owe them all my gratitude.*

*In the truest sense, however, this experience couldn't have possibly been translated into anything meaningful had I not been a student of Aalto University. I take immense pleasure to thank the Media Lab Helsinki for giving me the platform and opportunity to carry out this research, document the process and contribute in my own capacity. First of all, I'd like to thank my supervisor Rasmus Vuori and advisor Teemu Leinonen for accepting my thesis proposal and mentoring me during this research. I'm grateful of them for giving me the freedom and space to conduct this research remotely, even though it meant staying forever disconnected with the department. The knowledge I acquired from Teemu's valuable guidance on the theoretical framework and Rasmus's technical suggestions during the Thesis Seminars, are immeasurable.*

*During my stay in Finland, I was fortunate to meet many who supported me all along my studies. I'd especially like to thank Leena Vainio for providing me feedback on my thesis in it's early stages and supporting me like a family while I was there. I'm also humbled by Aija Elg for sparing her valuable time to take me out on school visits and introducing me to Finnish schooling system.*

*Since ethnography and contextual research plays a critical role in this thesis, I had to spend majority of my time in the field. I'd especially like to thank Shyam for being a truly remarkable companion in field. I consider myself lucky to have found such broad-minded and warm-hearted villagers who treated me like their own all throughout my stay in Dharamshala. I'll forever be grateful to them for being kind, engaging and cooperative.*

*The most memorable part of this thesis is the time spent with the children of Rakkar and Tilloo. I'd like to extend my heartiest thanks and appreciation for the all the*

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*Regarding development and deployment of the hardware prototypes, I couldn't have done it without the technical guidance of the Eka Foundation team; Mikko Kotila, Prasenjit Dey, Anish Mangal and everyone else who was involved in the various deployments of Mesh network. I'd like to thank them for their unbending support.*

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*\_Soujanya Boruah, Dharamshala / India, October 2019.*

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## INTRODUCTION

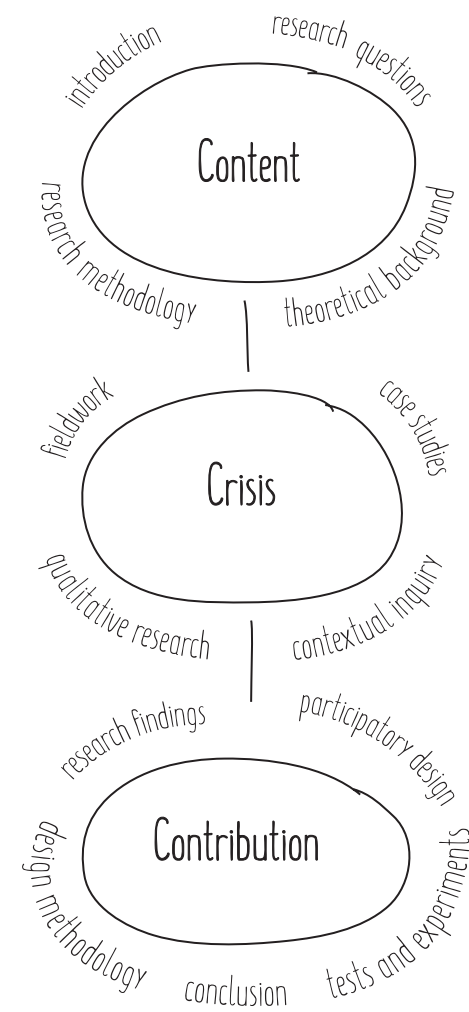
*“Education is not a preparation for life; education is life itself.” – John Dewey*

Human learning is at a constant flow. Once we arrive to a conclusion, a new quest begins. The perspective of learning, as a lifelong continuum, has been around for many years. However, education is still formally confined to schools, institutions and most recently, digital platforms. In most traditional classrooms, education is paralyzed by rote learning and the more contemporary issue of “bulimia pedagogy” (Handke, Kiesler et al. 2013); where students binge on information, without being able to get to the root of it or retain it for a long term. In the given world of information and data-driven technology, this process has only aggravated and left a generation of children to learn through thoughtless labor rather than thoughtful observation and creative thinking. Since the prevalent system of education is already very much a socially accepted way of cultivating children by enabling them to become social beings, within that domain it’d be rather challenging and rewarding to design “an ecosystem of learning” that supplements the learner’s developmental needs, restores their creativity and enables them to contribute to their communities seamlessly, very much like how organisms do to the micro habitats in nature. Drawing a parallel between sustainable ecosystems in nature and the ecosystem of knowledge, this thesis establishes a common ground for learning designers and explores the possibilities of implementing design principles of a sustainable system like Permaculture, into designing an educational system. The idea that is born out of this is a blend of Education with Permaculture; thereby, calling it “Permaeduculture”.

Over the course of this thesis, the author attempts to understand the factors that sustain a learning environment, critically examining the role

played by digital media in the current educational landscape of India and how it affects marginalized rural communities. In order to establish a context for design and development, a majority of the groundwork and research has been done in a cluster of villages located in a rural area of the state of Himachal Pradesh in India, as a fieldwork site. The aim of this research is to identify the scope of innovation for a learning environment that is sustained by its community, primarily focusing on its digital infrastructure development. The data collected during this research are presented in the form of quantitative data points, qualitative records and case studies, drawings, interview transcripts and maps. The anecdotal notes are transcribed in a way to preserve anonymity of the subject throughout the case studies.

The thesis is written by following the 3C narrative: Content, Crisis and Contribution. Wherein, “Content” comprises of the theoretical background that the author begins her work with and the research methodology that has been implemented to do the fieldwork. Having done the groundwork on site and reiterating the toolkits used for research, the author identifies and articulates challenges faced by the respective communities in the field of education, and in various digital media trends that are seeping into the educational landscape of the region; thereby, compiling it under the Crisis section of the dissertation. The last section of the thesis is the Contribution section, where the author proposes a design concept and its scope for solving the challenges identified during the research process. Moreover, focusing on the digital infrastructure of the design idea, a basic prototype has been presented to examine the User Interface and User Experience of the digital media that has been developed for the same.



## RESEARCH QUESTIONS

### What are the factors that sustain an ecosystem of knowledge?

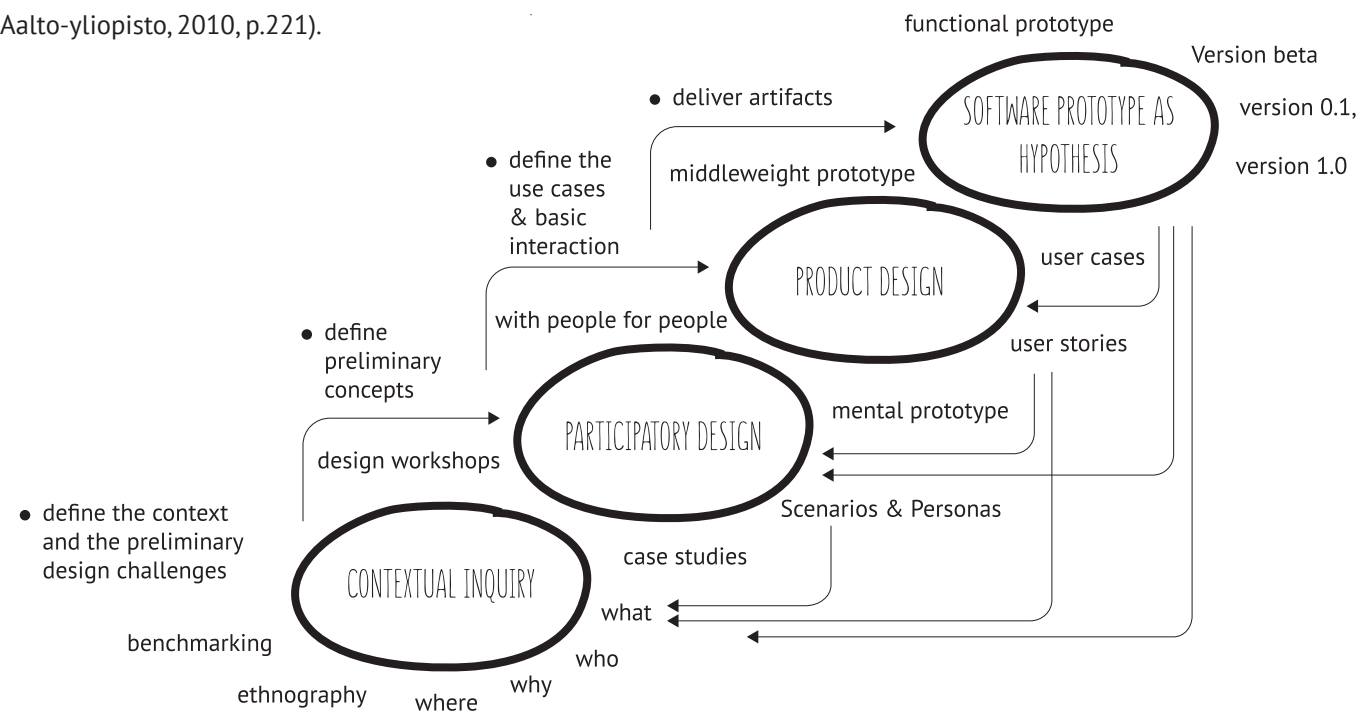
Human beings have gathered immense knowledge from nature. By emulating natural processes and nature’s creation, people are rediscovering new ways of solving complex problems. The idea of using an “ecosystem” as an analogy to understand the interaction between learners, teachers and content, has elucidated new theories breeding meaningful ways to understand how knowledge is acquired. Especially in the field of Information Technology, Information and Communication Technology (ICT) and e-learning, the term “Digital Ecosystems” has been widely used (Reyna, 2011). However, it is still a big challenge to understand the factors that create a balance between consumption and production of knowledge. As our society transcends from traditional ecosystem of knowledge to digital ones, it is worth re-examining factors that enable learners to make as much knowledge as the information partaken by them in the classroom.

### How do digital media facilitate learning in a rural educational setup in India?

The education system of India dates back to 700 BC, when learners were sent to a dedicated teacher, often referred to as “guru”, to attain knowledge about various subjects and receive formal education (Pandya, 2014). The “Gurukul” system of ancient India was however replaced soon after the country was colonized by the British Empire. What remains in the government run educational institutes today is a remnant of the British education system that is focused around academic performance as an external response to acquiring knowledge, rather than holistic development of the learners that enables them to acquire skills and be

aware of phenomena happening around them. Further adding to this is the recent advancement in technology that has brought about many digital trends in the educational landscape of India. This however has varying effect on different communities of India. Especially in the rural parts of India, where tribal communities live on the margins of economic development, new digital media trends play a critical role in shaping the future of young learners. This research tries to explore these grounds to understand how learning is facilitated in such rural communities.

Figure: Research based design process (Leinonen & Aalto-yliopisto, 2010, p.221).



## RESEARCH METHODOLOGY

### Research-based design methodology

Grassroots innovation requires an in-depth understanding of context, especially when it comes to designing intervention targeted towards a specific community of people. Like in many cases where design is used as a medium to achieve research objectives, many designers have opted to use alternative methodologies of using research as a medium to achieve design goals. Research-based design methodology is such a systems-based approach where research is done through active participation of the community. The artifacts designed in this process are the primary outcome of the study partaken (Leinonen & Aalto-yliopisto, 2010).

In this iterative methodology, the tools and devices used for the research are not the only factors that determine the design - the entire system of participating community plays a part. The activities carried out by the participants shape the final design of the intervention. This is an organic and a non-linear process of defining, redefining, designing and redesigning an artifact, where every phase occurs in parallel to each other, back and forth (Leinonen & Aalto-yliopisto, 2010).

The four phases of Research-based design methodology are:

**1) Contextual inquiry:** The process begins with the understanding of socio-cultural context of design. As developed by Karen Holtzblatt in 1986, contextual inquiry is a field study that enables designers to attain accurate details of the user's behavior, work and tasks by observing and analyzing them in their actual workplaces. It originated when, in the world of computer science, developers needed a more intimate understanding of the users' work in order to design software interfaces that address the



immediate needs of the user. Soon it became seemingly more significant to include methods like ethnographic research, benchmarking innovations from the past, studying the trends related to the context, making affinity maps and work models, etc, to understand the context of design.

In the case of this thesis, contextual inquiry was one of most important phases of the research, as the prime vive of it was to develop a learning technology for a specific community in rural India. It was of utmost necessity to first understand the community values, social dynamics, perception of education within the locals, various socio-economical constraints, challenges faced by the learners in their educative spaces and the livelihood trends of the community.

The first half of this phase was setout much earlier through active participation of the younger members of the village; the children who went to school, children who worked for daily wages and those who had left school. There were altogether two learning spaces set up for these children to meet and engage in various educational activities; the first one in Rakkar village and the second in the village of Tilloo. In these spaces, they were facilitated with stationery supplies, books, equipments and other resources. Within these spaces, children immersed themselves in various activities like art, music, ecologica/wildlife explorations, computer education, electronics tinkering, design, puppetry, cooking, making maps, learning language and practicing mindfulness; mostly during their free time after school or in the weekends. During the course of this research, qualitative data was gathered by observing and interacting with children through participatory workshops, interviews and discussions with individual children about their experience at school.

The second phase was however conducted through household interviews and discussions with teachers and seniors of the community. Additionally, participatory workshops were held to gather ideas and understanding of the culture that prevails in an educational setup in this community.



In the process of contextual inquiry of a design intervention, especially when it is particularly focused on a specific community of people; the need to consider the social and political aspect of design becomes vital. Without the participation of the local community, it is nearly impossible to tap into the complexities of these aspects.

**2) Participatory design:** In cotemporary design discourse, we have come a long way from designing things as an object or product of obsession to designing interventions as socio-material assemblies (Björgvinsson, Ehn, & Hillgren, 2012). The theoretical history behind this shift, however, comes from the understanding of the word “Things”. By dictionary definition; things are any inanimate objects, distinct from living beings. As Bruno Latour explored the understanding of “things” from the perspective of a matter-of-concern as opposed to a matter-of-fact. He revived Heidegger’s etymology of “things” as “gatherings” or a type of “assembly”, in order to highlight the notion that humans assemble not because they are socially compatible but because they desire to gather a common ground where they can resolve the differences in their matters of concern, in which case the understanding of “things” includes not only those who assemble because they are concerned but also the cause of the concern(Latour, 2005). This became a seedbed for ideas like aesthetic of matter-of-concern as opposed to aesthetic of matter-of-fact or simply **objects**. In the design world, we see this shift being translated as a new trend in designer’s work culture, where they are more focused in collaborating with users and being more pragmatic at exploring matters as socio-material foundations to ideate designs(Ehn, 2008), giving rise to practices like Human-centered design, Design thinking and Participatory design.

Participatory design originated as early as the 1970’s, when democratization of workplaces in Scandinavian countries began to demand co-creation, collective-agreement and collaboration between various stakeholders, accompanied by the birth of new technologies to manage work culture (Björgvinsson, Ehn, & Hillgren, 2010). It is a practice

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*Object is a material thing that can be seen and touched.*

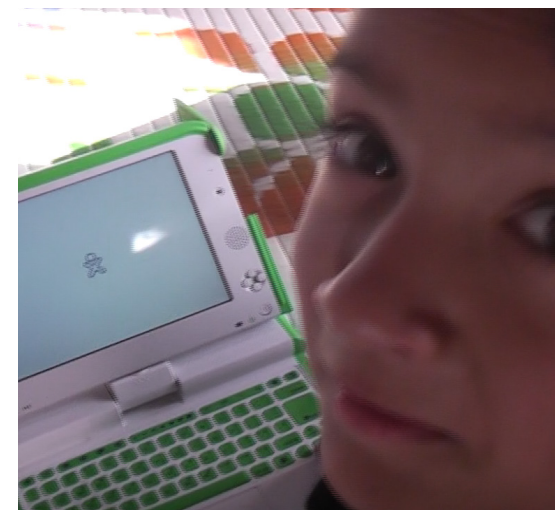
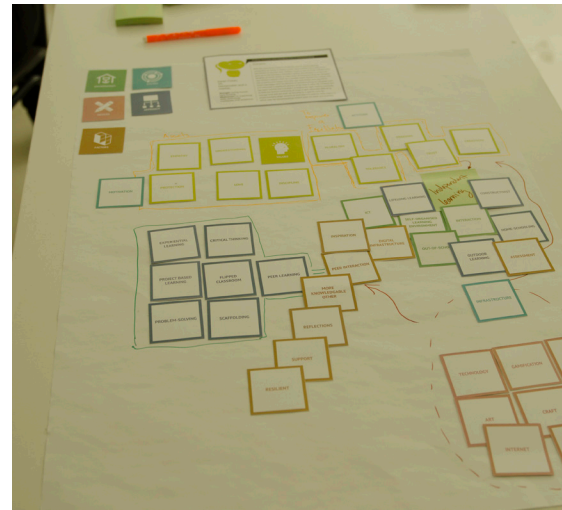


whereby the users and their user's behavior within a work environment are considered the primary source of inspiration and design cues. This process enables the designers to observe their users by directly interacting and collaborating with them through the medium of participatory activities. In a designer's workplace, co-creation of values became paramount with the process of participatory action.

At its core, participatory design is rooted in identifying stakeholders that are affected by the design and recognizing their role in the design process as the most important catalyst to innovation. This process is guided by two ideals: first was the democratization of workplaces as a value that leads to suitable and productive user participation, and second is to tap into the diversity of skills and tacit knowledge that participants possessed (Björgvinsson et al., 2010; Ehn, 1989). There is a hidden world of design cues in user's tacit skills and presuppositions that can be explicitly articulated through the medium of participatory design workshops, especially when it is well documented.

In this research, participatory workshops play a crucial role in highlighting problem areas and issues faced by learners, educators and educationist residing and working in the field area. The participatory toolkit was designed specifically to understand the value and fluidity of education within different communities and how people perceived sustainability when it came to ecosystem of knowledge. The toolkit comprises of a card game that assists in designing learning environments for a given "Persona" under a certain "Scenario". The conceived "Personas" are rooted in the facts collected during the contextual inquiry, via interviews and focus groups, conducted at the rural field site in India. Though most of the identities are made ambiguous using addition of fictional elements to the identity of the Persona and articulation of the Scenarios.

**3) Product design:** In research based design methodology, the product design phase starts as soon as the designer establishes an understanding



of the relevant context in which the prospective user community is embedded. This is the phase where the ideation and composition begins. In this phase, the designer draws themselves away from the stakeholders to focus on creating prototypes and Universal modeling language (UML) diagrams; based on the various notes and ideas accumulated during the phase of contextual inquiry and participatory workshops (Leinonen & Aalto-yliopisto, 2010). The prototypes are created by defining the **form and function** of the digital product, in a tangible manner. The data collected through fieldwork and participatory workshops is utilized to define the features, flow and structure of the digital product.

This thesis focuses on the digital infrastructure of the proposed concept of "Permaeduculture" education. The product, in this case, is essentially an educational technology innovation. It is rooted in the DIY culture of recycling materials, sourcing economical resources and open source technology to build digital infrastructure that can be efficiently replicated, developed and managed. The digital infrastructure used here is a wireless MESH network that enables learners from remote locations to access a large repository of educational content and provides a platform for them to communicate and build things together. The prototypes are made through design practices involving hardware assembly, information architecture, user interaction design, user interface design and presentation of Open Educational Resources.

The technology and idea behind the wireless mesh network was adapted from an open source project that originally started as "OLPC School Server" under the One Laptop Per Child (OLPC) project that started in the mid 2000's. This project was however forked into "School Server Community Edition" in 2012 from where it was developed further into a project called "Internet-in-a-Box". The prime feature of this product were networking capabilities, internet gateway with HTTP proxy and content filtering, data restoration as well as installation and upgrade service for the laptops and a tailored version of Moodle (Tran, 2010). Gradually, as the School Server

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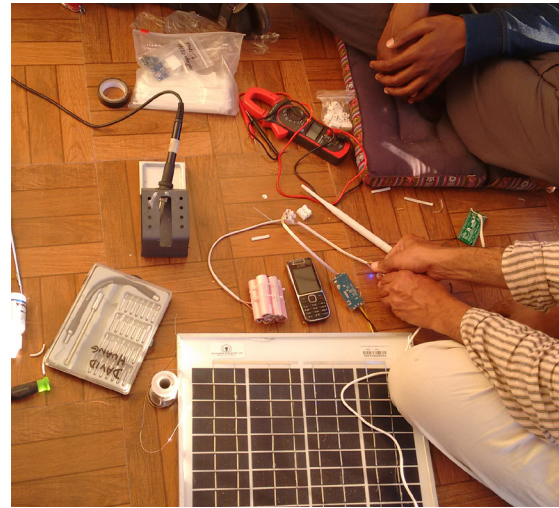
*"Form" is the external dimensions, weight, size, and visual appearance of a part or assembly and "Function" is the purpose that the part performs.*

Project began to morph into “Internet in a Box”, the core focus moved towards a movement of sharing World’s Free Knowledge; Open Educational Resources (OER). It became the most suitable infrastructure backbone to Digital Libraries set up across the world, including places where internet was not accessible, especially in the premises of schools, hospitals, prisons etc.

The hardware assembly of the Mesh network comprises of hard drives with built-in wifi to run the server, handmade DIY antennas made with recycled tin cans and a wireless module, recycled cells of laptop battery to make power supply and solar panels to charge the batteries. The usage of recycled hardware elements makes it very cost-efficient and easily manageable for remote communities with less access to hardware options. Moreover, the DIY nature of the installation makes it more interesting for young learners to understand and be involved through hands-on approach.

The software assembly involved, the user interface design and interaction specs, is inspired by the Sugar Operating System that runs on OLPC laptops. Since the digital infrastructure illustrated in this dissertation is specifically designed for children’s learning purposes, it was ideal to use such an activity-oriented user interface. Also, Sugar is radically different from other operating system, which makes it very interesting for children to adopt (Jeff Atwood, 2007). It provides an environment for children to explore, experiment and express. Hence, Sugar Operating system served as a base for the software design aspect of the infrastructure addressed in this thesis.

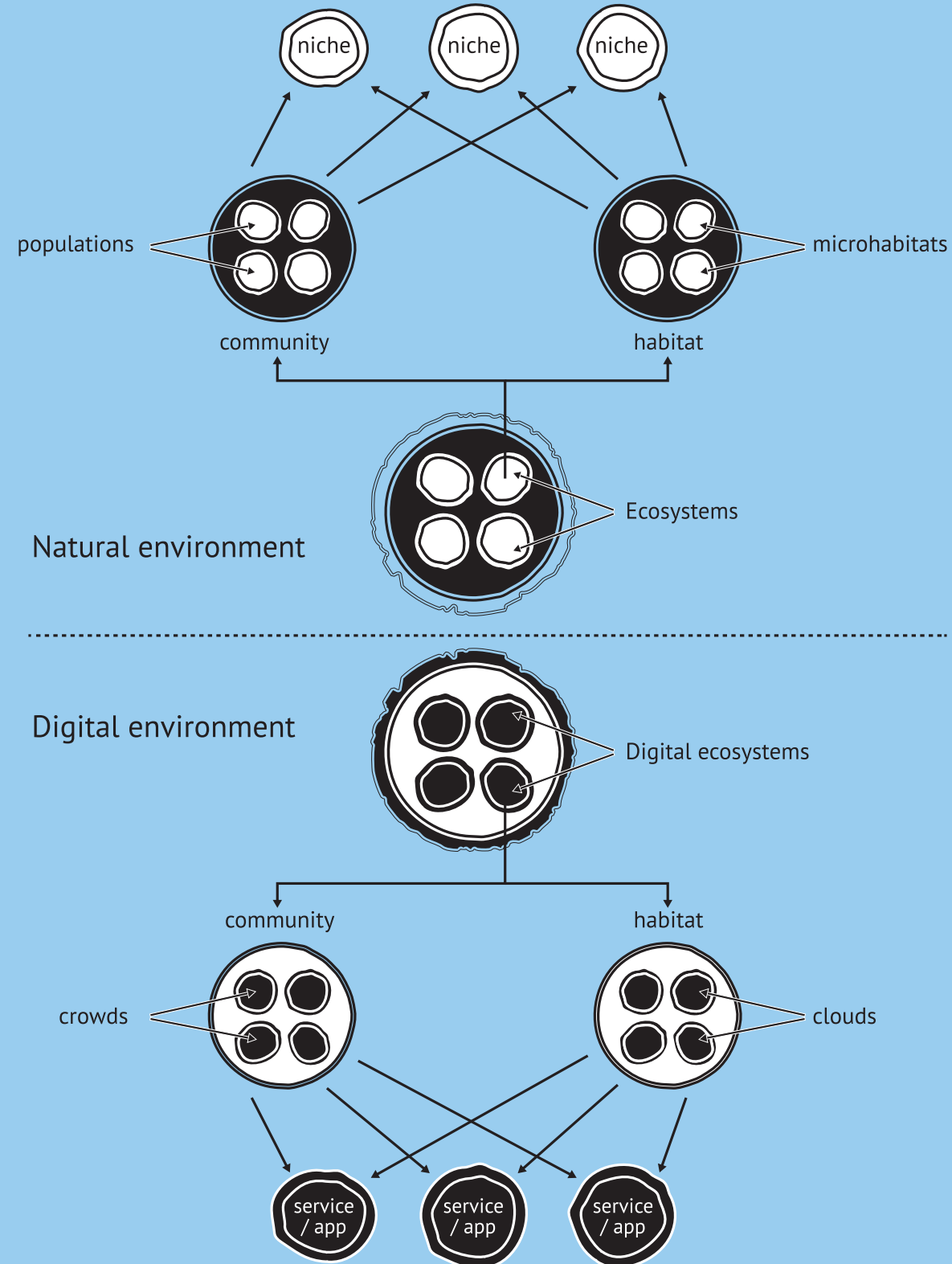
**4) The production of software as a hypothesis:** Software prototypes play a key role in the design process of an artifact. The most important aspect of research-based design is the development lifecycle of the product; the continuum of iteration that leads to development of any product. The iterations occur as the consequence of resolving the challenges identified during the previous phases. With every finding of research done during contextual inquiry, the designer implements them to design a draft of



the product. Prototypes are the drafted designs that are, to some level, functional and serve an intended purpose. They are used extensively to study user behavior and test the functionality of a design before it is sent out for production.

In the literature of design, the first model of a product that is predominantly used for testing and experimenting is called a Prototype (Krippendorff, 2006). The term “Prototype”, however, comes from the literature of categorizing and understanding perception of typicality differences (Rosch & Lloyd, 1978). It is the virtue of which one can define the “ideal type” of a certain category and categorize an object according to its typicality. This cognitive process of recognition is useful in identifying an artifact or a product by its forms and features. In research-based design methodology, the designer uses the first draft of the product to make user tests and uses the stakeholder’s understanding of the presented product version to identify points of resemblance to the most ideal type.

In this design case, the hardware prototypes were functional to the point where they could be tested with a few groups of children simultaneously; whereas, the software prototype are made as digital mockups. The testing of the hardware prototype of the Mesh network was done through a treasure hunt game where the children, who were the key user in this case, participated with each other by communicating, finding resources and clues, all through the Mesh network. This user study provided many contextual keypoints to designing and iterating the product. The study also focused on the tools and activity-based apps that the children used on the client-end device (OLPC laptops) that they were provided with to access the Mesh. The children also discussed their views by comparing the device to other devices that they have used in the past, further instantiating their involvement, reliance and affordances of digital product.



## THEORETICAL BACKGROUND

### Ecosystem of Knowledge

Learning is a perpetual process through which humans acquire knowledge. To understand the ecosystem of knowledge, one must delve into the depth of knowing the basic concept of 'Ecosystem' first. As quoted Guetl & Chang, an ecosystem was first defined in 1935, by a British ecologist A.G.Tansley, as a "community or assemblage and its associated physical environment in a specific place". However, in the process of time, the interaction and interrelation between the community and physical environment, in the form of energy flows and nutrient cycles, came to be acknowledged within the definition of ecosystem, further articulating it as "the complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space"(Guetl & Chang, 2008).

In nature, thereby, an ecosystem is made up of living organisms; which become the biotic component and the non-living factors; that become the abiotic component (Guetl & Chang, 2008; Põldoja, 2016). For example in a marine ecosystem, the aquatic animals, plants, phytoplankton, bacteria etc can be classified as a biotic component, whereas the environmental factors that influence the functioning of these living organisms like temperature, pH, salinity, the concentration of salts and pollutants become the abiotic component. Moreover, each of these two components can be further classified into subsets. The biotic component comprising of living beings in the form of a community consists of populations and individuals belonging to a certain species. On the other hand, the abiotic component; that is the area inhabited by this community consists of habitats and microhabitats

where specific population lives (Põldoja, 2016). The symbiotic co-existence of a population in a microhabitat is defined as niche.

Similarly, in context to humans, ecosystem can be explained as the web of dynamic interaction and interrelation between humans and their natural or artificial environment (Dimitrov, 2002). Humans beings are extremely intelligent and social, they thrive on meaningful interactions with their surroundings. Through the process of learning, they perpetuate their web of dynamic interactions with their environment. In the ecosystem of knowledge in which humans are constantly interacting, organizing and constructing knowledge, the range of abiotic units has transcended mere physical habitat and microhabitats to virtual and digital platforms. There is a plethora of digital environments where various learning stakeholders form communities, interact with one another and utilize tools and services to acquire knowledge, much like how a biotic unit in an abiotic setup does in a natural ecosystem. Such digital ecosystems have started to exist in most learning environments, schools and institutions today. This study explores the idea of using local mesh network and Open Educational Resources as an abiotic microhabitat of a learning ecosystem to design a self-sustaining learning environment for children, as opposed to traditional E-learning platform hosted in the Internet. That brings us to highlight the history and significance of the Internet in the field of education over the period; and the various threats and challenges a learner faces while using Internet for educational purposes.

## Digital Ecosystems

So far, many scholars have studied both natural and digital ecosystems, to draw a parallel between the two. In order to design digital learning environments with self-organizing capabilities of a natural ecosystem, it is crucial for designers to understand “digital ecosystems” from the perspective of biological “ecosystems” found in nature. Digital ecosystems can be analyzed or developed either by explicitly being defined by biological concepts, or by being inspired by metaphors from biological

*Those who are inspired by a model other than Nature, a mistress above all masters, are labouring in vain*  
*\_Leonardo Da Vinci (Bramly, Serge;, 1994; Briscoe et al., 2011)*

ecosystems (Pournaras & Miah, 2012). In a metaphor-inspired development process; the metaphors of biological ecosystems, like natural phenomenon or complex processes, are used as an analogy or an inspiration to solve problems. For instance biological phenomena like swarm intelligence, Ant algorithm; properties of cloud ecosystems; cellular signaling and genetic algorithms were used as a source of inspiration for systems like Peer-to-Peer computation, Cloud service, Agent-based computation and Grid computing, respectively. Whereas, in metaphor-defined development process, the functions of a Digital Ecosystem explicitly bank on the properties and concept of biological ecosystem by harnessing the dynamics that underlie the complex and diverse adaptation of biotic elements in it (Briscoe et al., 2011). For instance, concepts like self-organizing and self-sustaining properties of biological ecosystems were explored and utilized to evolve high level software application like Autonomic computing; that can be described as the digital counterpart of Human Autonomic Nervous system. Similarly, other examples of metaphor-defined areas include Organic computing; that is centered around decentralization and emergence, Evolutionary computing; that uses concept of Darwinian theory and Green computing; that focuses on sustainability.

In this thesis, the core concept of “Permaeduculture” is proposed to be a blend of metaphor-inspired approach; where we refer to design principles of Permaculture Farming to design Learning Environments, with a metaphor-defined digital ecosystem; where the digital infrastructure is aimed to be a decentralized Mesh network that is focused around the concepts of self-organization, sustainability and decentralization. The prototypes used as a hypothesis is based on the “internet-in-a-box” project. Although that has a few limitations and a centralized nature attached to it, the ideal software goals would be to go, as farthest as possible, from the prevalent centralized model of Internet to a decentralized, freely accessible Intranet of resources for educational purpose.

## Role of Internet in Education

Our knowledge ecosystem is changing rapidly from having a landscape of needs revolving around making meaning of the world through interactions, to a wholesome purpose of transferring values, culture and knowledge from one generation to the other; so as to prepare the new generation to thrive in the future. In order to cope up with the change, the need for lifelong learning has become crucial. Internet has been revolutionizing education by fuelling the necessities of lifelong learners for more than a decade now. It has pervaded in our daily lives, reshaping our society as well as learning environments, institutions and educational spaces (Volery & Lord, 2000). As stated by Volery and Lord, the rationale behind online education finding wide acceptance in our society and its various institutions, can be categorized as following:

**1. Accessibility:** According to the global digital population statistics published by Statista, 56 percentage ie; more than half of the world population were active users of internet in the year 2019. There are many learners who have limited access to academic programs owing to geographic isolation, overlapping of schedule with other workloads, learning disabilities, physical disabilities, etc. Since Internet is accessible and at the disposal of many, it becomes the key medium through which education can be delivered beyond physical institutions.

Even in cases of regular school-goers, Internet provides a platform for global connectivity to share and impart knowledge to a wider range of learners. Through online courses and e-learning, learners can reach out to a larger community of people having similar study matters in a synchronous manner. In comparison to physical learning environment or offline communities, online learning environments sustain a larger community or learners who are densely knit despite being dispersed in space and time and lays foundation for a homogenous spirit despite constituting individuals of a heterogeneous social characteristics (Hiltz & Wellman, 1997).

**2. Scalability:** With an increase in global population and surge in the number of learners within an institution, there is a growing demand for facilitation. Moreover, today's competitive landscape of education seeks to achieve higher yield of knowledge and learning delivery. Many institutions are faced with the challenge of accommodating an exponentially growing population of learners within their physical premises. Gradually with the virtue of internet, institutions are able to deliver education to a larger mass of learners without having to accommodate, simply by leveraging the scalability through online courses.

The trend of sharing educational content digitally dates back to the pre-Internet era of 1980's during the days of computer-aided education (Adams, Liyanagunawardena, Rassool, & Williams, 2013); Lane & McAndrew, 2010). In the early Web days, when sharing and publishing content online became more prominent, it was expensive to restrict access. That led to most content being freely shared or be available through open access. But with universities and institutions introducing virtual learning management software and environments, a lot of educational content were made restricted. In some cases, however, universities promoted the idea of Open Educational Resources (OER) shared through the Internet for non-commercial use like research or learning purposes. The classic example of it is the OpenCourseWare initiative launched by the Massachusetts Institute of Technology (MIT) to publish all its courses on open web in 2001. This initiative started from a cluster of studies done to improve the quality of education through application of technology to both on-campus learning and distance learning; marking the beginning of the era of "Open Educational Resources".

**3. Emerging market opportunities:** The learner community across several fields and professions, today, has embraced the idea and values of "lifelong learning". As Christopher Knapper and AJ Cropley put it; this idea appeared way back in 1970's and intensified all the way through to its peak in 1996, but it was only limited to substantial amount of discussions, theories and a very little practical implications during its early stage. But in recent years with global connectivity, learners from various segments of the society such as office-goers, creators, technology specialist, artists, other professionals, homeschoolers, working adult etc; are pursuing further education through various online platforms. Many institutional bodies started cashing in on this growing need for educational services, by capitalizing through online learning technologies. Paralleled by the era of the "dot.com" boom, many companies in the field of education had a high economic expectation from the Web and this period of "hopes, hypes and rapid development of online learning technologies" was hence termed "the e-learning era" (Põldoja, 2016).

**4. Catalyst for institutional transformation:** The Internet has played a catalytic role in transforming the institutional landscape of the world. After the advent of internet, education process changed significantly in the past few years; where online education becomes not just valuable for lifelong learners but also for full time students (Virtič, 2012). Online learning has taken various forms and identity throughout it's journey in the world of Internet.

E-learning was broadly classified into the following categories by Mateja PLoj Virtic and George Siemens (Siemens, 2008; Virtič, 2012):

**1. Courses:** are sequenced educational materials that are collated and “transferred” to the Internet or an online environment using media.

**2. Informal learning:** A learning that is achieved through observation, interaction and experimentation in a verbal or informal way. It is a kind of learning that is distinguished from formal education by lack of classes and workshops.

**3. Blended learning:** It is a blend of face-to-face learning and distance learning.

**4. Online communities:** These are the group of individuals who embark on the path of acquiring knowledge together in a community despite being displaced in time and space. The most significant mode of acquiring knowledge in this case is through dialogues and discussions with one another.

**5. Knowledge management:** Institutions and organizations have adapted various kinds of knowledge management system. It is an system to identify, index and produce knowledge, within the organization.

**6. Networked learning:** Networked learning is supported by close knit communities that are bound to each other by common goal, concept or theme.

**7. Work based learning:** It is a learning model where learning content is superimposed on the actual point of need to generate knowledge.

## Indian Context of Internet education

Internet is widely used by students in India both in their day-to-day activities and in school. Roughly 93% of students living in a city are able to access Internet for their educational requirements, according to a Student Online Behaviour Report by HT Digital and IMRB (Pretika Khanna, 2014). It's incorporated in interactive smart classrooms, laboratories and libraries in the form of Internet-based learning medium (ILM). Moreover, it has provided learning platforms for the underserved populations who are not able to access a physical learning space, owing to overburdening family responsibilities and lack of time.

However, there have been many limitations in the usage of Internet for learning purposes in the rural areas where the underprivileged majority of India can barely access schools, let alone Internet. An average Indian needs to work 13hours a day to access 1Gb of data and that too is often limited to entertainment-based searches in social media and audio video platforms (Skynet Foundation, 2016). This is leading to a polarization of learning capabilities of students in the cities versus the students of rural India. While one strata of the society is achieving new peaks of glory in academia, the other is struggling to get basic education. That is leaving most of the underprivileged far behind in the national ranking system of country. With the rise in use of Massive Online Open Courses (MOOC's) in the private schools, the gap between the students studying there and the government public schools are only getting wider.

Another drawback of Internet has been that in many cases young learners become an easy target for various malicious aspects of the Internet like cyber bullying, child abuse, identity thefts and fraud. Even though the Central Board of Secondary Education (CBSE) has issued guidelines for the usage of Internet and digital technologies in school, children fall prey to it outside school premises due to lack of facilitator and proper guidance. The need to educate and raise awareness about digital privacy rights for children has become ever more necessary on a national scale.

## Evolution of Learning Environments in India; Benchmarking educational reforms and innovations.

Understanding of learning in the perspective of “knowledge ecosystems” gives us a holistic view of the learning environment. This domain of ecosystem of knowledge is not just confined to the digital ecosystems of the educational landscape but also to physical learning environments and the plethora of educational reforms, movements and innovation taking place within its periphery. It enables us to perceive the existing educational system, identify the challenges and loopholes in it and thrive to solve issues to improve the quality of education offered by it. This chapter is focused around benchmarking as one of the most important aspect of the research. Here are some of such educational reforms, movements and innovation that has stimulated ideas and shaped the final outcome of this thesis:

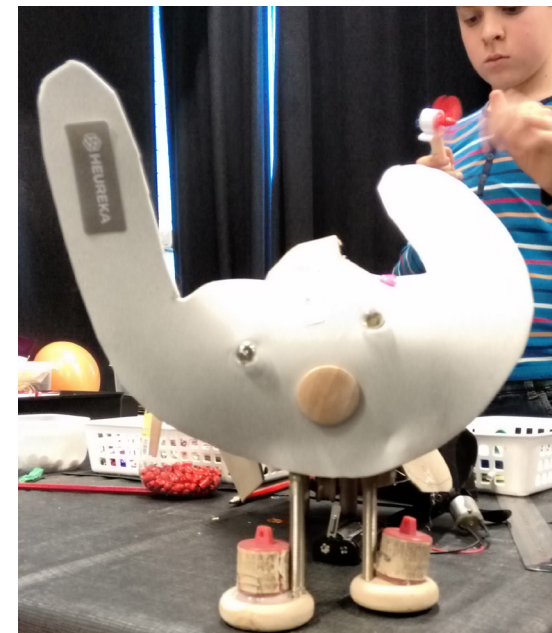
### 1) Alternative Education

The current educational system of India dates back to mid nineteenth century (Mehrotra 2007). Prior to the imposition of British educational system under the Raj, the indigenous system of education held field in pre-nineteenth century India. There used to be schools in the form of pathshalas or gurukuls and madarsas (Vittachi, Raghavan, & Raj, 2007); where learners were taught practical life skills, arts, philosophy, literature, lexicology, religion and grammar through academic education. However, this community-based education perished under the colonial rule of British empire and their deliberate implementation of new educational policies. Eventually, with the decline of local economy, these institutions were replaced by new system that shaped India's education for the centuries to come. Naturally, as much as there were supporters of this education system of the Victorian era, there were those who worked on alternative ideas opposing it. Reformers and educators like Vivekananda, Dayanand Saraswati, Syed Ahmed Khan, Jyotiba Phule and various others began



*“Makerspaces are physical spaces that have been designed or set aside to support the maker in creation, design and building of new projects and technologies” (Blackley, Sheffield, Maynard, Koul, & Walker, 2017)*

*Children seen immersed in Mini Maker Faire organised at the Design Factory of Aalto University, Otaniemi (2015).*



to plant the seeds of alternative educational system that could restore and revitalize the Indian society. And in few years, educationists like Rabindranath Tagore, Mahatma Gandhi, Jiddu Krishnamurthy, Gijubhai Badheka, Sri Aurobindo and the Mother became the pioneers of Alternative Education in India. They introduced various models of alternative schooling as a response to the drawbacks of the mainstream education. Additionally, several alternative movements from outside India were introduced to the educational landscape. Approaches like Montessori method of primary education gained popularity in many parts of the country. Among the most influential educationists were Rudolf Steiner, John Holt and Paulo Freire that found their spot in Alternative education scenario in the country. Such influence escalated alternative educational thinking and concerns amongst Indian educators and parents; leading to a rise in alternative schools in every state in India. Alternative educational practices drew educators to focus on socially relevant concerns like poverty and inequality in the new light of education. Further turning into an important benchmark for innovators working in the field of education.

### 2) Makerspaces

Human beings have always been sophisticating themselves by making things; from the time they made fire to the time they made wheels and to how they are constantly constructing today in order to acquire knowledge and make themselves more aware. The maker movement, however, is a fairly new phenomenon that gained popularity in the past few years. It took theories like constructivism (Piaget, 1973) and constructionism (Papert, 1986), to finally understand the value of ‘making’ as a tool for learning. Constructionism became the learning theory that shaped the maker movement, with Making, Tinkering and Engineering as its key guidelines (Martinez & Stager, 2013).

The maker movement has been defined in different ways in the scholarship. Erica Halverson and Kimberly Sheridan describes the “maker movement” as “the growing number of people who are engaged in the creative production of artifacts in their daily lives and who find physical and digital forums to share their processes and products with others”

(Halverson & Sheridan, 2014, p.496). This movement broadly constitutes three components – making as a practice of activities, makerspaces as a community of practice and makers as identities (Halverson & Sheridan, 2014). Influencers like Dale Dougherty has also defined maker movement by publishing related content in a magazine called MAKE and hosting Maker Faires or mini Maker Faires for children around the world (Halverson & Sheridan, 2014, pp. 496,497). The “Maker Movement Manifesto” elaborates on making, sharing, giving, learning, accessing necessary tools, play, participation, support, and change as the key ideas behind the maker movement (Hatch, 2013). Mark Hatch established one of the first community-based, open access, Do-It-Yourself (DIY) workshop and fabrication studio called the TechShop; that set stones at defining what “makerspace” is today.

The influence of this movement can be seen both on formal and informal education setups around the world. This culture is not only adapted personally by learners, teachers and parents but also implemented by universities and institutions globally. For instance, Fablabs and Design factories are a kind of Makerspaces that is widely accepted in universities across the globe. Further, extending it's limit to the premises of K-12 setting, projects like Fablab@School came into being.

The culture of tinkering and learning through creating aligns with the DIY nature of the Mesh network described in thesis. Taking maker movement as a benchmark, this thesis aims to implement the key ideas of using community-based pedagogical environments centered on activities that educate through the medium of constructing something.

### 3) OLPC School Server

Rooted in the constructionism theory of Seymour Papert, One Laptop Per Child (OLPC) project was conceived at MIT Medialab in 2005, with a vision to make education accessible to the world's poorest communities by providing them with an ultra-low cost, powerful, rugged, low powered, ecological, connected laptops with content and software designed for



*Children of Rakkar seen immersed in the Maker culture that was fostered in the learning space; soldering (above) and automating Finch robot using Scratch (below).*



playful, collaborative and self-empowered learning (One Laptop per Child (OLPC)\_ Mission.html, 1999). As an additional infrastructure to compliment the XO laptops, the OLPC community of developers introduced a low-end linux-based system called the School Server (XS). This system is designed to function as a server that provides connectivity, access to a large repository of resources and various services like school management, backup, video conferencing etc. It plays a vital role at scaling the local-area network capabilities of the XO laptops, as well as providing a gateway to the Internet.

The key purposes served by the school server are (“Deployment Guide/ School Server,” 2011):

1. it is a software stack that can be installed on any computer system or server to provide a better, safer and local learning platform in school environment,
2. OLPC laptop backups can be archived and managed through this server,
3. This server can host a Digital Library that enables learners and facilitators to have asynchronous interaction,
4. The OLPC Server software can run Moodle, that allows it to deliver customized teaching modules through e-Learning system,
5. The School server also provides management and security services that make it a safer learning environment,
6. It can serve as a Proxy for secure web-browsing,
7. It offers functionalities like lending computation power to the OLPC laptops,
8. It can support mesh networking.

The School Server Community Edition later came to be known as Internet-in-a-Box (IIAB) in order to bring the power of free Digital Library to a global community.

### 4) Open Educational Resources (OER)

With the launch of the World Wide Web in the early 90's, information and resources started to become freely available online. However, such



resources were of a varying quality and not all were considered capable of promoting enhanced learning or pedagogical achievements. This raised an interest amongst scholars on how the content is shared and reused over the Internet as well as a concern for quality assurance of the same content. It was in 1998 that the idea of Open Content came into being when Open Content Licence (OCL) was released by David Wiley to set the terms and conditions for copying, distributing and modifying online content (“OpenContent License (OPL),” 1998; Põldoja, 2016).

As the idea of Open Source Software culture emerged around the same time, some of its principles were then applied to educational content like scholarly research, literature, art etc. This quest for a universal access to high quality academic content led to the introduction of “Open Educational Resources”. The term first coined at a UNESCO conference in 2002 by the Hewlett Foundation was defined as: “The open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes.” (Hylén, 2006). However, today it is commonly defined as “teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others.” (Atkins, Brown, & Hammond, 2007).

The framework of OER includes the **5 ‘R’s** of rights/permission as defined by Wiley ;

Retain – the right that allows the author to have control over their content,

Reuse - the right that allows anyone to use it,

Revise - the right that allows people to modify,

Remix - the right to combine different contents to create something new,

Redistribute - the right to share copies of the original content, revised content or remixed content with other.

There are many different types of OERs ranging from large-scale repositories created by universities and institutions to small repositories created by individuals. The other way of distinguishing different types of OERs are based on the providers of the resources. It could be large-scale

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*Sustainability in Learning Ecosystems can be reflected through the 5 R’s of Open Educational Resources.*

top down initiatives coming from the institution point of view or bottoms-ups initiative taken by communities and individuals.

[Diagram: Topology of different repositories (Hylén, 2006)]

The digital infrastructure designed in this thesis, includes a Knowledge Server that is capable of hosting a variety of OER’s. The most significant of them are:

\_Wikipedia,

\_Khan Academy Lite; the offline version of Khan Academy online courses,

\_NROER (National Repository of Open Educational Resources); large repository of online resources published in Indian language by NCERT, CIET and other government bodies,

\_Project Gutenberg; the oldest Digital Library archived online, founded in 1971.

# SUSTAINABLE ECOSYSTEMS

## Between Sustainable Ecosystems And Ecosystem Of Knowledge

In the world of ever-increasing connectivity, individuals and communities are linked with a worldwide system of communication, transportation and commerce. This makes the possibility of a system that fosters learning as a lifelong activity and balancing the production and consumption of information in the ecosystem of knowledge not a very far-fetched goal to achieve. Moreover, such a system could function beyond its' machine-engineered practices and develop a characteristic of resilience in itself making it dynamic enough to suit the changing complexities and needs of the learners. Joseph Fiksel illustrates that the fundamental properties like adaptability, efficiency, diversity and cohesion makes a system resilient by making it capable of self-organizing; balancing between the production and consumption, preserving equality of each individual element, and by giving it a strong sense of identity despite being in a constant flow to dynamically suit itself with time. These properties and the state of flow, which is achieved in the process, is the prerequisite of a sustainable system. Likewise, one can relate this state of flow to the Flow theory proposed by Mihaly Csikszentmihalyi. He argues that people improve their quality of life when they find flow in work and in relations with other people (Csikszentmihalyi, 2002). Furthermore, Mihalyi (1990) explains that one can attain the highest sense of gratification if the mental state is immersed and at a zone of flow. This zone is ideal for one to be actively learning.

Likewise, Lev Vygotsky, an educational psychologist proposed the theory

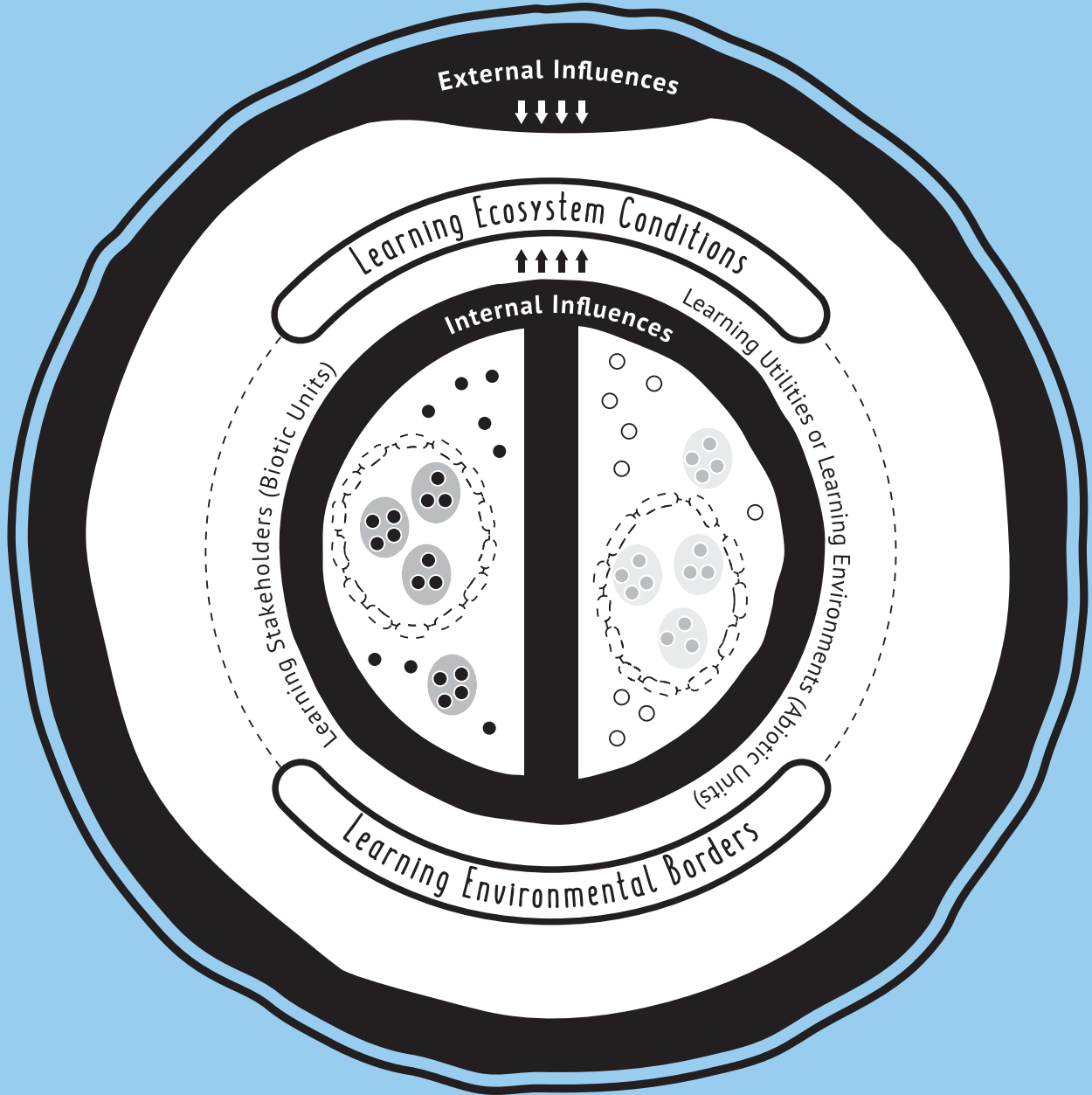
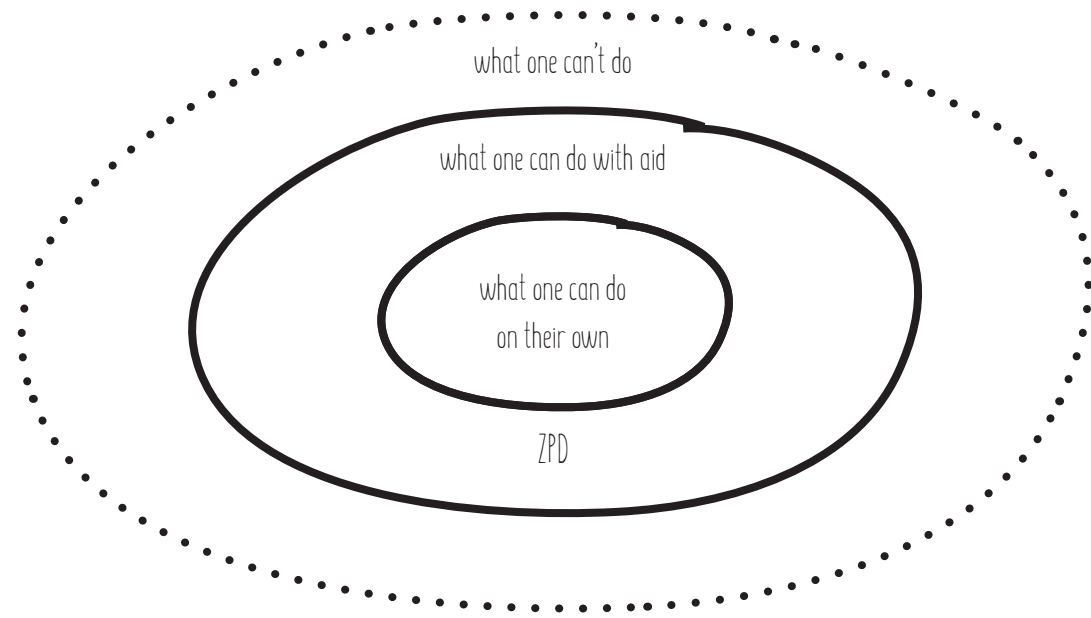


Figure: Illustration of a Learning Ecosystem component (Guettl & Chang, 2008, p.56; Põldoja, 2016, p.39)



of Zone of Proximal Development (ZPD) upon understanding the problems with traditional evaluation procedure and impact of schooling on children's development (Kozulin, Ageyev, Gindis, & Miller, 2003). Vygotsky defined "Zone of Proximal Development" as the distance between the developmental level through a child's independent problem solving efforts and the developmental level through problem solving with aid, guidance and collaborative efforts (Daniels, Cole, & Wertsch, 2007). He suggested that children be given only the certain amount of assistance that is required for them to remain in the zone between attaining boredom with multiple instances of successful independent efforts and getting frustrated by the challenges put forward by instructors (Crain, 2014). Aids like resources, tools and technology handed down from generation to generation, help children acquire knowledge in a continuum. In addition, the technology invented by new generation provides ground for information societies that reinforce a positive viewpoint about ideas like Lifelong Learning. However, some argue that in the near past learning environments have not changed much to suffice the objectives of Lifelong Learning (Karvonen, 2001). This broadens the scope of introducing notions of sustainability to the field of education.

Figure: Lev Vygotsky's Zone of Proximal Development.



## Permaculture

It is necessary here to clarify exactly what is meant by Permaculture. Originally coined by Bill Mollison and David Holmgren in the mid-1970's, Permaculture was defined as an "integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man"(Holmgren, 2010, p. 19). Today, it is widely viewed as an agricultural system that is intended to be self-sufficient and sustainable. As illustrated in the book *Gaia's Garden*, Mollison was believed to be inspired by the abundance and interconnectedness of ecosystems in nature and to have held a strong belief that he could build systems that would function as a rich and sustainable ecosystem (Hemenway, 2009). This led to a set of tools, which could be used for designing landscapes that were ecologically sustainable and productive. Permaculture principles were further elaborated and expanded by David Holmgren and a few other prominent naturalists. However, the scope of this sustainable practice and principles went way beyond the bounds of agriculture and today such principles are used to "design buildings, energy and wastewater systems, villages and even less tangible structures such as school curricula, businesses, community groups, and decision-making processes" (Hemenway, 2009). The 12 principles of permaculture (Holmgren, 2010; Mollison et al., 1991) are :

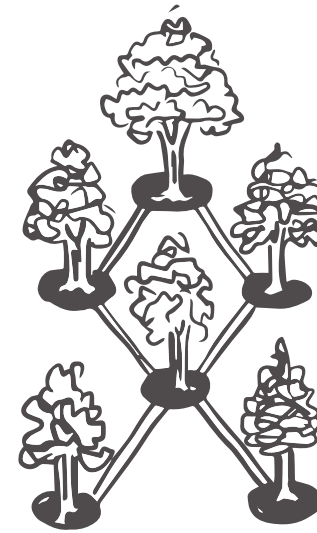
1. **Observe and Interact,**
2. **Catch and store energy,**
3. **Obtain a yield,**
4. **Self-regulation and feedback,**
5. **Use and value renewable resources and services,**
6. **Produce zero waste,**
7. **Design from patterns to details,**
8. **Integrate Rather Than Segregate,**
9. **Use Small and Slow Solutions,**
10. **Use and Value Diversity,**
11. **Use Edges and Value the Marginal,**
12. **Creatively Use and Respond to Change.**

In the light of these principles, this section speculates briefly how these design principles could possibly serve as an inspiration for learning designers to design a sustainable learning environment.

Observing the context and elements of a system throughout the changing seasons; designing for specific sites, clients and cultures; and creating useful relationships to preserve a long-lasting connection among the elements is the first principle. The significance of the number of connections between the elements over the number of elements itself is the most distinctive aspect of permaculture. If Mollison's approach was implemented on learning environments, it could foster rich diversity in the classrooms and preserve human relation that can facilitate learning. Identifying and preserving useful flows by promoting yield through every cycle, every gradient, permaculture focuses on production of energy. It reinvests resources to build capacity for energy resources. Comparatively, modern learning environments have several resources starting from digital technology to physical infrastructure; however, most of such technologies and tools are implemented to transfer information to the learners rather than facilitating learners to produce knowledge by creating, discovering and sharing.

Permaculture preserves a strong reward system; that ensures a resourceful reward to each element. Similarly, knowledge acquisition could be incentivized by feedback and regulation. Moreover, self-regulation helps prevent inappropriate activities and acceptance of feedback provides scope for improvements in learner's performances.

Many permaculture designers hold the view that using nature in the best possible way leads to the optimization of consumption and being independent of non-renewable resources. Comparing natural resources to knowledge resources like Wikipedia and Open Educational Resources (Hylén, 2006), learning approaches could perhaps consider restoring the value of resources to the individuals privileged with it. In most schools with abundant infrastructure, students are more prone to devalue the resources. If permaculture principles are accurate, a sense of gratitude towards every element in the system could be fostered leading to a



positive reinforcement of knowledge acquisition.

By observing patterns in nature, permaculture develops a resilient foundation of the system. To design learning environments, it is perhaps critical to start with understanding the fundamental construct of the society one prevails in and furthermore, be able to identify details of the state, form and media that have been attributed to it.

Permaculture integrates each element in the system in a way it can sustain each other and dynamically re-organize itself to sustain the living. Educators and learning designers have achieved milestones of progress by integrating technology in schools followed by computer-aided-learning and interactive classrooms. Moreover, Edgar Dale's Cone of Experience suggests that learning is constructed within an interactive social context (Jacobs, Hurley, & Unite, 2008). That implies emphasis on collaborative learning, through integration of diverse students within themselves, with their surroundings and technology in order to solve challenges and learn from it.

Diversity in human settlement and culture is viewed as a very significant factor that contributes to the potential of learning environments. It makes the system uniquely multifaceted and more adaptable to nature and the environment. In today's informational society, digital tool and technology unites a plethora of diverse communities and disciplines to interact and learn together from the commons.

Preserving the interface between the individuals around which most of the communication happens, permaculture principles identify the productive elements of the system and provide space for a symbiotic interaction. According to many in the field of education, interaction between students is a significant element of a learning environment. It could be in the form of user interfaces, networks or even physical spaces.

Finally, for a system to be resilient, permaculture views emphasize on the needs to adapt to change and dynamically re-iterate itself with time and confronted challenges. Comparing that to the learning theories, learning happens best when the learner is in the zone of the flow, where learner's challenges are constantly changing (Csikszentmihalyi, 2002).

# CRISIS

## FIELDWORK

*Intervention in school curriculum can be meaningful only when the socio-political context is understood and made part of intervention strategy and design. \_ Poonam Batra (Pinar, 2015)*

### History of Indian education

To understand the current state of Indian education, it is very important to learn its history and evolution. The historical timeline of Indian Education system can be categorized into two stages of educational advance; the Old Indigenous system of Education that prevailed in India before the missionaries from the west set foot on the country and the modern imposition of a tightfisted replica of British educational system that slowly replaced the indigenous one. This transition was catalyzed partly by the Indians of that era who were overwhelmed with the western civilization, truly believing that acquiring western knowledge through the medium of English language marks the revolution of a better educational system, and partly by the fact that the educated Indians were easily employed in Government services during the nineteenth century India. Even though the indigenous education system lost its value and popularity amongst the diverse Indian society during the advent of British rule, there were several instances where western historians like Sir Thomas Munro (1822) and A.D. Campbell documented the values and qualities of indigenous education system, highlighting on the fact that it was higher than any educational system in most other countries of that period (Nurrullah, Syed; Naik, JP;, 1951). Methods of instruction of the indigenous system; like the monitorial system of appointing a senior pupil as a monitor to teach junior pupil that simultaneously serves the objective of managing a larger number of pupils, was a revered concept that found its recognition and application even in the education system of England. This dilemma between the two systems led to a divide between people within the Indian society as well

as the western officials appointed by the East India Company. On one hand, there was one group of scholars interested to “unearth ancient knowledge in Indian religion and culture” and delve into the Oriental philosophies through the foundation of Royal Asiatic Society founded in 1784 and by setting up institutions like Oriental colleges at Delhi and Agra in 1822, Sanskrit College at Calcutta in 1824, recognition of Sankrit College in Benares founded in 1792 and Calcutta Madrasah founded in 1781 (Pinar, 2015). On the other hand, as opposed to the Orientalist perspective, there were reformers who demanded a more liberal education with mathematics, natural philosophy and other branches of sciences as the core of the curriculum as led by people like Rammohan Roy, or a utilitarian approach at modernization of India led by the likes of James Mill, Jeremy Bentham and Lord William Bentinck. The appointment of Bentinck as the governor-general of India (under the East India Company) in 1828 and consequently of Lord Macaulay as the president of the General Committee of Public Instruction, paved a way set in stones for Western education and introduction of English as the official language of instruction in India, for decades to come.

By the time India was independent, the education system retained many loopholes in terms of provision, resulting in large-scale illiteracy across the country. The census of 1951 states that only 9% women and 27% men were found to be literate during the early years of post-independent India (Kingdon, 2007). This resulted in an era of educational explosion, as Tilak describes, which is nothing short of an “educational miracle” (Tilak, Jandhyala BG, 2007). There has been significant progress in this field and many reforms were made along the years to recognize the role of education in development of the country. Resolutions made by the Constitution of Independent India in 1951 to provide free elementary education to everyone until the age of 14 yrs as per Article 45, still holds strong on improving the literacy growth rates of the country. However, with the various educational achievements, there have been several limitations and setbacks that make the educational system of the country a lopsided

one. While on one side, India has been successful in raising schooling participation through “free education for all” approach or churn out a substantial number of well-educated information technology graduates, it’s still a home to 46% of world’s illiterates and a large number of uneducated youth (Kingdon, 2007). In the level of primary education, even though enrollment rates have increased, it is estimated that between 35 million to 65 million children aged 6 to 14 yrs do not go to school (Lall & House, 2005). Especially in the rural areas, the performance of government run schools are far behind on the quality range as compared to the private schools. Overall, Indian educational system is faced with a wide range of problems and challenges like financial constraints, gender-disparity, low teaching attributes, obsolete teaching methods, poor facilities and resource allocation, research constraints, privatization, heterogeneous environment, involvement of political factors, economic fluxes and lack of value education (Chahal & Dar, 2015; Kapur, Radhika, n.d.).

The idea of education and development are interdependent or bidirectional (Education and development in India, 2018). As education contributes enormously towards development, so does the socio-economic development of a nation towards the state of it’s education. In developing countries like India, education plays a vital role in fighting poverty, reducing inequalities, promoting socio-political transformation, thereby contributing not only to the economic growth of the country but also it’s human development. India has taken many years to fully realize the link between education and development, economic growth and poverty. This emphasis served as the seed for India’s aim to transform into a knowledge society and place itself at par with other countries in technological front. From a Nehruvian perspective, India was envisaged as a secular democracy in which the approach of “education for all” was intended to unite the country that was once divided on the basis of wealth, caste, religion and it’s diverse culture. Once the objectives of the National Policy on Education (1968) to adopt a common structure of schooling across most of the states of India were met, the government subsequently announced the second

NPE in 1986. The aim of the new policy was to increase access to education and improve the quality of education, while preserving the values of secularism, socialism and equality. Under this policy, the government was open to accepting funds from the private sector resulting in promotion of privatization in education.

The responsibility of Indian education today, is shared both by the central and the state government, as per the Constitution of India (Govinda, Bandyopadhyay, Consortium for Research on Educational Access, & National University of Educational Planning and Administration (India), 2008). The central government works at a policy level; involving planning frameworks, introducing policies to stimulate innovation, designing and implementing development initiatives etc. Whereas, the state government is responsible for the financial aids and running the education system on ground (Govinda et al., 2008; Lall & House, 2005). The pattern of schooling adopted nationwide today is the 10+2+3, that is the general education for all children. The first 8 years of this period is called “Elementary education” which is accessible for free for any child between 6 to 14 yrs of age. Within this pattern, the first ten years of schooling is segregated into primary, middle and secondary school, at the end of which there is a secondary school examination (matriculation). The result of this examination determines the next two levels (also termed +2) of senior secondary education, which is when diversification of courses into various streams like Science, Arts/Humanities and Commerce takes place. At the end of the 12th standard or the two years of senior secondary education there is a public examination that allows students to qualify for university level undergrad programs.

Within the reach of the field site where the research for this thesis is carried out, the various types of schools are discussed below, based on how they are governed and funded:

**Government schools:** Schools that are run either by the state and local government or run by the central government.

**Government aided private schools:** These are the schools run by NGO's and charitable trusts that are partially funded by the government.

- **1987 | Restructuring and Reorganization of Teacher Education**  
*created a resource for the continuous upgrading of teachers' knowledge and competence.*
- **1987 - 1988 | Operation Blackboard**  
*aimed to improve the human and physical resources available in primary schools.*
- **1991 | Minimum Levels of Learning**  
*laid down levels of achievement at various stages and revised textbooks.*
- **1993 | District Primary Education Programme (DPEP)**  
*emphasized decentralized planning and management, improved teaching and learning materials, and school effectiveness.*
- **1995 | National Programme for Nutritional Support to Primary Education**  
*provided a cooked meal every day for children in Classes 1–5 of all government, government-aided and local body schools. In some cases grain was distributed on a monthly basis, subject to a minimum attendance.*
- **2000 | Movement to Educate All**  
*aimed to achieve universal primary education by 2010 through microplanning and school-mapping exercises, bridging gender and social gaps.*
- **2001 | Fundamental Right**  
*involved the provision of free and compulsory education, declared to be a basic right for children aged between 6 and 14 years.*

Figure: Chronological representation of initiatives introduced under the NPE (Lall & House, 2005)

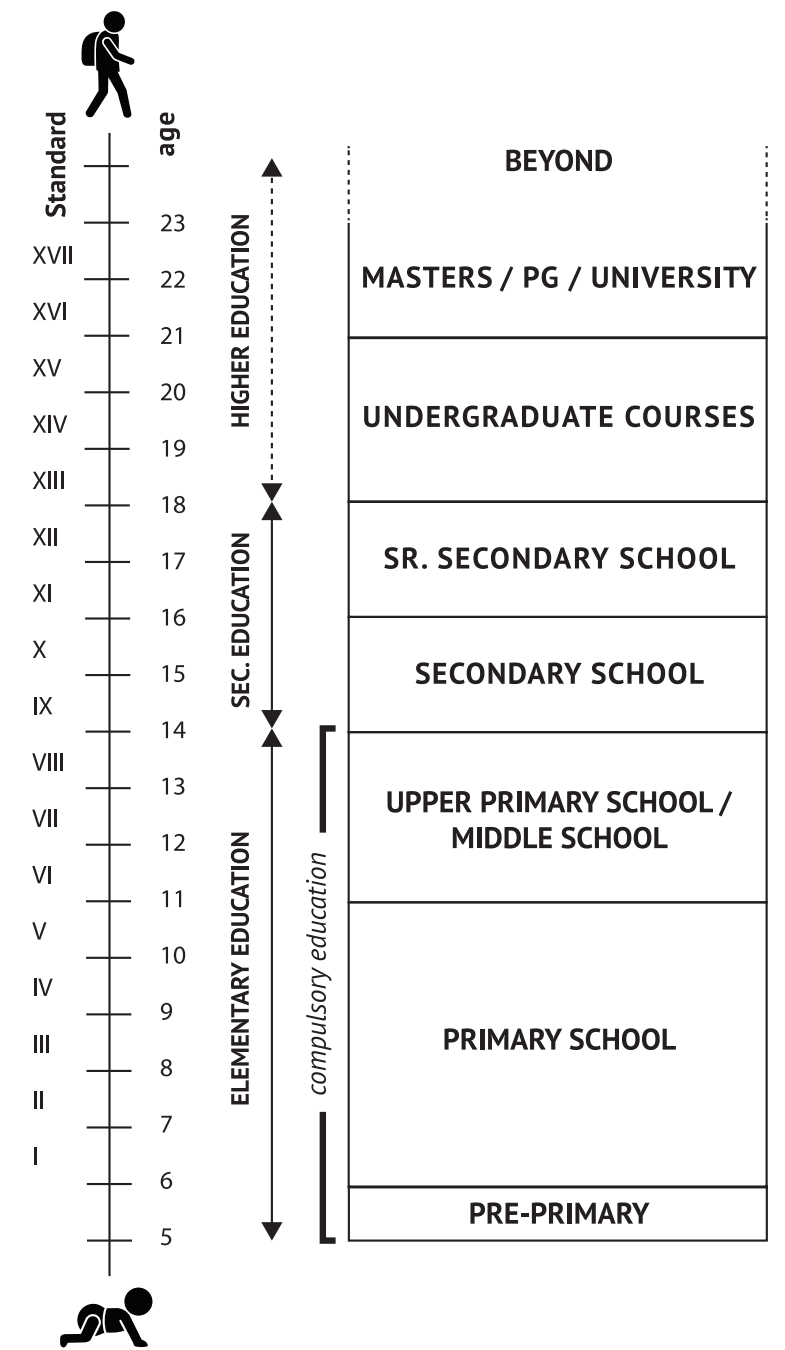


Figure: The Structure of the Education System in India (Govinda et al., 2008)]

**Private Schools (unaided):** The schools that are privately owned and managed. According to the ninth ASER, even though access to elementary education in government schools has been made free, the rate of enrollment to private schooling is as high as 29%, even in rural areas of India. Within private schools there are the recognized/registered private schools and non-registered/non-recognised private schools. The past few years have seen an expansion of alternative schools in this region, due to the growing population of young parents moving base from the India cities to lead an off-grid life in a rural area. Besides that, proliferation of unrecognized schools is also on the rise. Many researchers and educators have studied the role of private schools and have highlighted on the growing numbers of private schools in India, stating that private schools across India are outperforming the government schools in key curriculum schools (Agarwal, 2006; Aggarwal, 2000; Kingdon, 2007; Tooley, 2005, 2007; Woodhead, Frostb, & Jamesb, 2013).

**National Schools:** These are the schools that are run by government bodies or established societies that follow a national curriculum.

**International Schools:** These are the schools that are established as international by orientation i.e; it doesn't abide by national curriculum and follows a broad international curriculum instructed only through English medium.

## Exploring the field site

Nestled in the foothills of the mighty Dhauladhar range, Dharamshala is one of the most beautiful towns in Himachal Pradesh, a state in the Himalayan region of India. Having had a long political and social history, this place today is recognized primarily for the establishment of Tibetan exile administration and the settlement of Tibetan refugees led by the 14th Dalai Lama (Tenzin Gyatso). Besides the Tibetan Buddhist population, the area is inhabited by the Gurkhas, Sikh merchants, local non-indigenous people and the indigenous tribes of Himachal Pradesh. The total population of Himachal Pradesh, as stated in the last Census (2011) is 6,864,602, which constitutes 0.57% of the total population of India. As of 2019, it is estimated to be 7,435,000. Out of the total population, only 10.03% live in urban areas with a literacy rate of 91.10% amongst male and 74.25% amongst female. The rest of the population resides in the rural pockets of the mountainous region, where access to education, healthcare and other public services are meager. This brings one to highlight the need for educational reforms in the rural areas. Particularly in Dharamshala, the rural population is mostly constituted by the indigenous tribe of the region called "Gaddi". They are the nomadic shepherds who travel to the higher pastures with their herd during the summers and to the valleys during the winters. In recent times, however, a larger section of this community has settled down in the valleys leaving behind only a few to take up the occupation of shepherding forward. Most of the Gaddi settlers today, earn their livelihood from farming, slate mining, transportation, small businesses, weaving, carpentry and other occupational activities that provide a daily wage.

Located a few kilometers away from the town are the villages of Rakkar and Tilloo that served as the field site for this research. Rakkar is a rapidly developing village where the Gaddi tribe has been settled for many decades. Despite being dominated by the indigenous population of this area, over the years, these villages have provided home for the Gurkha,

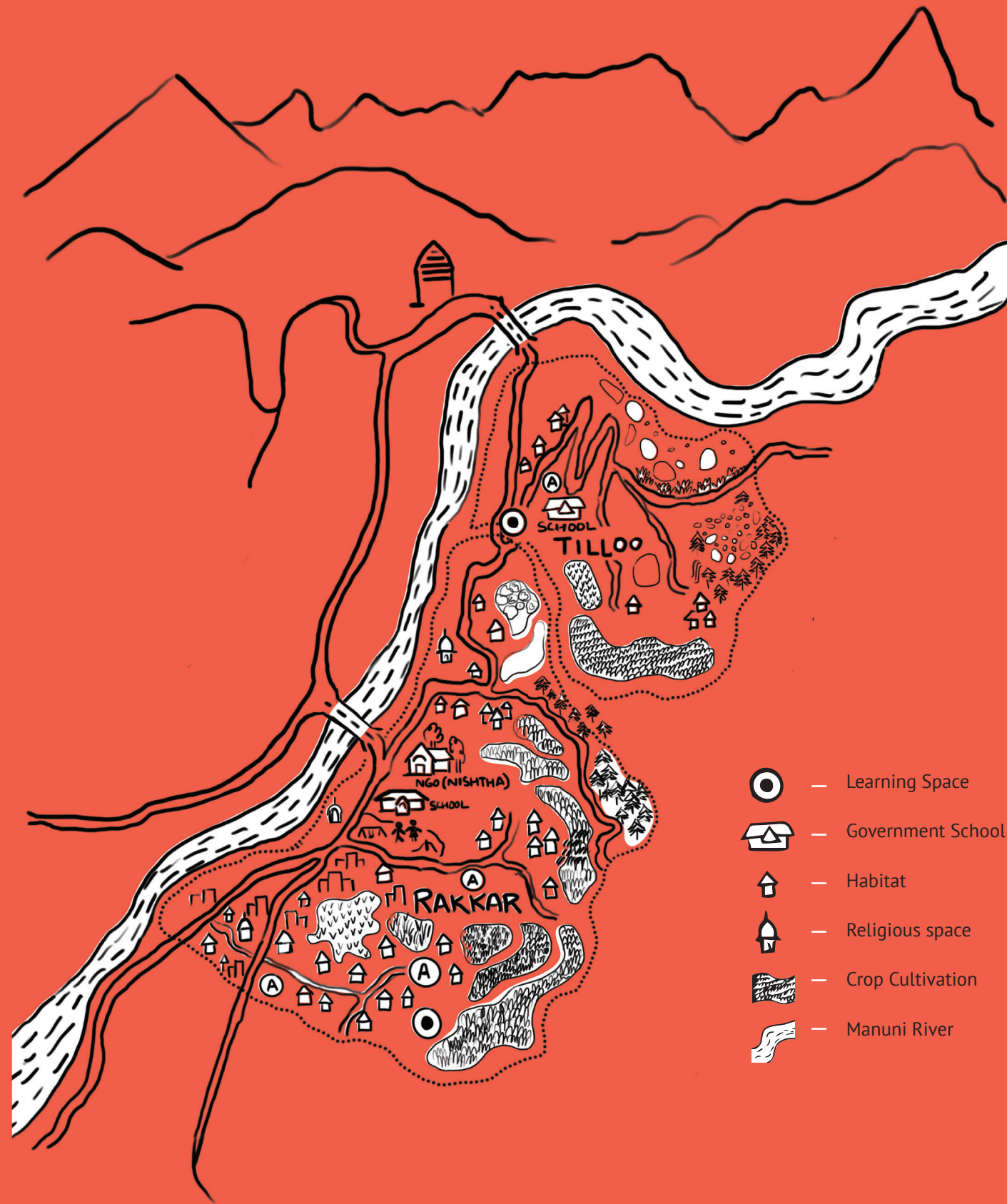


Figure: Illustrated map of the fieldsite



Pahari, Nepalese, Punjabi, migrants who came from Pakistan during partition of India and a few foreign settlers. Especially in the recent times, owing to the advantage of climate, scenic beauty, clean air and peaceful co-existence with nature, this village has become a hotspot for middle-class people from India's megacities who want to live 'off-grid' and lead a better alternative lifestyle away from urban life. Therefore, along with the local native inhabitants, there is a growing community of artists, technologists, educators, scholars, architects and other professional who have migrated from the cities like Bangalore, Delhi and even abroad, in search of a healthy and meaningful living. This unique mix of culture within such a small rural area signifies how diverse India is as a nation. This heterogeneous community has enabled the indigenous people not only to economically benefit from, but also to widen their perspective and progress as a society. There are several prominent Non-government organizations funded by international bodies established and located in the village of Rakkar where many villagers are employed as active participants of social work or part-time volunteers. The locals are not only open to social intervention but are also very supportive of it. The need for change caused by the disparities in literacy rates between urban and rural population and demand for a better education system for the children of such a rural area of the Himalayas creates a perfect ground for an educational intervention. Thereby, making Rakkar and Tilloo a very interesting place to base this research on.

## Ethnography of Childhood; Children of Rakkar and Tilloo

Caste based categorization of learning values

Whether it's for an educator or a learning designer, the idea of 'what children are' is a vaguely defined concept. It's often an overlooked fact that the idea of childhood varies from culture to culture. For instance, a child of a certain age group maybe spending most of their childhood playing computer games in a metropolitan city in India, while a child of the same age group living in a village a few kilometers away would be spending most of their time baby sitting their siblings. The understanding



of "childhood" across time, space and culture is very crucial while designing learning environments. Children can be classified both by age and development stages; infants, toddlers, young children, preteens, teenagers, youth (Allerton, 2016), or by the various stages of formal learning that the child qualifies; kindergarten, pre-school, middle school, high school etc. Children, often dismissed as gullible, unguarded and credulous according to certain social concepts, may end up being regarded as sensitive, priceless and rational in another. According to Allerton, this paradoxical shift of notions are born out of the "new sociology of childhood" movement, followed by determination of child rights movement. All along this shift of understanding childhood, the idea of learning has also changed. From the popular imagery of learning as an old man's trade; that occurs in the sedentary ages of life, as explained by Aries (1965), to current understanding of learning as an act of children to interpret things around them, there has been many reforms, innovations and theories of knowledge that led to the evolution of knowledge ecosystem. In India, however, the notion of childhood and, consequently, the understanding of learning vary not only within culture, space and time but also within various forms of social stratification like clan, tribe, caste etc. Owing to the social complexity of Indian society, there are many social strati. The government school of a single community or a village is thus a playground for children coming from various strata of the same society.

This thesis aims to study the understanding of learning and children's education across various strata of the society within the shepherd community of Rakkar and Tilloo, to establish a context for designing a learning environment for them. Two site specific learning spaces were taken into consideration to address this research challenge; a) group of children in an upper caste (called "Brahmin" and "Rajput") dominating area of the village and b) a group of children in a lower caste dominating neighbourhood located in a nearby village. The children volunteered to learn computer skills, English language and Mathematics in a group and were not motivated by any other external incentives. The first group of children from upper caste families was majority boys with merely 2 girls out of 28 children. Most of the girls in that area were confined to

homes and homely duties. They were not often permitted to go out to a public space for after-school education. The only place where they could possibly have social and educational interaction with others is in their school, temple, public water booths or children's park. Where as, the boys of this children's group enjoyed immense freedom in comparison to the girls of the same age. They were very enthusiastic about learning new skills, especially in the technological front. They were involved in numerous projects with Raspberry Pi's (a simple microprocessor unit that can be made into a computer); playing Minecraft, using Wikipedia and the Knowledge Server to write essays for their school assignments.

In contrast to this, the group of children from the lower caste community was majority girls, consisting about 12 girls out of 16 children. The girls of this group were a lot more outgoing and bold. Girl as young as 7yrs old took lead in organizing, preparing and conducting weekend get-togethers, skits and musical plays during the festivals. They were not only invested in household chores but were also very proactive about learning new skills. These kids motivated themselves to manage a small bookshelf library and were often involved in DIY activities at the studio. The girls also used online resources to learn skills like paper craft, origami, knitting and crochet. The boys were often seen playing chess and scrabble in their free time. Both these groups spoke the same language and belonged to the same community, yet they were very different in terms of their learning curve, enthusiasm, value of their peers, gender sensitivity and view of a learning space. During the end of this study interviews were conducted to understand their individual values about education and learning. An experiment was conducted with the two groups combined to study the collective behavior and response of the children to a common challenge in the proposed learning platform. This experiment was done through a treasure hunt game assisted by the Mesh network. (discussed in the Contribution section of this thesis)



photo source : Luisa Masznitz (NISHTHA)

## CONTEXTUAL RESEARCH FINDINGS

### Qualitative Data Analysis

*“Our greatest natural resource is in the minds of our children.”\_ Walter Elias Disney*

### From the perspective of the children

Even though children are not often asked to share their views about their school or education in general and consulted for ideas on how their school can be developed, they are often the best indicators of the education system they are associated to. Majority of the children of Rakkar and Tilloo belong to the working class or even poor families. Their daily routine includes not only attending school but also dozens of household chores like working in the farms, looking after the cattle and domestic animals, collecting water from the reservoir, delivering supplies like milk in the neighboring urban settlements, gathering fire-wood from the forests and helping their parents in other daily activities.

This thesis research was done while spending a lot of time with the children of the village, to observe them, understand their lifestyle and hardships and realize how they envision their life in the future. The surveys analyzed here were done with a sample size of 20 children within the age group of 7 to 15yrs. The interview questionnaire focuses on various aspects of their school education; ranging from questions regarding their personal experience in their school to motivation and aspirations for the future.

The interviews were analyzed according to the following various topics:

#### **Understanding the demography**

All the 17 children (7girls and 10 boys), belong to the ethnic group of Gaddi tribe. Gaddi is a tribe of nomadic shepherds who settled down in the foothills of the Himalayas a few decades ago. Out of these children, seven are from Tilloo, nine from Rakkar and one who is a summer visitor of Rakkar. Majority of them (88%) speak in their local Gaddi language. Even though the language is spoken in many places, it doesn't exist in written form, owing to it's script Tankari or Takri falling into disuse ("Tankri, once the language of royals, is now dying in Himachal Pradesh," 2006). Since Hindi is the most common spoken and written language used in this region, all of them are fluent in speaking and writing in Hindi. Besides that, some of them (constituting about 52%) are learning to speak in English in their schools. In many cases, learning English language provides them with almost a sense of empowerment, as it is considered an important communication asset. There are some children who also speak other local languages like Pahadi and Punjabi, making most of them multilingual.

#### **About their schools**

Most of the children in Rakkar and Tilloo go to the (state) government run schools in the village. 11 out of the 17 children attend Government Senior Secondary School (GSSS) Rakkar, while 3 attend Chakban Primary School and the rest go to private schools located in the neighboring urban areas.

#### **Motivation to go to school**

47% children stated that they are motivated solely by their studies and play at school, out of which half had job opportunities as the desirable outcome of going to school. Of 17, 5 children were purely motivated to learn new things and 3 specifically stated that they were attending school to progress in life. There were also a few children who went to school so they could socialize with their peers like friends and cousins.



There were also some who were motivated by drawing and art classes. While everyone was motivated by some way or other, there was also a student who retorted that nothing motivates him to go to school, where in fact, he's forced to go to school.

When asked what motivates them to go to school, following are some of the remarks from the children:

*"To study and to play."*

*"to learn, to study, so that I can get a job. to meet friends"*

*"to progress in life"*

*"to be learned, so that we can go to office"*

*"Drawing and playing motivates me"*

*"I'm not motivated but forced to go to school"*

*"Cousins and friends go to the same school"*

#### **Regarding facilities provided by the school**

According to the survey, students attending Chakban Primary school (located in Tilloo) have very poor access to sports facilities. They rely on local outdoor games like kabaddi and khokho that doesn't require any resource facilities. Whereas, the government school at Rakkar (GSSS) have better sports facilities like a Badminton court, playground and resources for other outdoor games. Even though there are playgrounds big enough for all, the outdoor spaces are mostly dominated by male students. A few girls have expressed their discomfort in the interviews and wishes to see a more gender-neutral playground in their school in the future. There is an upsurge of students attending private schools, as it is believed by the locals that private schools provide better facilities to children. However, from this interview, it was found that the students attending private school do not receive any better sports facilities than what the government school students do.

Regarding technical facilities in school, ICT and computer labs are only available in private schools. Students as young as 11 yrs old have access to computers and are trained to use software for drawing

and typing. In the government school, however, they have a subject that teaches about computers theoretically, but the students don't have access to computers to learn it practically. The computers in government schools are only used for administrative purpose.

Some of the things identified by the children as the good factors of a school are:

- \_ Teachers who taught with love,
- \_ Facilities like playground,
- \_ Peers and friends,
- \_ Natural Environment and flowers in the school garden,
- \_ Vibrant classroom with paintings in the classroom walls,
- \_ Meditation and prayers they sang in the school assembly.

On the other hand, some of the negative aspects of the school that the children hope to see changes in are:

- \_ Gender disparity,
- \_ Sanitation problems,
- \_ Poor waste management,
- \_ Over demanding teachers,
- \_ Poor infrastructure leading to leakage from the ceiling,
- \_ Lack of school boundaries,
- \_ Inaccessible school washrooms.

**Government introduced initiative of MDM (Mid Day Meals)**

Majority of children are satisfied with the Mid Day Meal service introduced by the government to provide nutritional diet to all the students between primary to 8th standard. They have described it as a beneficial aspect of schooling as most of them come from a poor background and cannot afford to bring full meals from home. Some students have expressed their fondness for the meals especially because an old lady who they are really fond of cooks it, suggesting that such a personal touch helps them connect better to their schools.



*While MDM is considered a blessing by many children, some teachers complain of it being a ground for corruption amongst school authorities (described in the case studies section).*



**Student-teacher dynamics**

From the perspective of the students, a teacher's main role in the classroom is to instruct and deliver lectures. Students are often not allowed to speak in the classroom, which according to them makes it unsuitable for them to interact with their teachers. In government schools, some teachers also instill fear in the students in order to discipline them, which hinders their growth and ability to learn. Besides instructional approach to teaching, some teachers also split the students into groups to promote collaborative learning. In this case, students have seen themselves helping their peers in learning vocabulary, Mathematics and spelling. In private schools like St. Mary's Convent school teachers use techniques like quizzes and rapid reading in the classroom to prepare their students for examination. Both in public and private schools, students end up helping each other in their learning outcomes, which shows that there is a certain lack of competitive spirit amongst the rural children as compared to the trends seen in the urban areas.

**Extra-curricular activities and outdoor events**

The government schools encourage students to do various extra-curricular activities like music, dance, essay writing, theatre workshops and quiz. On the other hand, the private schools have more of culture and craft based extra-curricular activities. Most of the children have achieved some awards in their extra-curricular work or participated in inter-school events. They shared their achievements with much pride and pleasure. Regarding outdoor trips, the primary school children of government school don't have the luxury of going out of the school premises. The middle school and secondary school have one outdoor trip like picnic or excursion in a year or sometimes even fewer than that. Private schools organize a wider range of outdoor trips like historical site visit, picnics, cultural and educational trips.

### After-school learning or private tutoring

The idea of private tutoring is gaining popularity even in the rural landscapes of India. 64.7% of the children interviewed have had paid private tutoring at least once in their lifetime. However, most of them weren't able to sustain it for reasons like temporary involvement of teacher, expensive prospect for low-income families and accessibility to a free Community Learning Centre (CLC) run by NISHTHA, an NGO (Non-government Organisation) based in Rakkar.

Other access to tutoring like online courses and e-learning has not yet reached communities like these. Although most families have access to mobile phones with internet and own a range of electrical or electronic gadgets like; Television; Laptop; Refrigerator; water heater; room heater and satellite tv, a very few of it is used for learning purposes. At best, only one student has mentioned using Internet on a smart phone to learn music and do homework.

### Children working for daily wages

Four children of the age 15, 14, 12 and 11 yrs, have worked for daily wages. This kind of job usually involves labour-intense work. In this case, such a job constitutes carrying rocks and construction materials, cleaning compound and boundary walls, working in the slate mines, farming for others and constructing roads. The amount of daily wages can vary with the kind of job and kind of employer. With the above-mentioned children, they were paid between 25 rs to 300rs a day. One child of the 10th standard earned a total amount of 6500 rs in one year. When asked if they'd stop continuing their education upon receiving a job that paid them well, most of them disagreed saying it's more important to be educated than work as a laborer. The children in this village have started to realize the value of education at fighting their poverty. While it was a common custom to work for daily wages from a very early age in the past, at present it's only a few children from the poorest strata that resort to such labour-intense workload and skill. Moreover, children are ambitious about their future and want



Students actively participated in after-school programs organised at the CLC at NISHTHA, a local NGO situated in Rakkar.



to make their dreams come true. That makes them more progressive about their education.

### Children's aspirations

When asked about what they wanted to do after finishing their school education, the children expressed a wide range of interests and ambition. While most of them wanted to join the army or police service right after higher secondary examinations, the rest dreamt of studying medicine, design, education, architecture and performance art. In the past generations, the general trend of the villagers was to join the traditional profession of shepherding, start a small-scale business or apply for the Military Engineering Service (MES) that secured them low-ranked government jobs in the Indian Army assuring a stable income for the rest of their lives. But most of these professions required them to drop out of education at a very early age, right after elementary education, that resulted in poor literacy in the particular region. In the recent years, however, children have been exposed to various other professional fields through television and newspapers, which has resulted in a shift in the aspirations of the young minds. Not only are these aspirations more demanding, but it is also challenging to pursue a professional discipline that has potentially negligible job opportunities in rural areas like Rakkar and Tilloo. Thus with growing demand of education, there is a demand in development. And with the development of rural areas into urban cities, a lot of their culture and heritage is lost.

### Overall experience of school education

Through this interview, many children ended up sharing their good and bad experiences in their school. Cultural programs involving dance and music like Annual Functions, Inter-school tournaments, sports day, charity events and award ceremonies were amongst the top things to be experienced in school. Some students also spoke highly of the remedial courses introduced by the government. It was aimed

at delivering extra-classes to the children who were lagging behind on their course or had problems learning through regular lectures. There were also some who enjoyed the absence of a teacher in the classroom. Some children mentioned how being rewarded with prize and merits made them feel good about themselves and motivated them to work harder.

Amongst the bad experience of children, the most common reason was physical violence and abuse by teachers. Harsh punishments and beatings in the class causes severe trauma in children, leading to inevitable damage of their self-respect, confidence and ability to learn. It is unfortunate that in government school setting especially in rural areas, such practices still prevail despite the government issuing strict laws against physical violence in school premises. Some children also discussed the lack of outdoor activities in government schools and some had complaints of the methods of teaching being very unidirectional.

#### **Children's view of best teaching practices**

There is a lot of research done on the way teachers assess their student. It's only recently that people have started enquiring students to assess their teacher's teaching practices. Sometimes, children as young as elementary school-goers can shed light on the values and setbacks of teaching practices like no other educators. This study tries to understand the teaching practices of rural education through the perspective of the children attending it. To achieve this, the children were first approached with the question "what is your favorite subject?". Most popular subject amongst this group is Hindi and Drawing(art), especially for the students of GSSS, Rakkar. The other popular subjects were science, environmental science, math and Yoga. As shared by these children, the teaching practice that they value the most are; teaching with love, avoid giving over-burdening homework to children, regular assessment of student's classwork, no physical violence on children, teaching with good presentation skills and using



visual references while teaching.

#### **Foundation of their dream school**

Towards the end of their interview, the children were asked to discuss ideas of developing their current school into their dream school. If there were given a chance to change their school into a dream school, what would it look like? Although some of them came up with the most whimsical ideas, most of them put forward many thoughtful and matured concerns about their schools. The desirables they highlighted were:

1. Teach non-violence to boys and girls,
2. Cleanliness in school premises,
3. Children should be taught honesty by prohibiting them from stealing,
4. Paint the school with vibrant colours,
5. Separate sanitation for boys and girls, accessible during school hours,
6. A big playground,
7. A separate room for cultural items like dresses, books etc,
8. Classrooms with food supplies (especially fruits and other nutritional items),
9. 60%play-40%study rule,
10. Better infrastructure with earthquake-prone buildings,
11. Better sports facilities,
12. No phone calls in classroom policy.

## Qualitative analysis of schooling from the perspective of parents

Throughout the research phase of this thesis, all in all, 25 household surveys were done within the villages of Rakkar and Tilloo, where parents of school going children discussed their views on their children's education. The purpose of this survey was to get a qualitative view of the schooling system available in this area from the perspective of the parents. This process has been significant in revealing the interest of the adult population of the village in the education of their children and in projecting the educational trends in the society. The interview has been analyzed according to the following key topics:

### Demography and Occupation of parents

The household surveys made during this research were mostly addressed by women of the Gaddi ethnicity. They were essentially the mothers of school going children. In Rakkar and Tilloo, unemployment rate of women is incredibly higher than the men, which leaves the women of the family to do all the household, bring up their children, manage families, farm in the fields and juggle between relationship with partner and in-laws. Nearly 76% of the women interviewed in this study described themselves as housewives. In the rural areas, housewives and grandmothers are the prime care-taker of children. Therefore, it's very important to understand their views on the role of education in shaping their children's life. The other people interviewed in this context were parents who are educators, army officers, ex-army officers, truck driver, Asha workers, Anganwadi workers, taxi drivers, shepherds and farmers.

### Expectations from children

These days parents are racing to send their children to the best possible school that they can afford. The motivation behind sending their children to school however varies from parents to parents. While some are seriously concerned about their children acquiring



photo source : Himadri Bhuyan



photo source : Hannah Cartan

knowledge, many act on the demand of the society they live in. It was very relevant for this research to understand what parents personally expected out of their children by sending them to school.

The key expectations as translated from the interviews, were:

1. *"to understand the world better"*, *"to acquire knowledge about the world"*

Throughout the interviews there were 4 to 5 families who solely focused on their children acquiring knowledge about the world. These families were the most lenient of them all, where the parents only expected their children to learn new things.

They wanted their children to have freedom to explore and acquire a learning that could help them in the long run.

2. *"to be a good human by cultivating good thoughts."* It was a very few (around 4 out of 25) parents who value wisdom and mindful thinking as an important aspect of children's education. Even though soft skills like compassion and mindfulness are being discussed often by HH Dalai Lama in his public teachings in Dharamshala, very few local people understand the importance of it. Values as such were an integral part of the indigenous education system of India in the past, where compassion or "Karuna" was taught in schools. The current education system rarely incorporates practices around emotional and ethical learning where children can be taught to deal with emotions in order to preserve a healthy mind.

3. *"to be learned and be someone successful"* Parent's obsession with their children's success is not a new story in the Indian society. With most social dynamics governed by family and kinship, there is tremendous investment of energy and money on children's future, leading to many expectations tied with it. The emphasis on "success" starts at a very early age and many parents are seen overinvesting themselves on their children's education. Sometimes, this pressure of success unfortunately becomes unbearable for children causing loss of interest and learning abilities. More than half of these parents expect

their child to be learned and successful.

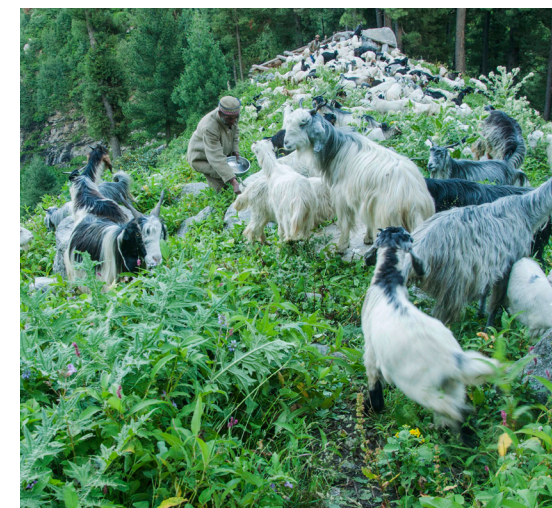
4. *“to acquire a job, earn a living and stand on their own feet”* In rural areas stricken by poverty, earning a living is the foremost goal of any family. This factor crossed with the idea of “progress”, makes parents expect a lot out of their children. They want their children to progress and earn better than them. The idea of self-dependency however comes from the fact that most villagers, especially women are dependent on their spouse or other family members for basic needs. Most unemployed mothers expect their children to be able to earn a living by getting educated and consequently by acquiring a job that provides financial stability. Nearly 10 families out of 25 have raised this expectation from their children.

5. *“to be disciplined and learn to work with others”* The most well-off and financially stable families of Rakkar and Tilloo are the ones with a military background like Army officer, jawans and constables or other government employees of the Ministry of Defense. The idea of being disciplined, well mannered and well spoken is born out of the regimental ethos of these families. There are many who expect their children to be disciplined like their uncles and grandparents who were a part of the Indian Army.

6. *“to study hard, be a topper and make the family proud”* There are also some parents who want to see their children join the cut-throat competition and attain the best possible academic achievements. Their expectations revolve around the scores and qualification of their children’s academic performance. Even though there are very few families as such, the competition has only increased over the past with the boom in private education and coaching centers.

#### **Teaching discipline at home**

There are various methods of teaching discipline at home. In this study, it is found that 36% parents prefer to discipline their children with positive reinforcements by correcting them with much love and respect, when they make mistakes. That is believed to strengthen the



bond between the child and parents. According to them, teaching discipline with love prevents children from holding guilt or fear about their misbehavior and is open to discussion with the parents to correct themselves. On the contrary 44% parents discipline their child through strict supervision, boundaries and, if necessary, suitable punishments. Many parents have confessed being angry with their children in their misconduct and later regretting it as it led to their children isolating themselves from them. There are many cases in rural setups where children are beaten and severely punished for their mistakes. There are also people, like the rest of the 20%, who believes that children acquire discipline by observing their parents. They affirmed that discipline can be taught by any member of the family by practicing it in front of their children. The parents need to be disciplined themselves first to discipline their child. Some values that constitute discipline, according to the parents in this case, are respect for elders, punctuality, selfcare, perseverance and respect for others. Some ideas of discipline are however adopted from military lifestyle, like living in a routine, following orders of the elders, etc.

#### **Imparting traditional knowledge and skills**

Traditionally this community used to earn livelihood from farming, slate mining and shepherding. However, very few people want the younger generation to inherit these professions. Infact, some parents have mentioned that they don’t teach any traditional or household skills to their children as it may distract them from their school education. In such families, children are allowed to focus solely on their school education. But in majority of cases, the villagers train their children to do household activities like cooking, farming, looking after their cattle and cleaning. Some parents are also seen imparting knowledge about traditional art and craft like weaving, knitting, stitching, embroidery etc. As the traditional craft of the Gaddi community is on the verge of dying, it is very important for the locals to impart their knowledge to the generations to come. However,



majority of the adults believe that traditional knowledge, owing to the lack of demand, doesn't hold a lucrative future for their children. They'd rather insist their children focus on school education than learn traditional skills. Moreover, in recent times, parents have also noticed that adolescent children are learning various new skills like beauty care tips, music, art lessons etc., through electronic devices like mobile phones and computers. They believe that the vast availability of resources through digital media can help their children to excel in their studies.

#### Values imparted at home

Indian parents are very concerned about the behavior of their children. Almost all the parents have referred to the importance of "Acche Sanskaar"; that translates to Good Manners (*acche* = good and *sanskaar*=manners). According to them, the idea of "Acche Sanskaar" constitutes values like; *good behavior, mutual respect, respect for elders, being polite, learning better communication skills, treat everyone with equal love, sincerity, obeying seniors, basic discipline like waking up early, hard work, anger management, non-violence, sobriety, self-control and modesty.*

#### Nutrition for child development

In rural areas like that of Rakkar and Tilloo, large number of people still rely on traditional health practices and family inherited nutritional knowledge for basic childcare. Most children eat home cooked meals and whenever faced with any illness, is treated by home remedies. Only in serious cases of health problems children are taken to hospitals and medical centers. In earlier times, there was lack of childcare and medical facilities. But with the introduction of primary healthcare centers, NGO run healthcare centers, Anganwadi Centre and ASHA workers, people have access to nutritional food supplies, healthcare services and childcare facilities.



*Children are often seen playing with and learning skills from their mother and grandmother, while they are in the field or at work. This indicates the need to empower the women of this community in order to change the lifestyle of children in the village.*



photo source : Hannah Cartan



*Roop Lal ji (photographed above) is a father of two students of Rakkar Government School. As a president of School Management Committee (SMC), he shared his views on the role of parents in contributing to government schools of the region. According to the RTE (2009), SMC was introduced to appoint a parent of a school going child to a managerial position of the school, through yearly elections. At Rakkar, it was started in 2011. However, it was later reformed to a triannual election. As a man of strong reputation in the village, he has earned himself the role through three consecutive elections starting from 2014. He stated that his role as a president is to supervise the deployment of government funds on school infrastructure. He believes that parents should be more aware of the educational environment that their children are sent to.*

#### Parents understanding of their children's schools

There is an upsurge of private schools in the semi-urban areas near Rakkar and Tilloo. Around 48% parents from this group, send their children to private schools like Adhunik Public School, Bhartiya Public School, Bhagsu School, Dhauladhar Private School, St.Mary's convent school and Sacred Heart Senior Secondary School, located in close proximity to the village. The rest of the 52% send their children to government schools run by the state government, while two families that have an army background send their children to Indian Army Public School run by the central government. Amongst this group were also parents of few children who attended Anganwadi Centre for basic childcare and NFE.

The parents of children attending private schools are in all praise of the learning facilities provided by the school, stating that; their children are performing better academically, they are disciplined, the quality of teacher is reasonably good, they acquire better communication skills and have access to computers. Private schools also have better facilities like healthcare, vaccination programs, sports facilities, technology aided learning, computer labs etc. More than 80% parents who send their children to government school aspire to send them to private schools in the future. However, some parents are very satisfied with the performance of the central government run schools like Army Public School. They have highlighted that an activity oriented teaching approach has helped their children to acquire a lot of knowledge. According to the parents, children attending state government schools need to struggle a lot personally, as the quality of instruction is very poor. Moreover, due to lack of guidance from the parents, students are bound to manage their education all on their own. Despite free elementary education, the drop out rates of student in government schools is the highest.

#### Values that they think should be imparted at school

When parents send their children to private schools investing a big

chunk of their earnings, they expect the schools to offer as much as possible to their child. Out of many things that one expect from private schooling are: learning approaches that raises children's curiosity, general knowledge, motivational lectures, personal development programs, teach students about environmental concerns, personal hygiene, morals and ethics, collaborative/team spirit, love and compassion.

Whereas, parents of government school students expect their children to be taught basic education, reading and writing skills, eloquence, hygiene and discipline.

#### **Quest for a better school**

Most parents in this village want to send their children to “a better school”. This either indicates that the quality of education in the prevalent schools is not up to the mark or that there is a certain sense of competition between the parents to bring out the best in their children. It could also be an indicator of the fact that the rural population has begun to value education. Parents suddenly have many expectations from schools. Even though some parents have declared the private schools that their children attend to be the most ideal school, there is still a vast majority of parents looking for development. The various pointers that they have indicated are gender equality, equal attention to students within a class, properly monitored smart classrooms, introduction of polytechnic skills in elementary school, introduction computers as a subject at an early age (primary school onwards) and classes on self-care.

#### **Parents' aspiration**

Most parents of this village are ready to let their children carry on with their academic endeavors as long as they can afford it. In such a rapidly changing economy, education provides opportunities for them to progress as a community. The government's effort to raise awareness about education through their “Education for All” initiatives has

fructed a sense of optimism in the parents from rural areas. However, there are still limitations in delivering quality education and better infrastructure in a reasonably priced and sustainable way. Few years down the line, parents see their child as well-educated successful professionals and yet there are many who drop out from school to join the working class.

## **Qualitative analysis of schooling from the perspective of teachers**

To develop a context of education from the school authority's point of view, a few school visits were made during the research period. This study was done through interviews and discussions with the staff members of few prominent schools in and around the field site. There were three levels of government school (Primary, Secondary and Senior Secondary) and one private school (Elementary School). The interview are analyzed according to the following topics:

#### **Establishment**

The Government Primary School (GPS), Rakkar was established in 1981. It is the oldest school in the village. The prominent school at the center of the village is Government Senior Secondary School (GSSS) that was established as a Government Middle school in December 2002. It was developed into a Government High School in April 2014 and consequently to GSSS in April 2016. The Government Girl's Senior Secondary School is one of the oldest schools in Dharamshala, attended mostly by the children from rural areas where education is only available until Middle School. The private school visited in this context is Wood Whistlers International School (WWIS), that is an elementary school known for their quality of education and the unique cultural mix of local children, migrant children and foreigner attending it. It was established fairly recently in 2014.

### Annual Enrollment

GPS Rakkar witnesses an annual enrollment of about 7 students a year. The presence of other government primary schools in close range from the village makes it a sparsely populated school. In comparison, the school adjacent to GPS is GSSS which has an annual enrollment of 133 students in a year. It is a home to children from Rakkar, Tilloo and many other nearby villages that doesn't have other access to secondary education. The private school WWIS saw an annual enrolment of 15 in 2014 and 70 students in 2016. These statistics are a clear indicator that private schools are gaining more acceptance and popularity in rural areas of India.

### Staff Appointment

Government school staff is appointed by the selection board of the state government and central government. It includes school principal, teachers, para teachers, administration staff and helpers. The teachers are usually from the background of Bachelor of Education (BEd) and Masters of Education (MEd). Some however are appointed after teacher's training programs like Junior Basic training (JBT), Teacher Eligibility Test (TET) and Post Graduate Teachers (PGT). In GSSS Rakkar there are 15 staff including the principal. Whereas, in GPS rakkar there are only 3 teachers, each of which teach all subjects in different standards.

In private schools, the staff is appointed in terms of policies defined by the private body that owns the school. For instance, in WWIS the teachers undergo private in-school trainings before they are appointed. BEd or JBT provides additional credibility to the teachers but the in-school trainings are compulsory. They have in total 10 teachers (one for each subject) and 3 supporting staff. The owners of the WWIS are educators themselves, with extensive knowledge owing to prior experience of teaching in government-aided private schools in the past. The teachers appointed in the school belong to the local communities. Usually the teachers are from a background of traditional



*The principal of Government Senior Secondary School, Rakkar (2016) says "Government schools need better parent's involvement."*



*Teacher of Government Primary School, Rakkar appointed since 2000 says "Government schools require better infrastructure"*



*The founder and director of Wood Whistlers International School says "It's challenging to financially sustain alternative schools"*

teaching environment so they are trained by the in-school educators through a set of instructions and given basic exposure to go beyond what traditional teaching practices hold.

### Teaching Approaches and techniques

The method of instruction in most government schools is through indoor lectures. However, students are encouraged to participate in various outdoor activities, group discussions and competitive events outside school. In some schools teachers have started using online tutorials as a reference. There are seminars conducted for teachers to train them on different approaches and techniques. For students, there are also remedial classes where students can attain extra hours of tutoring in the school premises. In the past, there used to be student outings. But lately, due to lack of funds and provisions such activities are being halted. At time, the school also invites speakers to motivate the students.

In WWIS, teachers follow an activity and games oriented teaching. The teaching techniques emphasize on interaction between students and staff. The teachers also make use of audio-visual references in the classroom to give an immersive experience to students.

### Expectations of the School

In government schools, the authorities expect the teacher to work hard and produce better learning outcomes. The average academic scores of a class are based on the quality of instruction provided to the students. On the other hand, students are expected to co-operate with the teachers, be sincere about education and be a good human by the end of the schooling. According to government school principal, elementary education is the most important education of an individual. It shapes the way the individual performs in the future.

In WWIS, the teachers just expect their students to be happy. For instance, if some student likes to dance, the authority tries to find the best possible career guidance for the student to pursue it.

### Student's demography

The total number of students in the Primary school (GPS), Rakkar is 23 comprising of 9 girls and 14 boys; out of which a majority belongs to the Gaddi community that is classified into Scheduled Tribe category. In GSSS Rakkar, local inhabitants dominate the student population. The overall demography, according to social category, comprises of 67 students from the Scheduled Tribe (ST) community, 41 students from Scheduled Caste(SC) community and 5 students from Other Backward Class. It is a co-ed school with 69 boys and 64 girls attending it regularly.

### Facilities of the School

Government schools like GSSS Rakkar provide very basic facilities like library from where students can issue books, sports equipment, badminton court and access to playground run by a local NGO. WWIS has a wide range of facilities for their students ranging from sports facilities to library and common rooms. They also conduct workshops instructed by external visitors; usually a professional from the field, like puppetry workshop, creative writing session, electronic tinkering workshops, etc.

### Academic outcomes of students

Government schools are facing tremendous challenges in the academic outcome of the students, according to the school authorities of GSSS Rakkar. The concepts that should have been cleared in primary school has to be taught again in middle school as students are not capable of retaining fundamental knowledge. It is noticed that many students have poor vocabulary skills, communication skills despite the efforts of their teachers. It is anticipated by the teachers that there is a lack of environment for learning at home and students have very little guidance from their families in their study matters. This is due to high rates of illiteracy amongst the parents and inability of parents to supervise them academically. Moreover, most educated parents



*Students of government schools resort to NGO's and CLC's for better infrastructure and resources.*



photo source : David Huang

send their children to private schools. In government schools, the involvement and cooperation of parents is very poor.

Regarding WWIS, the director could not describe much about their academic outcomes since the school is a K-7 school with no students appearing for board examinations as yet. But they wish to grow their school and prepare their children for higher studies.

Regarding students who don't perform well there are foundation classes to teach them better. The students are never detained or failed. There are no such negative terms applied to a student's performance. Instead there are provisions for retest, where students can take their time to revise on their work and perform better. Moreover, if students are unable to pick up the pace of their peers they are accessed separately in terms of their own pace.

### Achievements

The track records of the academic outcomes of government schools are digitally documented and archived by the Government of India under the Unified District Information on School Education (UDISE) initiative launched in 2012. Among the achievements of the school, academic results have improved over time and the enrollment rate of girls has increased in recent years.

According to the director of WWIS, there has been many improvements since the year they started. The biggest achievement for them was that the parents of their students were very happy and appreciative of their school. Some parents described observing many changes and academic improvements in their children. Other achievements include training students with extremely poor confidence and communication skills to be able to speak confidently, address bigger social groups by themselves, fight social anxiety and be independent.

### Challenges

The biggest challenge of the government schools as identified by the principal of GSSS Rakkar is that there is lack of parent's concern and



Photo: Government Senior Secondary School, Rakkar (2019).

participation the student's education. With the introduction of Sarva Shiksha Abhiyan (SSA) initiative to freely educate all in elementary education, the promotion of students to higher classes is mandatory until the 8th standard. Under that policy, the students are being promoted every year despite their learning setbacks. As a result, the knowledge base of students appearing for 9th standard or board level examination is very poor. A lot of students get detained in the 9th standard, which also leads to school dropouts. Similarly, other government initiatives, like introduction of remedial classes, have been rendered ineffective by the fact that only a section of students who are highly motivated end up enjoying the benefits of it, further aggravating the inequality of academic performance.

Some government-employed teacher's have also raised the issue of curriculum mismatch, stating that; there is a lack of smooth transition from Secondary school to Senior Secondary School. Students studying at Secondary school are instructed in Hindi while the same group of students is then instructed in English at the Senior Secondary School. The students are not able to cope with the differences in the medium of instruction, owing to lack of English language proficiency. Besides this, the differences of curriculum between state government and central government also creates similar problems for students to adjust, especially in occasion where students are being transferred or promoted from one school to another. This leads to majority of dropouts in the education system of this region.

The students of WWIS are brought up in a very open environment like many other alternative schools. So when they are exposed to a traditional environment, as the director says "*they don't fit in*". That becomes a challenging situation. They are trying to grow the school so that the students can continue until an age where they have better understanding and cope better in other environments. Since WWIS is a Budget Private School, the biggest challenge that the school faces is monetary problem. The director believes that the authority is not able to remunerate the teachers enough due to lack of funds and to



build the ideal infrastructure they need a better financial position. Other challenges include lack of Internet connectivity in school due to obscure location of the school.

## CASE STUDIES

The three stakeholders of an ecosystem of knowledge are the learners, the facilitator and the environment. In this thesis, the surveys and interviews were effectively used to highlight some special cases of learners, facilitators and environments. These case studies provide an in-depth understanding of challenges that need to be addressed directly by this design intervention. The case studies are focused around individuals from the village of Rakkar and Tilloo who has provided this research with invaluable insights about the prevalent education system. Henceforth, their identities shall be not be revealed in order to maintain anonymity for safety reasons. The facilitator case study is based on one of the oldest teachers of this village who has the experience and understanding of the educational landscape of the village like none other. In terms of physical learning environment, the most striking example identified during the research is the case of “Anganwadi Centres”. This model of learning space has not only been successful at solving the problems of primary education but also given opportunities to women; the other marginalized section of the community. Taking that as a case study, this article attempts to have an in-depth analysis of the challenges faced at the grassroots.

## Learner Case study

### Sneha

Sneha was a participant at one of the workshops organized in context of this research. She was alumni of the Rakkar Government Senior Secondary School and an old acquaintance. She had just finished her Senior Secondary Boards examination, upon which her family was insistent that she studied Bachelor of Computer Application. As a girl studying in the Science stream of secondary education, she was of an excellent academic background. She faired very well in her board examinations to be able to join the competitive field of Sciences study. Although her original motive was to study undergraduate course on mainstream science (Bachelor of Sciences) at a government acclaimed University, but her family had other plans for her. In this struggle of selecting a prospective career option, she missed the opportunity to join a government university. Much to her family's liking she ended up enrolling to a private institute to study BCA (Bachelor of Computer Application). Few weeks into the course she realized that it is an undergraduate diploma course in the disguise of a degree course. Accepting the limitation of the kind of certification that her course was entitled to qualify her with and the amount of financial investments she made to undertake that course, she began to seek other career opportunities. Moreover, her problems didn't end there. Around the same time, her family that was already a working class poor family underwent a financial crisis. Her father, who was the sole bread-winner of the family couldn't sustain the household. Being one of the more sincere children of her parents, she began a desperate mission of job hunting. This had her on her toes to meet companies, seek advice from professionals and stay aware about any job application offer that was announced in the region. Her desperation for financial stability brought her to an online platform where she was contacted for a job interview. Upon following up on that, she entered a deep dark network of cyber fraud, which ended up costing her a big financial setback, further aggravating on her problems. Even though she was an intelligent, bright and educated student, she was naïve on the face of the new technology and digital media that she was

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exposed to. Penetration of internet in the rural spaces, brings potentially grim consequences for the digitally illiterate youth of the region. Sneha is unfortunately a living testimony of the dangers of digital illiteracy. Despite the setback, she holds immense sense of responsibility towards her family and her village. She decided to join the participatory workshops to share her challenges with others and find solution to her problem.

## Facilitator Case Study

### Vijay Sir

One of the oldest local teachers who is looked up by everyone in this village is "Vijay ji". It's been many years since he retired from his post as a teacher of a state government school, but that hasn't stopped him from teaching. At the age of 70yrs he's still working at a school as a teacher on a full-time basis. In this interview he shares an in-depth view on the schooling system as he has experienced it. Vijay sir is a very traditional classroom teacher. But unlike other teachers who were interviewed in this village, he is very observant about his methods of teaching, in fact to a very surprising detail. He also held some strong opinions about the educational system in general. He looks at teacher's responsibilities from a broad standpoint where it is not just limited to classroom lectures but also covers other habits and skills related to planning, management of records, management of courses and healthy teaching etiquettes. According to him the key problems faced by schools in this area are: lack of dedicated teachers, poor recruitment in schools, lack of teacher transfer criteria, corruption, money-minded faculty, policies like MDM that provides poor quality food, physical violence, over obsessed parents and dynamics between teachers and students. The interview is transcribed below:

**Q: Tell us about the challenges faced by the education system that prevails here today.**

*Actually, in our education today, our teachers have no command over grammar and they don't know how to teach grammar. And for English the grammar is a must. Without grammar we can't write, we can't speak, we*

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can't discuss. So grammar should be strong. Teacher should have command over grammar. Since most of the teachers don't know grammar, they are unable to instruct in English.

These days there are a lot of differences between private schools and government schools. Even those who are appointed on regular service in government schools, send their own children to private schools. It means they are not able to teach. One who can't teach their own children at home or at school, they shouldn't be a teacher. If we send our own kids to private school while I'm earning a salary from the government for teaching in a government school, then we are only employed in a government school for entertainment and relaxation. We won't be able to give attention to any children in that school if our own child is studying somewhere else (private school). Maximum (almost 100%) teachers who teach in a government school send their own children to a private school.

I have been a teacher all my life and my kids (a boy and a girl) have always studied in the same school I've taught. They can read, write and speak. They are good at English, math and other subjects. There were private schools like Sacred Heart School very close to our homes, I could have very well sent them there but I send them to GS where I taught.

Another weakness (limitation) of Himachal Pradesh is that in here recruitment opportunities for teachers are very less. I'm not satisfied. It's because of the politics involved. To get votes there is always someone being employed without scrutiny, volunteer teacher, PTA teacher. They are not well trained. If government employs people who are not properly trained how will they teach?

Secondly, this Mid Day Meal (MDM) is a big problem. I'm against MDM. At 11 they start cooking MDM and that distracts all the kids. And in that meal, there is no quality or quantity. Above that, most teachers they keep portions of the MDM to themselves and cook it separately for themselves

with rich ingredients like "desi ghee" (clarified butter). They consume it themselves when the MDM is only provided for children. There is a lot of misuse of MDM.

Another point is, a lot of teachers beat their students to teach them complaining that students don't study otherwise. A teacher should make better impression. Students should be carefully taught and next day they should be tested if they retained anything. They should be given attention. Make children practice repeatedly, If students can't answer something then ask them to remember it again or write it again for 10 times. Then automatically they'll remember. They shouldn't be beaten. Beating student's won't help them be better. They should be punished with practical workload not beatings. Doing practical work is very important for learning. They should be made to practice what they learn. If one chapter takes 10 days to learn out of that 5 days should be devoted in checking how much the students learned. E.g.; if there is a spelling mistake, the teacher should demarcate it with an arrow and write the correction in legible handwriting (not in cursive but in blocks) so that the student can read it and understand and correct it. 3rd or 4th standard kids are too young to understand running hand writing of grown up teachers. Teacher should use blackboards more often. For instance, if we are teaching science and specifically about Human Brain, then at least we need a model to show the kids and make them understand that this is brain and these are the parts of it and this is how these parts are related to each other in function and in physiology. Today's teachers don't take any help of the blackboard or pictorial depiction. They just ask questions verbally and say the answers. They never show the students on the map. They should be able to show them by pointing out by finger on the map to show them where they are: where is Himachal Pradesh, what's in the south of Himachal Pradesh, what's in the west, north and east. Students should know.

I hold the teachers responsible if the students can't acquire simple knowledge like that. Today's teachers are careless. They don't teach the



student thoroughly.

*Due to politics, a lot of teachers remain stationed in the schools they prefer and slack in their responsibilities. Most teachers are transferred. But some teachers don't get any transfers. In order to avoid being transferred they maintain ties with politicians. Due to this the teachers who are positioned in remote areas don't get transfers elsewhere. They stagnate and feel helpless and lose the motivation to teach. Our government is responsible. There should be better transfer criteria.*

*Another point I have noticed is: Earlier the parents used to give the full responsibility of their kids to the teachers but these days the parents behave differently, they come to school and threaten the teachers if the teacher raises any voice against their children's behavior. So in many cases teachers try to avoid circumstances like that and in the process they neglect the student. They shouldn't do that because the relationship between teacher and student is bigger than the relationship between the student and their parents. The teacher shouldn't take it seriously when parents get upset. They shouldn't take it personally. They shouldn't take it to their heart and ignore the student. We shouldn't keep such differences between students because teachers are meant for children. If we behave like this to children then we don't deserve to be called teachers.*

*In schools where there is less salary the teachers are working hard while in schools where the teachers are paid a good salary they get comfortable with it and don't put any effort in teaching. In private school, an educated new teacher gets low salary and on top of that there is always a senior teacher/administrator sitting above him/her overlooking and ordering. In private schools, administration authorities give a lot of pressure to the teaching staff. In GS, if some teacher even comes late, the principal doesn't have the authority to tell them because they may have political ties with some ministers in the higher post of government. So the head of the school is constantly under fear given that he/she has already put a lot of*

*effort to reach that position. So that's a huge drawback of our education system.*

*The teachers are not devoted to children. Like when we teach in one period we have 35 min. Most teachers take 5 min to reach the class (that involves bumping into other teachers on the way and catching up on them). They teach for about 15 mins and look at the time waiting for the bell to ring. Then another 10 mins goes by while monitoring the class to make the children retain their focus on their books. And remaining 5 mins to wrap up. So out of the 35 mins only about 15 mins of the time is spent teaching. The teacher should teach atleast 30 mins with full attention to the children. Teachers have become corrupt this way, no longer deserve to be called teacher.*

*Today, our education standard has gone down.*

*It's not that only private school kids become successful, and become IAS officer. GS kids also become successful if they are motivated to study. We teachers also studied in GS. In our time there was no private school. We worked in public school. There are many famous and successful people who studied in GS like: General Karriappa who was the first Chief of the Army staff. Radhakrishnan is also from GS, he had in total 20 years of teaching experience and with that he became the president of India. He got his primary education in his own village. But then in those days, the teachers devoted their body and soul to their students instead of working for money. Today no teacher gives that kind of attention and heart and soul to teaching, they teach for money. In some places, teachers have protested and demanded that their increment shouldn't be dependent on the performance of the students. They only care about increment. Recently when one entire batch of students didn't do well in the boards examination, the government decided to stop one increment of the teachers teaching in that particular school. The teachers protested against it by tying a black cloth in their arms on the teachers day so that their*

increment shouldn't be stopped. One batch has about 50 students. It can't be possible that any of them are not capable of doing well. Out of 50, atleast 48 should be able to pass if not with great scores. If there is 0% student passing his or her basic assessments then the teacher might as well send someone who has no clue about teaching to go spend the day and get paid the daily wage accordingly. Teachers are not devoted anymore. They shouldn't focus on money. The teacher is a nation builder. These days the only conversation between teachers in a school is "how much salary do you get?"

My first pay was 456 rs, as a first appointee (TGT). Nowadays, a first appointee TGT is getting more than 35000 rs. Just imagine. When I retired my salary was near about 20000. Ofcourse I am happy. Still I'm happy. Now I'm getting pension and m happy. I did my graduation from Degree College Dharamshala and BEd also from Dharamshala. I am the 3rd graduate of this village. 2 are senior to me. That time very few people (90% gents and 10% ladies). That time, girls were not sent to school, only a very few people sent their girls to school. After middle schools, most kids went and joined the army. After metric, some joined clerical line job. Those days everyone was very poor. Not everyone could afford education even though it was not very expensive to go to college. Also parents had very poor financial position in those days. Most of the kids who pursued education were the ones who were very rich and the likes of us pursued education because the college was nearby. I didn't opt for the Army life because I am a physically handicapped. . I lost a finger to fire when I was an infant. but that didn't stop me from writing. You can see my handwriting.

**Q: What is your view on Sarva Shiksha Abhiyan (education for all initiative)?**

The value of education has increased in people these days. Every family thinks that education is important, whether they have a girl or a boy. They consider it very necessary for their children to be educated.

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These days the parents are more keen on sending their kids to school compared to the older generation parents. In our time, our parent's financial condition was very poor. So in case of the girls in the family, even if they studied till 7th or 8th standard they were exempted from studying post that. That time they used to worry that if a girl child is very educated then they may not be eligible for marriage. But now every parent hopes that their daughters get educated enough to be able to stand on their own feet.

**Q: When did the trend change?**

Earlier, women were oppressed. So they were not given much importance. They were mostly trained to do household work. If they ever required money for themselves they had to ask the male members of the family. If the male members refused to give they'd have no alternative. In this process a lot of women used to get exploited. Everyone needs money may it be male or female. But these days' women have progressed a lot and they go hand in hand with their brothers in every field. And that's the way it should be as well. If in future a girl's in-laws are not good to her and her husband is exploiting her, at least she should be able to support herself. If she is educated she can stand on her own feet and resolve her own problems.

**Q: Which school did you start your teaching career at?**

Government High school Chinair, dist Shimla. It was a high school. I'm still teaching. Actually, something amazing happened today. Usually in school I always take a cup of tea. Couple of days ago I was in a class with 2 kids from LKG (lower kindergarten). Upon seeing me drink tea they said "even we want to drink tea". I said "oh but I already drank half of the cup today. I'll definitely share a cup with you tomorrow". Today when I got myself a cup of tea, I told the kids that they shouldn't drink tea, they should drink milk. To that they replied "where can we get milk in school? Chai should be fine". Hearing that I asked my assistant to bring to empty cups. I poured some tea from my cup to theirs and shared it with each

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other. They drank with much pleasure. I asked them how they liked it. They were in all praises. They also spilled some on their shirts and started cleaning with their hands. They asked if I'd treat them to tea the next day too. I said yes. They were very happy. In this age, when we see such behavior from innocent kids like that, that gives us a new life. They gave me a big hug after drinking tea with me. That filled me up with new life.

I was instructional teacher and a principal too. The position I liked the most is to work under someone as a TGT. I liked it because as a TGT when I taught, I got to teach more number of classes and from those books and kids I got to learn a lot. Secondly, my boss guided me from time to time.

I still teach (70yrs old) 9am to 3pm without any hassle, without any help of chair I can teach. Also whenever I taught I never used the chair. Always delivered lecture standing and taught classes standing. I tell my boss, that he should remove the chairs from the classroom. The teacher's job is to teach and not to sit comfortably in the chair. What will a teacher teach when they keep sitting. If they are sitting on a chair, they can see the first few rows of students, what about the backbenchers, who'll teach them? If I'm standing I can see the full class both the students in front rows as well as students in back rows. If I slack in class by sitting in a chair and not putting any effort in teaching, we set wrong impression.

Teachers should be disciplined because kids learn from teachers. Teachers should be very aware while teaching. When they use the black boards its not that they only write in blackboards. They should check on the students once in a while if they are being naughty or obedient. It's also necessary to make rounds and check if every child is coping up well.

There should be a good mix of demonstrating on blackboard and interacting with students by checking on students, giving feedback to student. It's also a good idea to get their parent's views on their performance once in while, like getting their assignments signed by their

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parents. Then the students will be more serious about their studies.

Beating students instill fear. That kind of fear is not productive. It's not humane to inflict physical violence on someone or get physically beaten by anyone else. But in some cases where student's behavior deteriorates and if they get aggressive and violent to other students, there should be some form of punishment to avoid repetition of that behavior. Shouldn't be punished because of bad performance. They should be taught better behavior and that should be different from academic performance.

**Q: What is your principle of teaching?**

Today, I was giving someone an advice. Today a girl, maybe around your age, came to me with the attendance register. She had marked the attendance of the student with red markers without mentioning if it was due absence fines. The school takes absence fine from students. By the end of the year that is calculated through these attendance reports. If there is no demarcation, it becomes difficult to trace the amount of absentees responsible for the fine. Certain practice like these should be made in such a way that there is no loophole left for the future. In the future, better practices like these also help auditors to audit. These are small things but they matter a lot in the long term. Simple tasks like preparing the registers are also very important for teachers to pay attention to. But this guidance is not available these days due to half-heartedness of faculty. I always believed in using my experience in guiding and giving practical tips to the new teachers regarding the better practices in the classroom.

**Q: These days many student skip classes. They don't go to school because of various household duties or family problems. Do you see that as a problem?**

Yes, it's a big problem. These days, teachers don't care much about it. The student who often skip classes should be counseled or atleast asked why they have been missing classes. There should be proper system of accepting leave application or documents to support the reason of taking

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a leave. For example, medical reports etc. But in GS, nobody cares. Nobody checks on student if they have missed out on classes.

According to SSA, students are not failed until 8th standard. Sometime ago, it was until 10th standard that they weren't allowed to be detained but now the bar has been limited to 8th standard. These policies have destroyed the education system of the country.

In some cases, I've noticed that when teachers are transferred too often, it makes the students lose interest in attending schools. In our times, we were not transferred for many years. These days, due to political connections of teachers with higher officials in the government they get themselves transferred to suitable places.

I get a lot of respect from students. The kids who studied under me 49 years ago, I can't recognize them but still they make sure to greet me with equal respect. They call me "guruji". I prefer them calling me "guruji" than "sir" or "master". The relationship between "guru" and "shishya" is very different from western perspective of "master" and "apprentice". I have been strict with my students but I always wanted them to perform better in their studies. With every student performing well, there was always a sense of satisfaction. With students only being strict is not the right approach. You need to be equally friendly and respectful towards them. You need to sit and spend quality time with them, by interacting, sharing stories, meals and maintain a heart-to-heart connection. Sometimes I learn from them. For example, I didn't know how to play Volley ball so I went to my students to learn from. This "guru-shishya" relation also helps improve their sense of leadership and ability to encourage others. They often encouraged me to learn things that I didn't know.

**Q: What was the biggest personal challenge in your experience?**

I was very lucky in this sense that I never really had that many challenges. Wherever I was posted I always got lot of love from the students and also

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their parents. They regarded me very well. During my tenure, I used to go to school a few hours before the regular classes started and devote my time to teach extra classes for students who were lagging behind in their course, all of this for free. So a lot of students respected me for the time and sincerity.

**Q: While you were teaching did you ever assess the students in a way that they'd be good for a certain job or certain discipline?**

There was a student who is a professor in a central university now. When he was a student of 9th class, he couldn't pay the fees. I volunteered to pay fees for him because I knew he was very bright and had the interest to study. There are two such cases. I similarly volunteered to pay the cost of another student who was from a poor family. I paid his travel cost to move to the centre where I was transferred to and supported him financially to finish his Bachelor of Pharmaceutical. Now he's a compounder in a medical company.

Now I'm in a private school where there is a very dedicated student from a poor family. I'm in conversation with his family to support his basic education. I'm not that rich to finance 10 students but sometimes there are some students who are so brilliant and dedicated. Personally, I can afford a few so I decided to do it. I do that because poor people are exploited in this country so the more you help them they are empowered.

**Q: What is your approach with students who are not very dedicated or not so disciplined?**

I give them responsibilities and make them the class monitor. I encourage them to take up responsibility with care and love. They get very happy and encouraged to channelize their energy on something more productive.

**Q: In this village, education for boys is very well assured. But do you**

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**think girls are equally allowed to pursue educational interest?**

*Yes. These days girls are pursuing higher education way more than boys. They are sincere, intelligent and hardworking. Because these days everyone wants their children to be eligible for jobs and it's only through education you can qualify for a good job and good income. Of course there are other ways of acquiring jobs, like through connections with political leaders but that usually is an option for people who are very rich or corrupt. For the villagers here, where majority is very poor that is not an option so every child must study.*

**Q: What is your view on children preferring to join the military services over pursuing higher education?**

*That is a huge problem here. Majority of students in this village study until 8th or 10th and apply for the military service. This has hindered the public's interest for education. A military service guarantees a secured financial support, even after retirement so it's more favorable over spending time and money on higher education. Most students join the army after matriculation, but those who are left behind must study. But even from that lot, most of them drop education because of lack of family support.*

**Q: What is your view of parent's expectation of students? A lot of people educate their children with the expectation that they'd be earning a living for them in return. Do you think it's a good approach?**

*Every human expects to earn money. But running after money sometimes doesn't allow them to be satisfied in life. Expecting money from children is not a very healthy approach. It also happens so that some parents expect their children to work on the same profession they have invested their life on. But ideally, the children should be asked what they really want to be in life and given the freedom to choose their own field. In our village, there was one case of such pressure from family, which eventually led the student to take his life. Here parents,*

*even the educated ones, don't have much knowledge on guiding their children.*

*In fact, in this area especially there are many cases of domestic violence. When parents are constantly at arguments and friction, children acquire the habit from them and lose track of their education. There are cases of alcoholism here which damages the lives of children. The environment really matters a lot.*

**Q: As a teacher, what have you been most worried about?**

*Balancing the gaps between teacher and student. Students should be loved but too much of love may also misguide them. Neglecting them will also lead to nothing positive. There should be a balance in the attention the teacher has to give their student. They should be taught about their mistakes with love. That is the biggest challenge.*

**Q: Have you ever used computers in your teaching practices?**

*No. Never. Computer is fairly a new advent in this area and I'm already retired so I never had the chance to use it. But I'm not against it. If it helps the students, they should use it for educational purposes.*

**Q: What would be your dream school?**

*First of the space or building should be attractive for children. Playground is a must. Besides that, staff should be well trained and highly qualified with good language proficiency. English is very necessary since most of the educational materials are in English. Computers should be introduced at an early age. This generation requires knowledge about technology.*

## Learning Environment Case Study

### Anganwadi Centre

According to the Census of 2011, around 158 million of Indian population is constituted by children of the age group 0 to 6 yrs. They are the future caretakers of the country. Hence it is of utmost importance to provide care and healthy upbringing of children. "Anganwadi"s are the rural child care centers introduced in October of 1975, under the Integrated Child Development Services (ICDS) Scheme of the Government of India. This flagship programme of the Indian Government, rooted in the country's long history of child malnutrition, was introduced to provide a platform for psychological, physical and social development of children and provide nutrition and healthcare knowledge to the mothers, enabling them to fulfill the nutritional needs of their children.

In Rakkar, there are five Anganwadi centres spread across various neighborhoods of the village. While, in Tilloo there is only one. During the contextual inquiry of the research, two of such centers were visited in order to have a better qualitative view of such an environment. Interviews and discussions were conducted with the Anganwadi workers to understand their role in the care and development of children in the village. The excerpts from the interview transcripts and discussions are translated and articulated below with a brief analysis:

#### Q: What is your understanding of "Anganwadi"?

*Anganwadi is a "bageecha" (hindi word for garden). When we plant trees in a garden, we take care of it in its early stages. Similarly, this is a garden for children at their early stages of life, where they are given basic care.*

*The things learnt in childhood are something that stays with them all their life. But with growing competition even in primary schools these days, children don't get enough care. Children learn better after 6 yrs of age, until then all they require is basic care. Today's parents want their children to join school at 3 yrs of age and become active right away by reading and*



*writing. The parents imitate their peers and send their children to schools at very early age these days. But they lack the care and play, required for the child to grow.*

The Hindi word "Anganwadi" literally translates to "Courtyard shelter" or "garden in the courtyard". It is a rural child healthcare center that provides non-formal education, nutritional supplements, healthcare guidance on pregnancy, childcare, contraception and other basic facilities for child growth to people living the rural areas of India. Growing competitiveness in schools and rising demand for better performance of children in their schools, robs children off their childhood. Anganwadi is government implemented public childcare center that provides early childhood education and a platform for children to nurture their basic skills, cognitive abilities, attitude and habits, before delving into the rigor of mainstream schooling.

#### Q: What is the age group of children attending Anganwadi?

*Usually, children as young as 3 and half yrs and 4 yrs start attending Anganwadi. They continue until they are 6yrs old.*

One of the core objectives of the Anganwadi Centres is to provide Non-Formal Pre School Education (NFPSE) to children below 6 yrs of age.

#### Q: How many members/facilitators + students are there in Anganwadi?

##### What is the strength?

*In each Anganwadi, there are two staffs: one worker and one helper.*

*Worker 1: "There are 11 children attending on a daily basis. Besides that, there are also 6 children, 4 pregnant women and one lactating mother with child, who is supported by this center for monthly ration and food supplies. Some mothers come with their infants as young as 2 yrs, few months. Sometimes the mothers even drop their infants off at the center for daycare."*

*Worker 2: "In my center, there are 7 infants (between 0 to 6 months) with lactating mother and 6 pregnant women benefiting in terms of nutrition supplies and food. There are 10 children (between 2 to 6yrs) regularly attending. Once in a month we distribute ration like milk, grains, rice etc. to the children and the eligible mothers. We also conduct camps and workshops on nutrition and childcare with the women of the village. That happens twice a year. Both pregnant women and children get nutrition supplies in the form of cooked food or ration. We also do home visits to check on pregnant mothers and their infants to give them guidance on nutrition.*

In total, Anganwadi is envisioned to deliver the following services; i) supplementary and therapeutic nutrition, ii) immunization, iii) health checkups, iv) non-formal preschool education and v) referral services and nutrition and health education for mothers/pregnant women, nursing mothers and adolescent girls (NIPCCD, 2006; Sandhyarani & Rao, 2013). Besides, regular attendees for preschool education, the Anganwadi Centers are responsible for providing government subsidized food supplies to children and pregnant mothers. People who are located in remote areas and aren't able to visit the centers frequently, are issued with raw grains and dry food supplies. Whereas, nutritional meals are provided to children attending on a regular basis.

**Q: What is your designation?**

*We are Anganwadi workers.*

**Q: How many hours a day do you spend in Anganwadi?**

*We work 5 hours a day. Sometimes 9 am to 2pm or 10am to 3pm.*

**Q: What is the nature of your appointment?**

*We are being outsourced as a worker called "outsource karmachari". It's not a full-time government job. It's on a contract basis. We are not eligible for*

*pension.*

**Q: What was your procedure of being employed in Anganwadi?**

*We get training about the job and are employed through interviews. Earlier the training period used to be for three months but from last year onwards, it's reduced to a month long training. We are trained to direct people on nutritional diet and healthcare, conduct group meetings and rallies.*

**Q: What is your academic background?**

*Most of the workers have higher secondary qualification. Some have matriculated and joined as a worker.*

**Q: What does a day in Anganwadi look like? What are the facilities the centers are supposed to provide?**

*Children start a day by wishing each other and warming up with exercises. They also say their prayers etc. They are made to settle down and rest after the exercises. They also talk a lot. They often tell us stories and of things they have seen around. Sometimes they are taken out to sit in the garden and play outdoors. They play indoors with boardgames, puzzles and toys, with our assistance. We also help them identify things around them. We also feed them with nutritional diet and planned food that is cooked within the premises. Earlier their food habit was poor, but now they have a good appetite.*

*Some children wants to come back to Anganwadi, they get used to the love and care here, so when they are moved to a Lower Kindergarten or Nursery school, they feel a bit lost and neglected. And in mainstream schools with many students, it becomes impossible for teachers to offer that individual care.*

Most Anganwadi workers spend 5 hours everyday at the centers doing various chores ranging from assisting children in learning basic motor skills through physical activities, teaching vocabulary and healthy habits, to providing care, love and attention. They are also responsible for keeping

log of daily activities and reports of the children's growth. Additionally, the government equips these spaces with resources like games, puzzles, toys and other learning tools for children to explore.

**Q: What cultural background do you belong to? What changes have you noticed in your life after joining Anganwadi?**

*We belong to the Gaddi tribe. When we are confined to homes, we don't have much to do. Through this job we are able to make social interactions with our peers and we get to learn a lot from the monthly meetups and yearly trainings. We also get to train other women in the village, that gives us confidence in what we do. We also earn a living from this job so that helps us to be independent.*

For people of remote communities like that of the Gaddi tribe, unemployment is a serious crisis, especially for women who are mostly marginalized. Having a job with a stable income serves as a blessing for women who want to be independent from the prevalent patriarchal grip of the society. Most women in this region are hard working and sincere. Average women in Rakkar, spend majority of their time in farming or bringing up their children. For those who are engaged in a regular 9 to 5 job, bringing up children becomes a tedious affair. Hence, Anganwadi's tend to be beneficial not only for the women workers but also for the mothers who want to continue working in their own field.

**Q: What motivates you at work?**

*Our biggest motivation is to spend time with children. It really freshens our minds and gives a sense of satisfaction. There is no competition or pressure, like in other professions. Love is also a very important part of childcare. Children crave for love and that's all we need to give them at this age. We really enjoy the work.*

For Anganwadi workers, the center becomes a therapeutic space; where

they can interact with their peers, acquire new knowledge about caring for themselves or others and spend quality time with children and young minds. These are some of the most desirable factors for any learning environment. Facilitator's life and experience is as important as the learners.

**Q: What are your key principles of teaching?**

*Children and their parents really need to believe in us. Some parents have really appreciated and encouraged us. We are extremely careful when dealing with these children. Like we can be strict with our own children, we can't be very strict with them. We need to control our anger and temperament in such an environment. In meetings we also include experienced people to come and share knowledge with us. You can also come.*

**Q: Have you been on other profession before taking up a job in the school? Would you choose other profession? If so, which profession?**

*Used to work in a shop. Worked in the craft sector as a weaver in a weaver association. We needed a more secure job on a regular payscale, so we moved to this job.*

**Q: What do you have to say about your relationship with the kids? Tell us a bit about their behavior towards you and if you have experienced anything special with them.**

*We are like mothers, aunts and friends to the children. We love to listen to stories narrated by them. We still remember some children who were very close to us. There was one child who cried a lot on my wedding thinking I'd leave the job after the wedding. We were personally very connected to them. Sometimes when we go on holidays, we bring back sweets for all of them.*

To sustain a healthy relationship with young learners, facilitators need to maintain a bridge of trust. The core principles of teaching and facilitating are born from the sense of trust that one builds with their



students. Sometimes being reactive or overtly disciplinarian can breach the trust between the facilitators and learners resulting in learners from withdrawing from the ecosystem of knowledge.

**Q: What are the biggest challenges you have faced in Anganwadi?**

**What are the negative aspects of Anganwadi?**

Biggest challenge is to make register entries for everyday activities. That's a lot of pressure for us, given that children need constant attention. Daily chores of weighing children, taking notes on their growth and nutrition becomes challenging for us. Especially when it comes to writing these entries everyday.

All these official work and formalities are slightly difficult. This year they are going to introduce online methods of making entries. Hope, that'll be easier.

In a village it's very difficult for women to work. Another big challenge is dealing with troublesome parents especially during distributing resources like ration and food supplies. A lot of people complain about the quantity of supplies provided. But that's not in our hand. We distribute what the government provides.

Given that these workers have very limited access to education themselves and most of their knowledge on childcare is based on an initial pre-job training session, their capabilities reach an impasse. Despite regular trainings, the workload of managerial duties get overwhelming for some workers due to the lack of skills. This calls for the ICDS programme to rethink their provision of training the workers, ensuring their credibility and qualification.

**Q: What is your annual income? Are you satisfied with it?**

Our salary is 6300 in a month. Last year our monthly salary was 3500.

With the new government our salary has increased.

**Q: Is there a use of technology in Anganwadi?**

No.

**Q: How has Anganwadi changed people's life here?**

These days women can't look after more than one child in a family. If there is second child they need some kind of support and help with raising them.

Earlier with bigger families it was not a problem but now children are also smarter and active, so women find it extremely difficult to take care by themselves. Anganwadi provides support and care for their child while they are at work or busy earning a living.

Anganwadi has been around in Rakkar since 2007. However the numbers have increased with the growing demand of rural childcare. This clearly states that it has been more or less successful at providing pre-school education and childcare to the underprivileged infants and children of this village. Such an ecosystem proves ideal for the community that resides in this area. However, there is a huge scope of innovation within the framework of ICDS to include values like sustainability and inclusiveness. Therefore, this can be highlighted as an area of challenge for this thesis.

Photo (below): An Anganwadi Center located in Rakkar has one classroom and two staffs.



# CONTRIBUTION

## RESEARCH CONTRIBUTION

In the history of education, conventional research practices have contributed very vaguely – mostly in a form where education researchers imparted their knowledge and theories to educators and consequently, the educators applied it in their own fields. Such theories that are based on research, however, ends up being more of philosophy for the educators than an educational innovation by itself. This has drawn researchers to the fact that the field of educational reform has an undeniable connection to the field of design. Resulting in a new arm of research known as “Educational Design Research” and most recently to the field of “Learning Design”. In design research, practitioner’s involve themselves in rigorous analysis of a learning problem leading to generation of ideas for innovation (Walker, n.d.). To bring changes in education, it’s not only necessary to have a theoretical understanding of the context but also to design new interventions and toolkits to provide concrete solution for the long run. And in order to design intervention as such, the designer needs to understand how the ideas suggested by theories affect the stakeholders at the grassroots; like teachers and students in this case.

As a part of a pilot attempt to design a learning ecosystem for a specific ethnic community, this thesis was focused around “research-based design” methodology where a number of ethnographic studies, in-filed observation and interactions were conducted with students, their parents and teachers. Further, the findings and understanding from the research done were then used to formulate the model of Permaeduculture Learning Environment, especially focusing on the digital infrastructure that constitutes it.

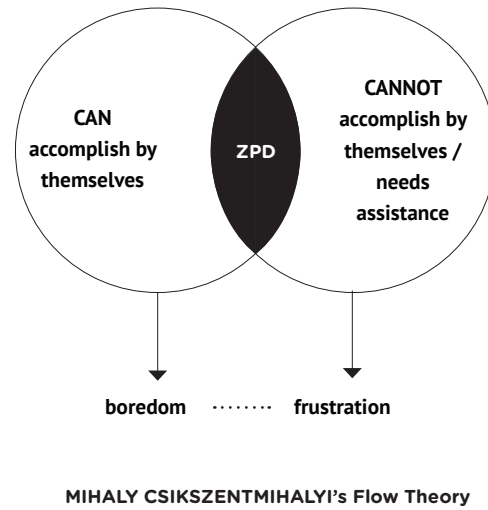
## Findings

To establish a background for the design and development of the product, it is significant to highlight the key findings of the design research undertaken under this thesis. Through the process of Contextual Inquiry, the following few challenges were identified within the larger scheme of things:

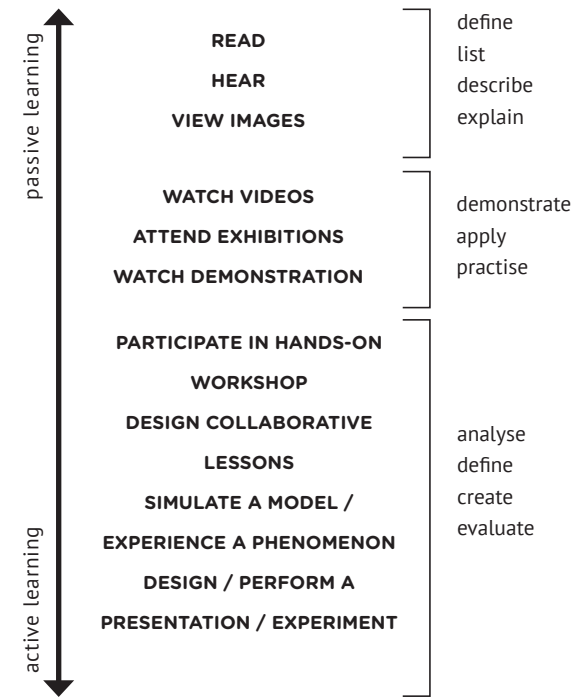
**1. Disparity in learning abilities:** In most traditional schools in rural India like that of the area of fieldwork, there is a huge gap between students who are considered potentially competent, or in simple words; a better performer, and the other students who are not. In fact, it is also seen that various efforts of the government to train the potentially incompetent students through extra classes and remedial sessions are not being very successfully implemented, as the specific group of students that it is aimed at is already frustrated and apprehensive about attending classes. On the contrary, the majority of students who end up attending these extra classes are actually the most competent ones, further aggravating the gap between them and the in-competent students. Seen through the perspective of Vygotsky's Zone of Proximal Development, there is clearly a lack of development in learner due to them being out of the zone where they can develop mastery and understand topics and lack of collaboration between them and their peers (Kozulin, Ageyev, Gindis, & Miller, 2003). Additionally, the instructors seem to have no understanding of the learner's potential, which makes it difficult to identify their zone of development.

**2. Obsolete mode of instruction for children:** This has been a classic setback of the educational system in rural India for the past few decades. In the interviews conducted, the mode of instruction in the majority of government schools was found to be limited to classroom lectures. Despite investment of public funds on schools to integrate technology in classrooms and promote experiential learning, the efforts have not fruited any yield. E.g; GPS (Rakkar primary school) had invested on smart classrooms but it was shut due to lack of facilitator. This is partly because; such mode of active learning is not implemented in regular classes but in

L.S.VYGOTSKY's Zone of Proximal Development



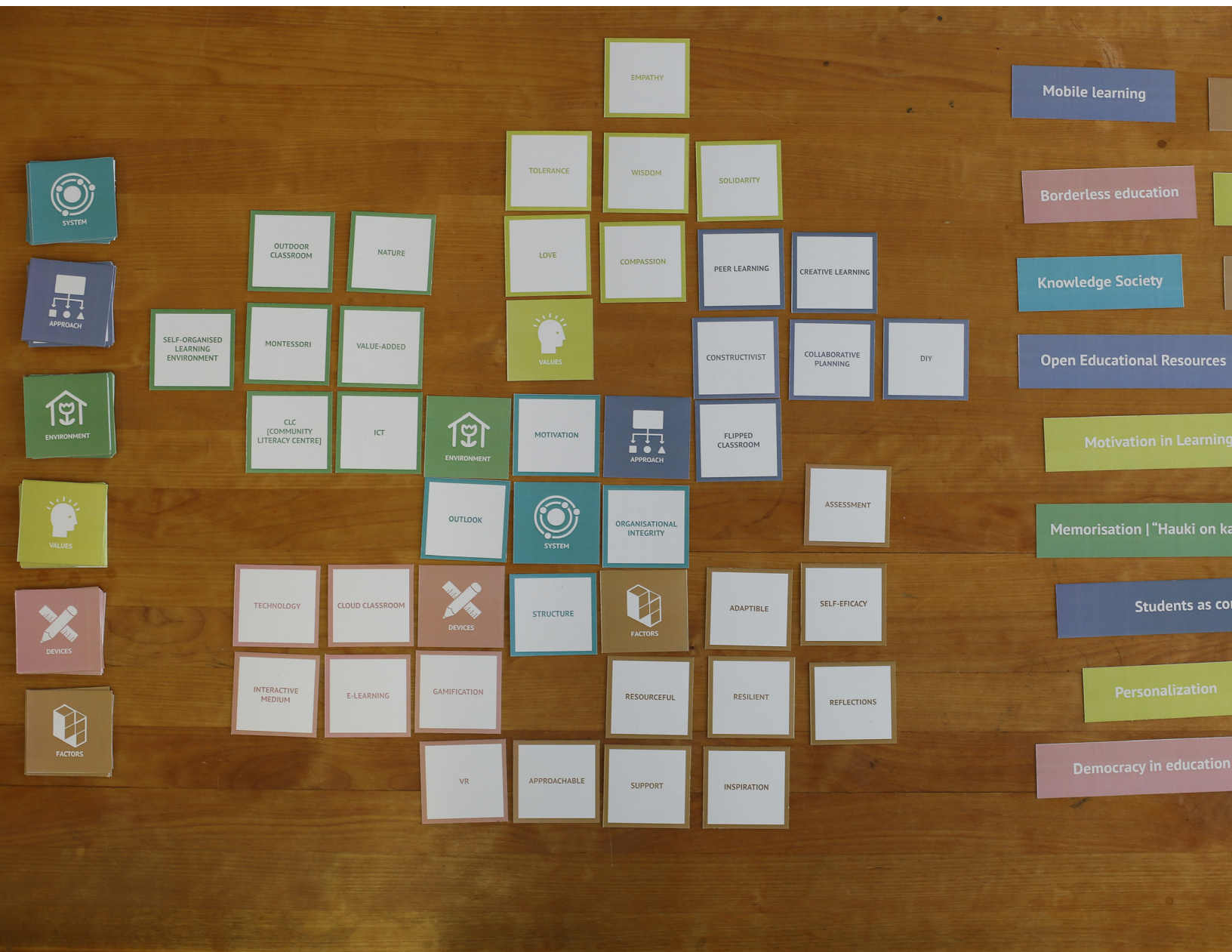
Edale's cone of experience



a highly specialized smart classroom that is provided to a few selective schools. In other cases, there is a lack of facilitation. There are only a very small percentage of teachers who use technology in classrooms, mostly in the form of audio-visual references. As explained in E.Dale's Cone of Experience theory, it is necessary for schools to adopt methods of active learning from reality or experiences as opposed to passively sitting, listening, watching and reading (Matijević, 2012).

**3. Lack of in-depth Learning:** One of the pitfalls of the rural Indian schooling system, identified during this research, was student's reliance on rote learning. It's not about the use of memory, rather it's about passively reproducing facts mugged up during classes without reflecting on it or fully grasping the fundamentals of the topics learnt. This kind of surface learning is sufficient for the students to perform well in their examinations but in the long run they are faced with challenges in pursuing higher academic endeavors. As opposed to this approach of "data-reproducing", students would achieve better learning outcomes if they are encouraged to adopt a "knowledge-making" approach in class (Entwistle, 1991; F Marton, R Säljö, 1976).

**4. Upsurge of digital infrastructure but lack of digital literacy:** India has progressed remarkably in the past few years in terms of digital infrastructure like network connectivity and Internet. With companies like Jio aiming to set up the largest fiber footprint delivering broad spectrum Internet across the country, India is expected to be a home to around 627 million Internet users by the end of 2019. Being a country where the world's extremely poor and deprived live, an average waged person has to work 13 hours in order to pay for 1GB of data (Skynet Foundation, 2016). Moreover, a majority of the rural population's usage of Internet is limited to entertainment and communication. There are very few who are aware of using such infrastructure for educational purposes. Even in schools, facilitators are faced with difficulties educating learners about Internet and digital technology. Therefore, it's of prior necessity to build awareness on digital literacy and educate learners about the new digital media that they are offered with.



# PARTICIPATORY RESEARCH

## Participatory Workshops

In the Participatory design phase of the research, workshops were organized to bring together learning design enthusiasts, educators and designers to discuss challenges faced in current learning environments and educational spaces. One was conducted at Aalto University to test the tool kit. The other was conducted at the field site in India where Indian parents, alternative educators, schoolteachers, artists, innovators and young students participated. The sessions mostly involved discussions based on scenarios provided, identification of key challenges, desirables for educational spaces, building strategies for learning and co-creation of learning environment using a participatory kit. The participants were provided with Personas and Scenarios based on the qualitative research that was done during the fieldwork. A participatory workshop toolkit was designed to assist the participants to generate ideas and initiate discussions about education. The purpose of the participatory workshop was to facilitate collaborative effort through which the participants could share their insight and experience on learning and educational systems prevalent in that area. The Scenarios represented by a Persona were used as design challenges to discuss and generate new ideas for a suitable learning environment. At the core of it, the main objective of the workshop is to identify methods which can enable creative problem solving in educational systems, school infrastructures and learning design in such a way that it can nurture the adaptability of learning environments and enable sustainability in learning.

The workshops began with a basic introduction to the thesis topic and introducing the idea of participatory design workshop as; an immersive get-together of like-minded people to engage them in design activities

that help solve problems, uncover new ideas and innovate in the respective field of interest.

Objectives/questions of the participatory workshop can be categorized as below:

**Awareness:** What does sustainability in learning mean to educators?

How can we sustain learning in a way that the learner feels as much a part of the learning environment as much as the people who built it?

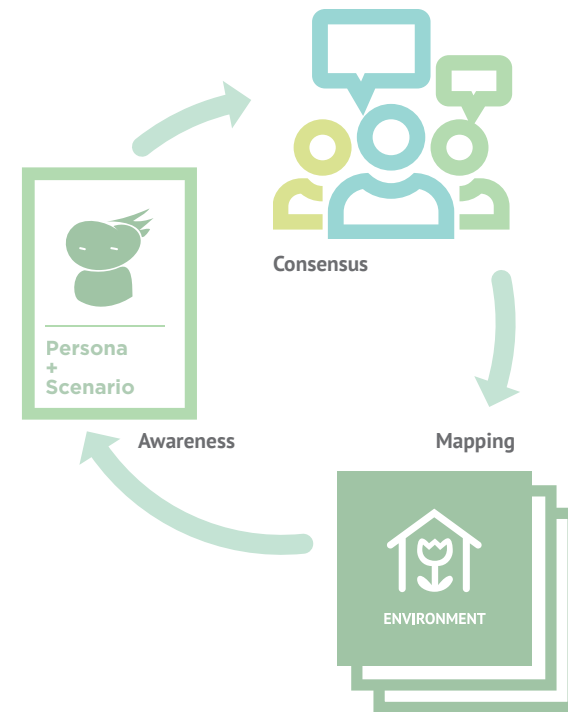
**Consensus:** Can learning environments adapt itself to solve the challenges faced by the learners or educators? Understanding the boundaries of adaptable ecosystems.

Is collaborative problem solving in education feasible/enjoyable/effective?

**Mapping:** Is it possible to collaboratively map out the diversity of learning environments?

OR to draft a spectrum of ideas and methods used by educators and Learning Designers to perceive and solve challenges/issues faced by learners.

Do educators have enough resources to solve problems in their profession as an educator?



*Construction cards arranged in an order below to articulate ideas for Learning Environment.*



## Participatory Toolkit

### Construction Cards

The construction kit was designed to enable participants to derive at the most suitable learning environment for the provided Persona in the given Scenario. It is in the form of a card game that consisted of the following elements:

**Core cards:** The kit consisted of 6 main “core cards”; system, environments, approach, devices, values and factors.

**Element cards:** These “core cards” were accompanied by “element cards” that belong to the subset of each core card.

**Voice cards:** There were also “voice cards” to raise questions and contradict an idea in the process of constructing a model.



**Idea cards:** The “idea cards” were to document the new ideas that came out during the process of this collaboration.

**Personas:** are a piece of descriptive note that’s used to model, summarize & communicate qualitative research about individuals. In this case it was about learners, teachers and facilitators (parents etc.).

**Scenarios:** a storyline or narrative that is followed by the individual persona. Each scenario represents challenges that need addressing.

## Workshop 1: conducted at Aalto University, Finland

There were ten participants who organically formed three groups after a general discussion before beginning the activities. Once the Scenario and Persona card was provided to each group, they started with the construction kit. Most of the participants instantly started mapping out the persona using the cards based on the strength and weaknesses of the Persona. Once they had a clear idea about the character of the Persona, they started identifying problems faced by the persona in the given Scenario. This led to many discoveries. Some participants could relate to the challenges faced by Personas. Having understood the problems, they started generating ideas using the core cards. Since it was a blank canvas, they struggled with the structure of the construction but having a blank canvas also made them achieve standpoints where they were able to ideate new concepts and use the cards to add/modify new links/arms to their models.

Some groups used the flipcharts to draw out mind maps and diagrams to discuss sustainability in learning and some groups drew on the canvas to differentiate between the weak points and strength of the Personas. At the end of the activity, the group presented their model and spoke about their journey through this activity. There was a group-based question round where the other group members shared their opinion or queries and the facilitator asked questions aligned to the objective of the workshop. At the end of all the presentations their was a general discussion on the activity, process, the kit and overall the workshop. In the process of which everyone introduced himself or herself.

1 Understand the personas and scenarios.



2 Get together into groups to discuss the scenarios and collectively design solutions for the persona provided.



3 Use the construction cards to articulate your solutions and design the most suitable learning environment for the Persona. Make suggestions and new ideas on the "voice" cards and "idea" cards.



A Start from the core cards; SYSTEM, ENVIRONMENT, APPROACH, DEVICES, VALUES and FACTORS.

PURPOSE	VALUES	CREATIVE CONFIDENCE
STRUCTURE	SYSTEM	OUTDOOR CLASSROOM
FACTORS	PLAYFUL	ENVIRONMENT

forest kindergarten

NATURE EXPLORATION

B Fill it in with details using the element cards.

C Use idea cards and voice cards to articulate your own ideas, concerns or resources.

"little forest folks" is a good example of such learning environments.

Discussion

The workshop also had a world café round table discussion. There were several topics on the table related to the theme of the workshop. The discussion started with the topic of Memorization "Hauki on kala". Some believed that memorization is very shallow way of learning since the learner retains the knowledge for a very short period of time. Further having discussed the process of reflecting and reproducing from memory, discussed about neurons that responds to space and how spatial memory helps in higher form of knowledge acquisition. This discussion was followed by a discussion on Borderless Education and Lifelong Learning. With devices penetrating everyday life, how easy it is for people to access information. There is no border to how much one wants to learn, how one wants to learn, where they want to learn. Discussed concerns about the validity of the content that could give independence and security on accessibility of content while comparisons were made with the validity of classroom knowledge.

This led to the topic of "Rational Inquiry" in education. Discussed on the idea of nurturing children's curiosity and ability to question. There are various advantages and disadvantages of children questioning information that they gathered in school. The participants discussed views on nurturing critical thinking in schools. They raised concerns about how humans being overly critical and skeptical, can determine their learning curve. This led to a discussion on how critical thinking may help understand concepts better. How both meta-cognitive and cognitive skills are required for understanding concepts and how it can be nurtured in learner.

The next topic of discussion was "Societal pressure on education in Finland". The discussion started with all the participants expressing the topic from their viewpoint of their native country like Mexico, China, India etc.. Comparing that with Finland, the three Finnish educators in the group highlighted on how society has viewed education in Finland. There was a debate about the university education being too basic and unrelated to what the learner may have to face in their work environment. There were many counter discussions of how basic knowledge earned from Universities

has also been effective to students. This brought up discussions on the diversity of work culture etc. Participants also brought up the topic of evolution of education in China, India and Finland (since the 1600's). The last topic of discussion was "The upcoming trends in Education". Current understanding of education is focused more on generic skills rather than very specific technical skills. There is a need a to introduce soft skills with more core values like grit and determination. The education should not be planned according to the current economy but should be far sighted because job opportunities are getting obsolete faster. The participants also raised a concern that in future educators may be replaced by AIs, fearing that learners might trust Artificial Intelligence more than human tutors.

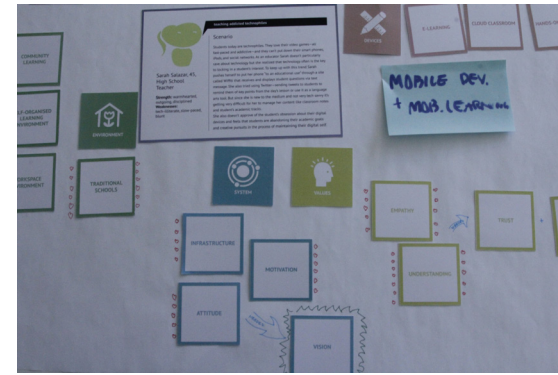
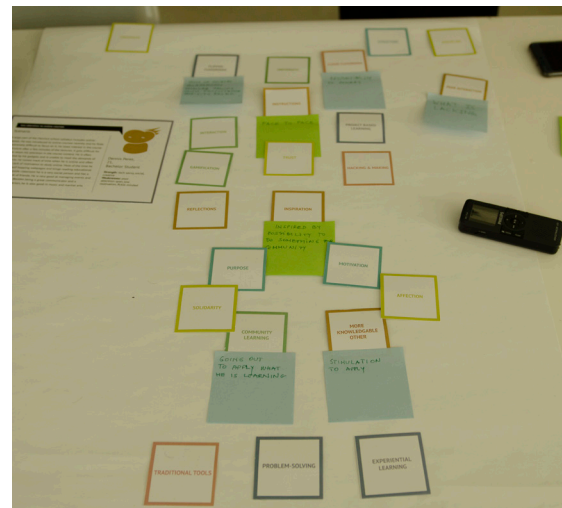
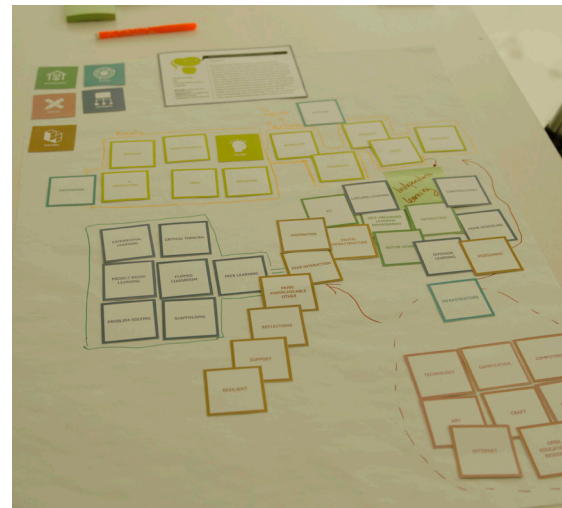
### Participant's feedback

Group 1:

*"The cards were very resourceful. In a visual sense it may be confusing what we made here but a blank canvas gave us lots of freedom to come up with ideas. Some idea on how to use the visual space and organize may have guided us better. It'd be nice to have a structure or trajectory to guide the model. This was inspiring. We have new ideas. It'd be easier if there were certain guidelines. But this was very organic so it didn't guide us to a certain point. We came up with one new idea "independent learning" which we drew from the structure that we drafted. It's at a junction of the elements and if there was a set structure we'd probably not have come up with it."*

Group 2

*"There were many structures that we came up with but we finalized on this. There was a blurry line whether we should design it from the system point of view or persona point of view so that was a bit difficult to orient with. We were debating whether we should use the same colours or mix the different colours. We'd prefer writing these elements down than placing the cards. It worked out well that it was an empty canvas that we had to design a model with our own structure. There could be some anchor points that limits us into whether the cards can have bidirectional relationship or multidirectional relationships;*



*since it also brings up the question on the ability of system to afford such adaptability. These cards (names of the parameters) enable us to think of the direction and keep in mind the elements that could be explored while educating."*

Group 3

*"We found it very fluent to work it, perhaps because we took the keywords (parameters) as the steps. And around those we found the idea. We have worked quite a lot with schools in the past so this was very convenient. Initially we were missing the guidelines but eventually we realized that it was better for us to work together this way. If there was a same target for every participant then it wouldn't be very collaborative..We found the persona very relevant because we often come across such problems in real life as educators. "*

### Follow Up

Following on the workshop, visited a Finnish school with Aija Elg (a participant of the workshop) to understand different teaching methods used in Finnish education. Through this got introduced to the English Stream education method that is used to promote functional bilingualism by the end of primary school. Attended a middleschool English class 5E in Kaivoksela School, Vantaa; where students were actively participating in conversations and discussions on their reading materials. They were also analysing stories from their own point of view and suggesting learning methods that they would like for the particular course. In the class, they also listened to audio lessons and shared their opinion about it. In the English stream classes their is a significant involvement of parents which is what makes it unique. Parents can keep a track and contribute to the lessons simultaneously.

## Workshop 2: conducted at the field site (Dharamshala), India:

This workshop was conducted at the field area to identify challenges that students face in this community [locals + migrants]. Within the periphery of few villages neighboring Rakkar and Tilloo, there is a wide range of people working towards educating children or providing support for the youth of this area; all in their own perspective. This workshop aimed at collaboratively mapping out the diversity of learning environments prevalent in this area and challenges faced by them in sustaining it.

The participants include parents of school going children, school teachers, NGO workers, psychiatrist, homeschooling parent and people who are involved in some way or the other in educating young students through alternative and traditional approach; for instance, tutoring children at home and informal spaces, building educational tools and technology, mentoring students or children, writing educational content etc. There were around 10 core participants attending this workshop.

### Discussions

After introducing each other, the participants had a discussion on their experience as educators and the problems they have faced during their involvement with learning spaces, homes, schools and institutions of this region.

Some of them have home-schooled their children without having much involvement with other children from the village. Their knowledge is specific to how learner's do when they are homeschooled and what they've experienced so far in educating their children at home. Their involvement in education has been more towards giving the learners basic life skills and understanding of why one should study, rather than aligning them academically. The most vital understanding of this approach is that the learner learns as a family and having moved to different places, as a family, during the course of time helps the learner adapt to the new changes that they are faced with. However, in such cases, sometimes, the new excitements that are thrown to the learner along their journey, often make



*NDP states that until grade 8, no child can be held back or expelled from school (Azim Premji Foundation, 2015). It was introduced in the Right to Education (RTE) Act in 2009 along with the concept of age-appropriate class and Continuous Comprehensive Evaluation (CCE). These concepts were introduced to facilitate education according to children's own pace of learning. But unfortunately the progressive vision of the RTE 2009 was rendered irrelevant or to some extent counter-productive by the curricula and classroom process of the country. Majority of teachers interviewed during this research were apprehensive about it.*

it difficult for them to detach from the excitement and focus.

Another participant discussed that in the past 5 years of understanding the educational standpoint of the village, he observed that an average parent would consider it a "progress" when they are able to send their children to a big school in a school bus and where they are taught in English, regardless of what they are actually taught or what they actually end up learning. His idea of what education should be for a society or what should be valued as education is largely at conflict with the villager's idea of education. "Sending the child to a big private school will lead to a better future" has been a more recent outlook. 5 years ago there weren't so many private schools in this area and children had more time to explore the nature and learn life skills. What is seen today is pretty much like what happens in the cities where children are loaded with a school bag bigger than their own size and sent to a big school believing they'd achieve something, while giving them zero attention at home as to what they are actually learning from their schools.

Another participant discusses her experience with painting and making wall art for government schools. She notices that schools at government schools in Palampur, a town located 28 kms away from Rakkar, have students of mixed age groups and class, studying together. The teachers are very experienced and the students are very knowledgeable and attentive. Comparing that with the government school students she tutors in Rakkar, she notices that despite having the same subjects and classroom culture, the students are far behind on their academics. They are extremely poor in English, which leads to them not being able to read any chapter thoroughly. They manage to pass their tests by mugging up the exercise answers given by their teachers without understanding anything. The students can write in English but can't read. Even in the English test paper reports, teachers comment in Hindi because the students cannot read in English. The situation in the schools in Palampur is however very different. The diversity in seen in classroom helps promote better learning outcome. Additionally, qualified and experienced teachers add to the quality of teaching in the schools in towns like Palampur.

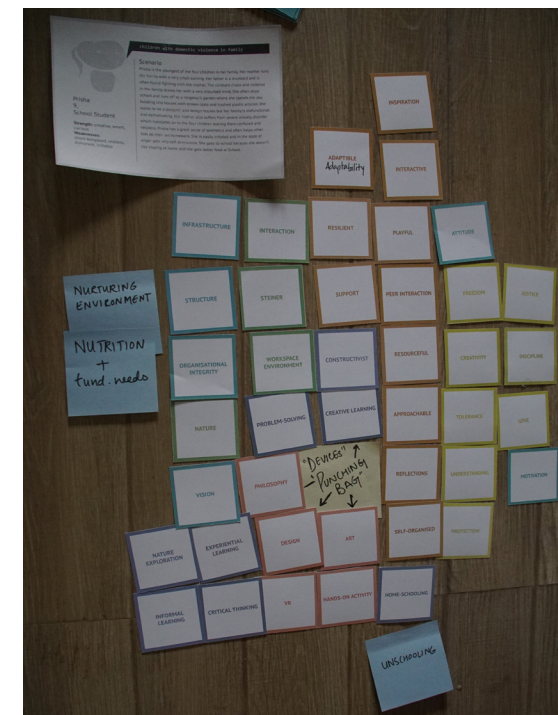
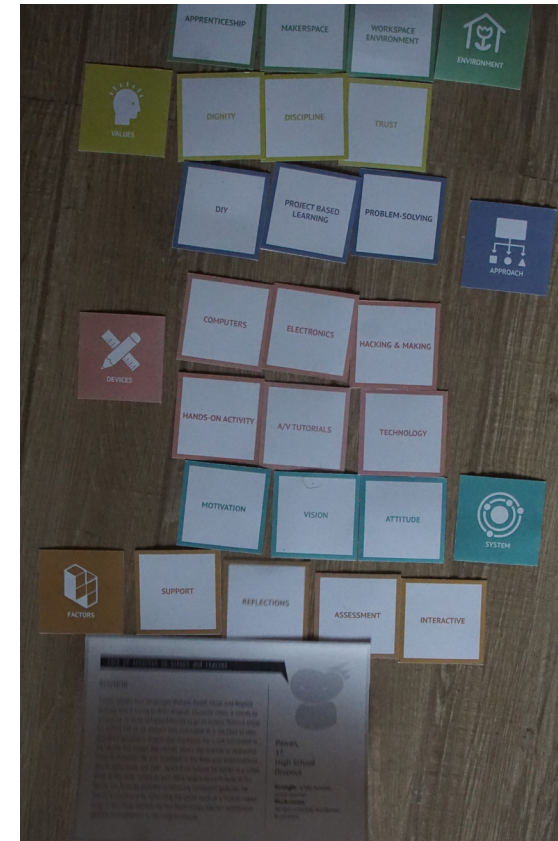
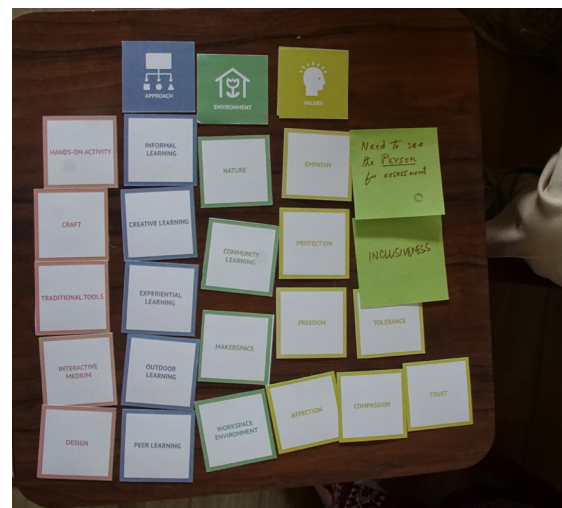


The relevance of English learning is very high in this region. One argued that, earlier, it used to be a middle class mentality of Indian society but now even the poorest of the poor wants their children to speak in English and be able to read and write in English. There is a lot of pressure on children to learn English,

To find clarity in this problem, a participant who is a government school teacher explains how the mandatory rule of promoting the students to a higher class according to NDP (No-Detention Policy), even though they have failed in their exams, has brought a setback to the entire education system. The students don't make efforts of learning in the early stages of school; given that they'd be promoted anyway, which leads to them being not knowledgeable enough to grasp the advance courses of the higher classes. As a result of this policy, students take classes very casually and that demotivates the faculty. The teachers don't have any authority to assess them correctly. Moreover, the students who attend government schools in rural area are from relatively poor background so they definitely have lot of work at home. Once they get home from school they are involved in a number of household chores, as a result of which they don't have enough time to study. The environment at homes in these villages donot favor any kind of academic work. NDP is one of the most argued topic amongst educators in India.

These policies attempt to promote progressive ideas of peer/group learning, however, it is not implemented in full capacity in areas like these where the community and context is completely different from that of the cities.

The discussion also touched topics like "remedial classes" to which one described that in government schools there are government sponsored remedial classes for 9th and 10th standard students. These classes are targeted towards a smaller group of students with specific learning setbacks. Since the quality of education is already at a level where majority of the class has academic severe setbacks, these classes get flushed with a large number of students, making it very cumbersome for the teachers to handle.



In government schools these days, CCTVs are installed in many classrooms so it's easier to evaluate where education system in India stands today. Some participants believed that in a few years the result of these policies would be clear.

Comparing the government schools with private school the teachers in the workshops discussed how Parents Teachers Meet (PTM) plays a role at improving learning outcomes of student. In private schools, both teachers and parents participate in discussions actively. Whereas, in government schools; the footfall of parents in PTM is very less. Out of 100 parents only 10 parents manage to attend, that too the parents of students who perform very well in the class. The attention of parents towards their children's education in this region is very poor. There are also cases where there is a lot of gender disparity that leads to parents focusing more on their sons and younger children. In traditional households, it is noticed that parents are not very concerned about their daughters or elder children. A teacher cited an example to illustrate this.

A participant who worked in a school in Ahmedabad before, shared her experience with assessment in alternative schools. The school she worked was an experiential learning school, so the director incorporated rules like no homework and no evaluation. But a lot of parents were concerned and apprehensive about it. In this school, there were practices like self-evaluation and group evaluation instead of tests assessment. The students could select their own classteachers. In fact, teachers were called "facilitators" and "initiators" who could design their own curriculum; keeping the competency of Gujarat board of education in mind. It was run by French people but a diverse group of students attended it. There were 3 municipality sponsored students amongst students of various class strata. The first five to six years of the school when the participant was involved it was a very experimental school but few years down the line the vision got diluted. Eventually it became an IB school and had to follow the norms of the IB schooling system.

She also gathered that the students seemed very happy initially because they had the freedom to learn through creativity, project-based learning

and holistic approach. But as the parents started comparing them to other children in their family who went to mainstream schools, things started changing. Few years later things got confusing and a lot of pressure was imposed on the students. The students, she taught ten years ago, are now architects, engineers and call center workers who are very confident with what they do.

Similarly, another participant mentioned having visited Wood Whistler International School many years ago (2014) when it was just started. In those days, the school had only 4th grade and it was in an experimental phase where the vision was to value creativity, energy, good education. It seemed to be a great initiative but soon because of pressure from parents the school had to chose a board of education to be affiliated with and a lot of the system changed since then.

The parents who are homeschooling their children stated that they used to send their children to alternative schools in the past; where the student strength was 7 to 8 children in one class. Even in those schools, something similar happened. Many parents insisted the school to change their approach and introduce evaluation. Today, all across India, the main challenge faced by alternative schools is that the schools eventually ends up being shaped by the societal pressures, despite it's original alternative vision.

Sometimes, it even gets difficult for parents to homeschool their children because people all around are so apprehensive about schooling that is not mainstream. This whole idea of “compulsory school education” is so strong in the society that there is hardly any scope for alternative schooling. Even if there is an alternative school performing well, with very basic challenges parents lose faith and withdraw their children back to traditional schools. By the end of the discussions the participants noted down the desirables for the dream school.

#### Feedback on the participatory toolkit

Though most participants actively used it to construct learning environments, there was stern criticism regarding the use of Personas by

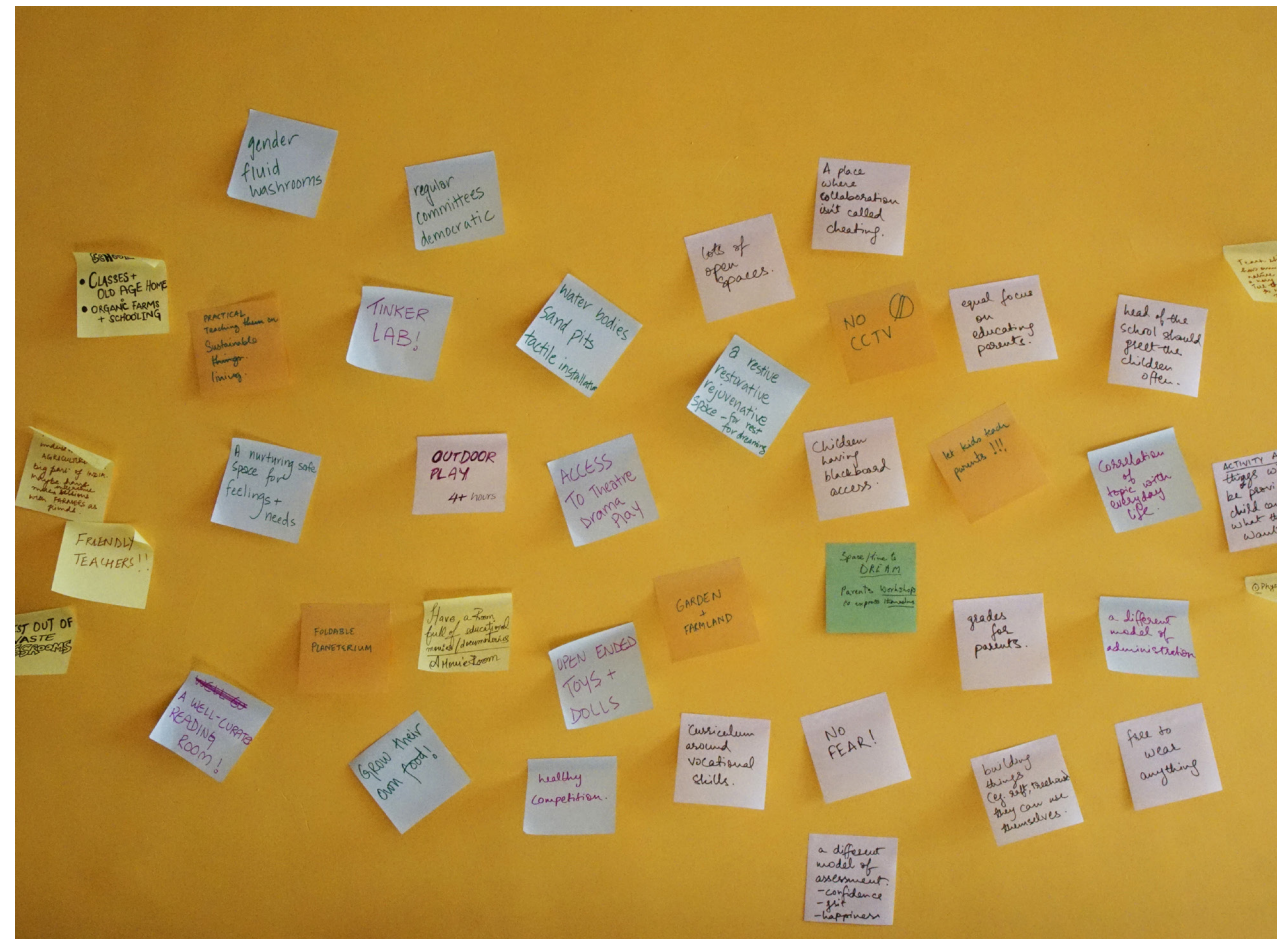


Photo (above): Desirable wall; participants displayed the desirables for their dream school.

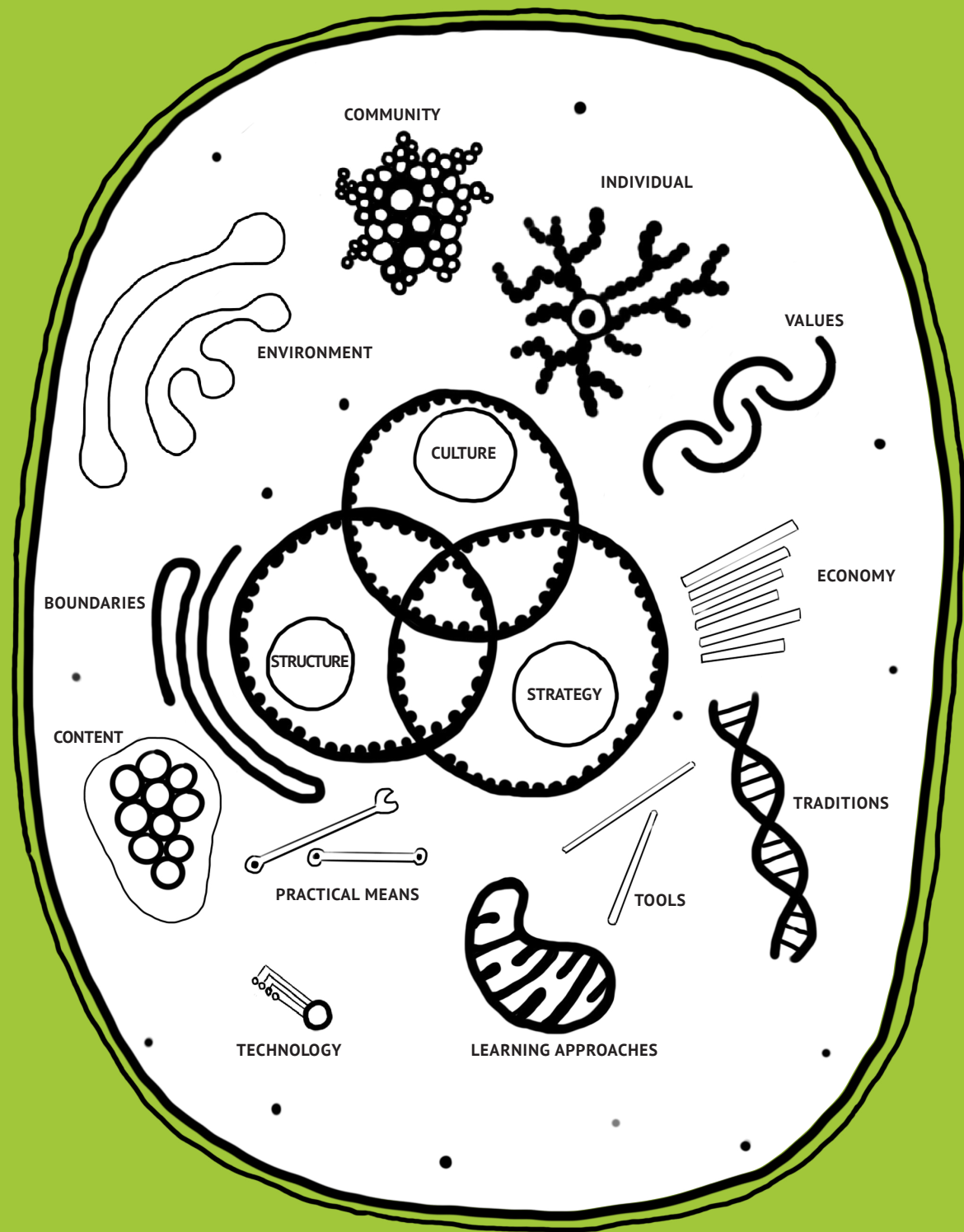
the senior most participant of the workshop. Being a psychologist and a counselor, she argued that Personas lead to stereotyping learners which could be derogatory towards learners personality. Moreover, it is extremely hard to pin point Personalities into Persona through interviews and surveys, especially when it comes to young students. A student that may appear low on intelligence or as a “poor performer” to their teachers or peers or even themselves, can actually be very high on IQ. Since personality is influenced by many factors like circumstances, mental health, physical health etc, it is not ideal to sum it into a Persona. She highlighted the value of a psychiatrist and psychologist in education and stated that the students who are not performing well should be first counseled before exposing them into a new learning environment.

#### Follow up

The same workshop was conducted with local children, however, there weren't much response from them. The children of Rakkar and Tiloo weren't able to actively participate due to lack of English language understanding. Moreover, translating the toolkit into Hindi was an impossible option, as it would narrow the vocabulary substantially. This drawback can be noted as a scope of improvement in the future.

#### Overview of the Participatory toolkit

The toolkit was best used when one had fair knowledge about educational technologies, learning approaches, theories and elements of learning environments. For example, innovators and educators who participated in Finland were way more active at constructing solutions owing to their expertise and knowledge. For such participants, it provided a vocabulary to articulate the vision of a LE; making it adaptable to iterations in future. However, in the Indian context, it was not relevant beyond creating hypothetical solutions to existing problems and conversation starters between parents and teachers. This toolkit needs to be implemented in a language more familiar to the local population in order to utilise it fully in studying sustainability.



LEARNING ENVIRONMENT; more as a LIVING SYSTEM than a MACHINE ENGINEERED DEVICE

## SYSTEMS DESIGN

### Systems Thinking as a Design Protocol

The quest for educational research, however, doesn't end here. In this world of rapid change, be political, economic or social, educators are having to get a more holistic understanding of problems, possibilities and future scopes. Since, education is a complex social institution, it is necessary to have a systems thinking approach to develop and deploy innovation. That brings us to the concept of "Systems Thinking". Systems' thinking has been around since the first half of the 18th century, not as a discipline but as a broad interdisciplinary conceptual framework (Shaked & Schechter, 2017). In fact, Ludwig Von Bertalanffy traced it's history back to the sixth century BC, implying that the notion of system was discussed by great philosophers and thinkers like Aristotle, Nicholas of Cusa, Leibniz, Hegel and Marx. Aristotle's idea of "The whole is more than the sum of it's parts" defined the early fundamentals of systems theory as a holistic view of matters, as opposed to Descartes' scientific reductionism approach where complex systems are understood by reducing them into their simpler parts (Von Bertalanffy, 1972). Today, there are many definitions of systems thinking based on a wide range of fields, but the most relevant for this research is that it is a discipline of recognizing a unified whole rather than an isolated part and studying the interrelationships between things rather than the things themselves (Arnold & Wade, 2015; Miller-Williams & Kritsonis, 2009; Richmond, 1994; Senge, Peter M., 2006; Shaked & Schechter, 2017; Sweeney & Sterman, 2000; Von Bertalanffy, 1972). In the field of Education, however, there has been little research done or documented with respect to approach, despite the growing use of system design in complex problems.

From a systems thinking point of view, Education encompasses a wide range of aspects that go beyond courses and instructions. Factors like the community to which the learners belong, the cultural values of the learner, nature of learning of individuals associated, training programs and curriculum, learner support, environment etc. are equally important at shaping ones learning outcomes. In order to design a process and environment that fosters learning, it is very necessary to understand the learning process in context to the larger whole. That brings one to highlight the theories of learning in terms of how learners are perceived in the society.

Contemporary theories of learning have come a long way from the traditional objectivist foundation of instructional pedagogy. As per the traditional instructional model of learning, teaching/learning is considered a process of transmitting knowledge from teachers (or technology) to learners, an understanding that's rooted in behavioral psychology and communications theory. This idea of learning through knowledge transmission and reception, almost as though knowledge is an object, still substantially prevails in Indian educational practices.

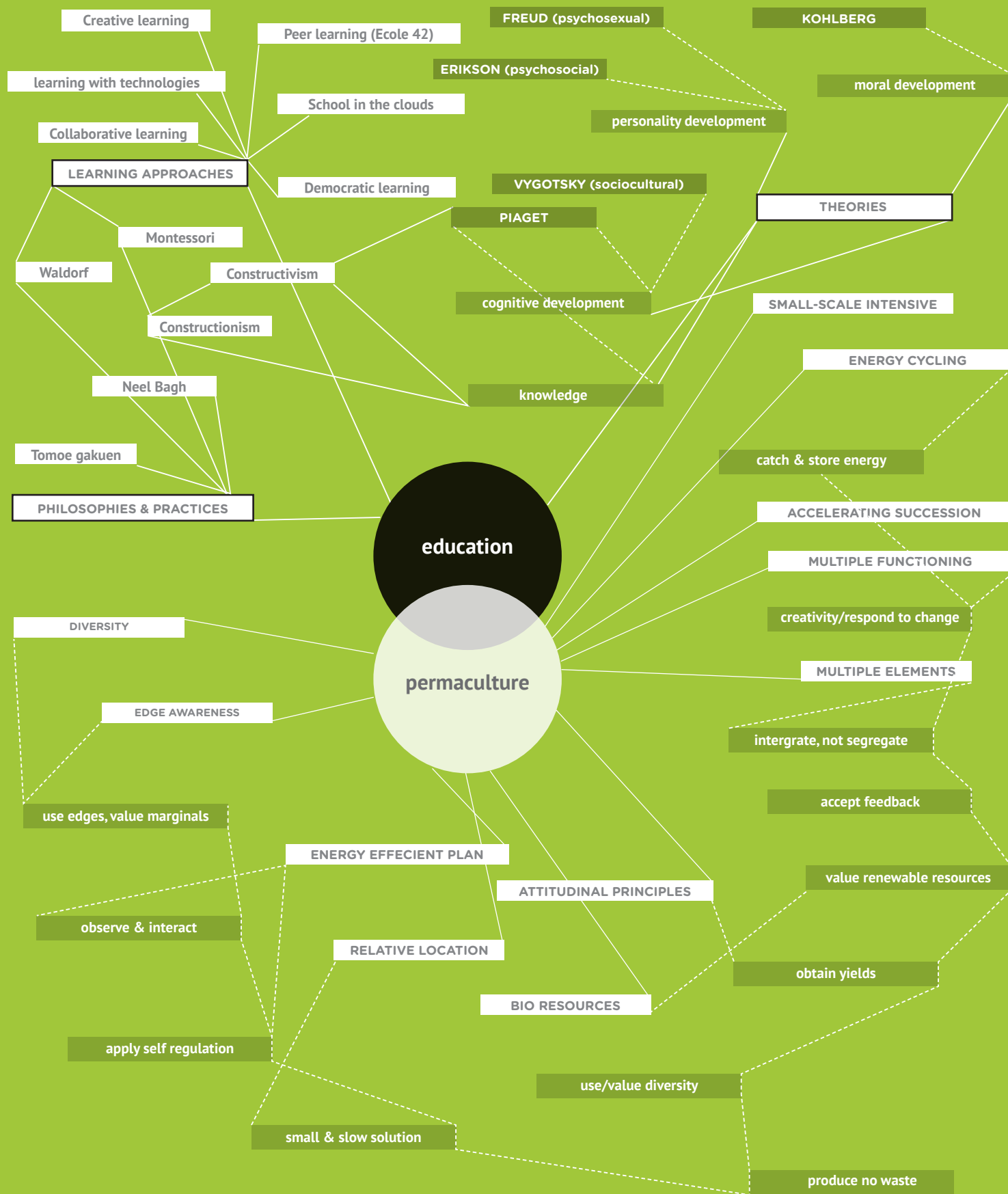
However, in today's society, being a student is a culturally accepted responsibility of a growing adult. Therefore, the meaning of being a student largely constitutes someone who has embarked himself or herself on acquiring knowledge and skill through the instructions of a master. On the other hand, a learner is defined as anyone who constructs their own meaning from their experience. In the contemporary, socio-cultural and constructivist theory, learning is not just a transmission of knowledge but also a process of making meaning through reflection of experiences. In order to design learning environments, one has to consider not only the learner's performance, but also the sociocultural and socio historical setting in which learning occurs as well as the tools and mediums used by learners in a larger context ie; to make meaning (Jonassen & Land, 2000). This shift of focus from students to learners clearly changes how

*Instructional design, as an activity system emerged during WW II as a mechanistic process for producing reliable training (Jonassen & Land, 2000)*

learning environments are viewed today. People are exploring new form of holistic pedagogies through open-ended learning environments. This broad perspective was implemented in understanding what “learning environment” constituted, especially for a community like that in Rakkar. [figure: jonassen et al]

## Learning Environment

As defined by UNESCO, a learning environment (LE) is a social, physical and organizational setup that fosters learning. The key components of it being: i) space, ii) media and iii) content. Space can be further distinguished into physical space or a digital space. Physical spaces enable social interactions, which is an integral part of a community. The digital spaces are essentially the technological platforms that facilitate learning. The medium through which learner acquires knowledge is a very important aspect of any learning environment. It could be through digital application, physical experience or mental reflections. It is usually defined by the learning approaches and strategies undertaken by the LE. Finally, content and availability of resources plays a critical role at improving learning outcomes. As a result of the variety of resources, a wider group of learners can be benefited. There are also various other aspects that sustain a LE; like culture, structure and strategy. The community it serves, the environment, the individual/learner's values of learning and societal outlook that fall under cultural aspect, has a great impact on LE. The structure, boundaries, practical means, resources and technology also influence the learning outcome and functionality of a LE. Other aspects that need to be considered are economic strategies, learning approaches, tools and traditions. The relation between all these elements and aspects keep the wheel of education turning.



Mindmap: Draft of the intial concept of Permaeduculture; drawing lines between Permaculture and Education.

# DESIGN CONCEPT

## Permaeduculture

“Permaeduculture” is an attempt to explore the possibilities of designing an educational system inspired by the principles of sustainable ecosystems in nature. It is derived from a blend of the words “Permaculture” (i.e; a model of agriculture that is self-sufficient and self-organizing) and “Education”. It is a concept that draws a parallel between sustainable ecosystems and ecosystem of knowledge, thereby developing opportunities for learning designers to promote sustainability goals in the premises of knowledge ecosystems. Through this concept, this project envisions a Learning Environment that serves like more of a living system than a machine engineered device.

The core principles of Permaculture Design and the way it inspires this model of learning environment (as also briefed in the “Theoretical Background” section) are:

### 1. Observe & Interact

Permaculture garden is designed by observing the context and elements of a system throughout the changing seasons. Creating useful relationships to preserve a long-lasting connection among these elements is the first principle. Similarly, in LE every element plays an important role at facilitating each other’s learning. The relationship between learners and facilitators is equivalent to the learners and their peers.

### 2. Connect

This approach also emphasizes on the use of relative location by placing the elements of the system in ways that create useful relationships and timesaving connections. It’s a holistic approach where the number of connection between the elements is given more emphasis than the elements itself. If this approach is implemented on LE, it could preserve a rich diversity in the classroom that can adhere learning. As quoted by Lev Vygotsky: “All the higher functions originate as actual relationships between individuals”(Vasile, n.d.), it is primarily very important to focus on the relationship between the individual elements rather than the individual elements itself.

### **3. Catch and store energy**

A critical factor at attaining sustainability is identifying and preserving useful flows.

The production of energy is maintained by enhancing yield through every cycle and every gradient. Similarly, Permaeduculture focuses on sustaining the knowledge ecosystem by enabling production of knowledge through reflections and meaningful learning as opposed to rote consumption of information and instruction.

### **4. Obtain a yield**

There is a strong reward system in permaculture farm. Similarly, knowledge propagates when feedback and rewards are incorporated to the learning system. This has also been identified through qualitative data analysis of the field study. Many young learners have raised the point that they feel motivated when they receive rewards for their learning efforts. Not only rewards or awards, even feedback from teacher helps boost learner's confidence and adds to their learning outcome.

### **5. Self-regulation and Feedback**

For a self-sustaining environment where there is no central governing or managing body associated, self-regulation is the key to sustaining. Through self-regulation, a system can avoid malfunctioning and through feedback the system can be reformed. Self-Regulation and peer reviews have also been proven to be successful at aiding a better understanding of ones own performance in a learning ecosystem.

### **6. Use and Value Renewable Resources and Services**

In nature, elements by itself optimize consumption and are independent of non-renewable resources. In LEs, knowledge resources like Open Educational Resources contribute in many ways. OERs are valued as a resource of educational content, learning approaches and technologies in todays LEs.

### **7. Produce no waste**

Permaculture design principles aims at valuing and making use of the resources. If permaculture principles are applied to LE, a sense of gratitude towards every element in the system could be fostered leading to a positive reinforcement of knowledge acquisition.

### **8. Design from Patterns to Details**

In Permaculture, patterns observed in nature and it's various elements are used to design an environment. Similarly, to design learning environments, it's important to start with understanding the details of the fundamental construct of the society it prevails in.

### **9. Integrate Rather Than Segregate**

Permaculture integrates each element in the system in a way it can sustain each other and dynamically re-organize itself to sustain the living. In LE, similarly, various elements like tools and technologies can be integrated in to achieve better learning outcomes. Technologies like interactive classrooms, ICTs etc that emphasizes on collaboration, can be blended into LE to promote active learning.

### **10. Use Small and Slow Solutions**

"Small and slow systems are easier to maintain." [Toby Hemenway, 2009] Permaculture farming focuses more on local resources in order to promote sustainability. In case of LE, local factors like diversity and culture have great influence on the process of learning. It is often noticed that educational content designed for a global audience is rendered irrelevant in a community that has no access to the rest of the world. It might make learning and understanding concepts better if one starts with local resources that make more relevance to the participating individuals.

### **11. Use and Value Diversity**

Diversity helps provide equality to every individual element and reduces

vulnerability to variety of threats. In current knowledge societies, LE's need to be equipped with tools and technologies that provide a platform for a diverse range of learners to interact and learn from each other.

### 12. Use Edges and Value the marginal

Permaculture designers value edges and intersections. Since communication plays an important role in preserving relation between the various elements of a system, the platform of interaction becomes a key component even in learning ecosystems.

The symbiotic interaction between natural elements helps identify the potential of each element. In case of LE, learning platform where learners can interact with each other seamlessly facilitates synchronous learning that further improves their learning outcomes.

### 13. Creatively Use and Respond to Change

Resilience is another very important value of Permaculture. The ability to adopt to change and dynamically re-iterate itself with time and needs, allows a system to sustain itself. Projecting that to learning theories, learning is fostered when the learner are in the zone of the flow, where learner's challenges are constantly changing, placing itself in a category perfectly between those that manifest boredom and those that creates frustration. [Mihalyi Csikszentmihalyi, 1990].

In this model, the learning environment proposed has two major components: i) physical learning space ie.; a community learning center where learners can meet and have meaningful social interactions, and ii) digital infrastructure that enables networking between the individual learners, provides educational resources and promotes accessibility. However, this dissertation is primarily focused on the digital infrastructure. The development and deployment was done mostly within the boundaries of the digital infrastructure. Since physical space is an area that requires a long-term investment and planning, it has been left for future implementation. [diagram]

LEARNING ENVIRONMENT



PHYSICAL LEARNING SPACE



DIGITAL INFRASTRUCTURE

## DIGITAL INFRASTRUCTURE DESIGN

*Educational technology is first and foremost a design field, and thus design knowledge is the primary type of knowledge sought in our field. \_ Thomas Reeves (Van den Akker, Jan; Gravemeijer, Koen; McKenney, Susan; Nieveen, Nienke, 2006)*

## Background

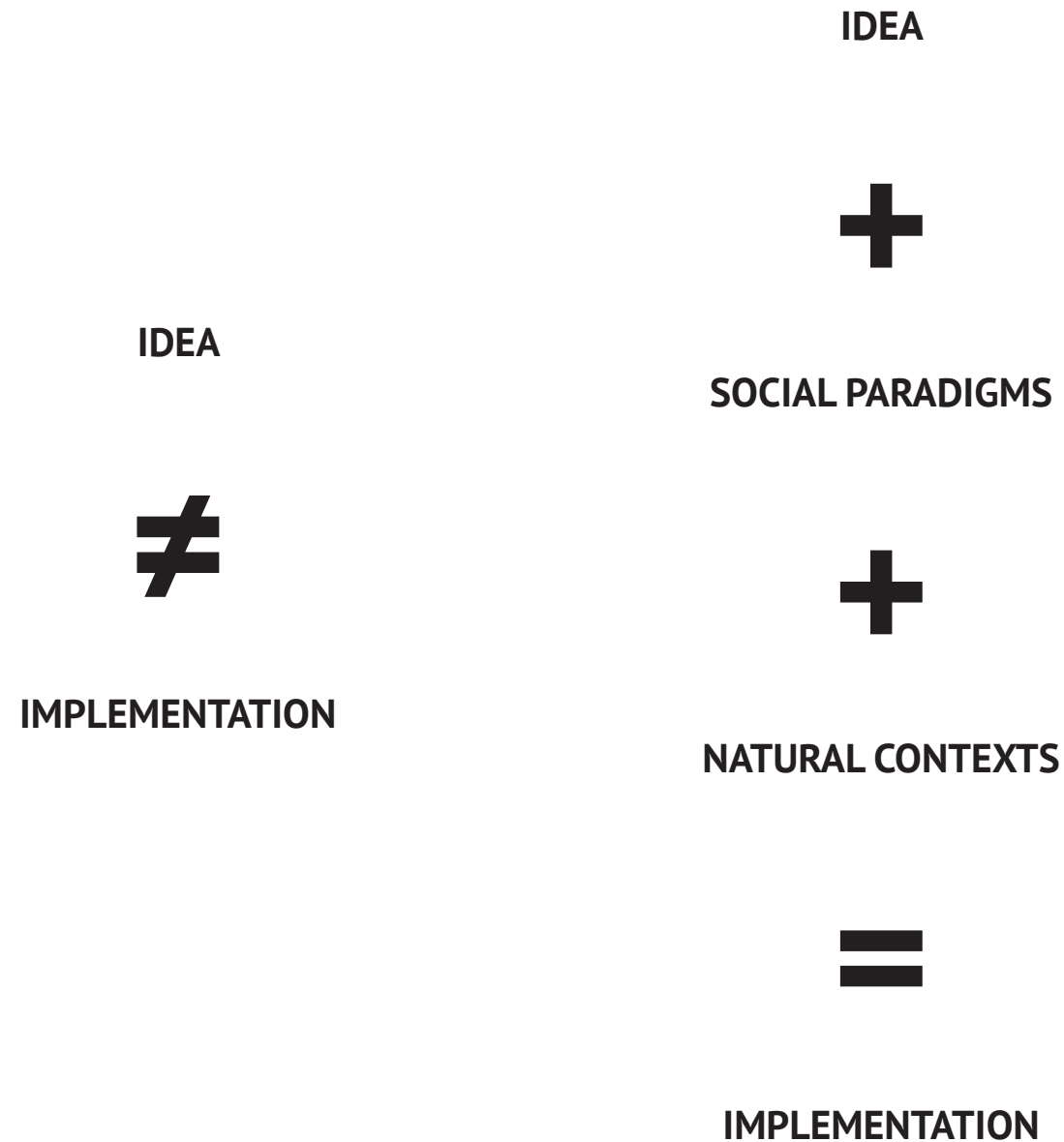
There are a large number of EdTech innovation projects that aim to deliver education to children in remote areas of the world. One of the most notable of such initiatives is the One Laptop Per Child project that was launched by MIT Medialab in 2005. The journey of OLPC from one end of the world to its various remote corners, has seen many ups and downs ever since. Up against the goal of distributing one laptop per every child in a developing nation; which constitutes about 100 million children, the project successfully delivered nearly 3 million laptops to children in countries like Africa, Latin America, Australia and the United States. Moreover, it attracted a large number of volunteers across the globe that resulted in the formation of a strong community of developers, scholars and researchers, to provide support and grounds for R&D. Unlike how the OLPC project eventually phased out, the community of volunteers remained and dispersed across the world to carry the vision and legacy forward. The community efforts that commenced during this period led to the emergence of projects like OLPC School Server (XSCE), UnleashKids, Sugarizer etc. OLPC School server was designed as an extension of the XO laptop in order to enrich the capabilities of the laptops in terms of its infrastructure. Even though the laptops were fairly self-sufficient with a range of learning activities, the school server acted as an additional hardware platform that provided network connectivity, better storage capacity for educational resources, computational power and asynchronous learning services. This project, however, took a new form called "Internet-in-a-box" (IIAB)

to specifically focus on delivering the best of world's free knowledge to remote communities where Internet is scarce. The IIAB initiative serves as the backbone of the digital infrastructure proposed on this thesis, in the context of Permaeduculture LE.

The digital infrastructure of Permaeduculture LE is essentially a wireless Mesh network that provides a virtual learning environment to host a large repository of open educational content for local learners and facilitators, fostering collaboration between them in the process. Besides working as an off-grid knowledge server, the Mesh also provides a network for the local communities to share information with each other through VoIP calling and video streaming.

This infrastructure is designed with a team of researchers, developers and volunteers under a Non-government Organization called Eka Foundation. Eka was founded towards the end of this research, with the core idea of developing cost-efficient wireless Mesh network technology and delivering it to remote communities where Internet has still not arrived. The long-term vision of the organization, however, is to move away from the centralized system of Internet and promote the idea of a decentralized network in the form of local Intranet.

From the view of Permaeduculture, the idea of the network doesn't necessarily mimic a natural ecosystem; instead the network aims to imbibe values that are inspired by nature like self-organization, decentralization, and resilience. Since values like these are quite complex in nature, there are only elements of the infrastructure that are decentralized or self-organized. Moreover, the infrastructure is drawn more on the social and community realm rather than natural processes. This is mainly due to the fact that it is not developed as a stand alone technological intervention isolated from the reality, but as a grassroots approach implemented over a system already existing with some intent baked into them. For instance, deployment of the Mesh has to take into account what is the prevalent



client-end device in the community. In this case, majority of the client-end devices are low-end android phones. So the idea does not directly correspond to implementation. Rather, the idea blends with existing social paradigms or natural contexts in order to be implemented.

The other insights taken from the community perspective is that there are certain qualities inherent in these remote communities, like resilience to survive under extreme conditions, collective decision-making, trust-driven society and values that are not limited to transactional interaction. This infrastructure is aimed to be a tool that supports the community values and structures like these, rather than imposing an alien concept. If one were to draw a parallel between this ecosystem and natural ecosystems, it would be that nature draws resilience from having a wide range of species; similarly in a network like this every individual, may it be learner or facilitator, plays an equally important role in its functioning. For instance, if the network was like a tree with many branches, it'd be difficult to eliminate the whole tree by eliminating a branch. The tree would keep on growing with the support of other branches, resilient of any external influences.

Another parallel drawn from nature and human history is the analogy of Spider versus a Starfish. According to historic references, the Incas and Aztecs were obliterated by the Spanish invaders, but the Apaches stood a chance against the mighty Spanish army. This was however not an accidental victory but the outcome of the way they were organized as a society. While Incas and Aztecs worked under a politically centralized society which made them vulnerable in war, the Apaches were organized in a P2P trend where it functioned like a starfish. Wherein, individuals can automatically become a part of the leadership like the arm of a starfish, the moment they joined the community. Lack of centralized administration and responsibilities distributed between every member within an organization, makes it more resilient as a system. This is what inspires how the Mesh network is designed and deployed.



A mesh network providing Internet access via multiple internet gateways



A mesh network providing connectivity through local Intranet

## Technology behind the Mesh

At the core of this technology is wireless communications. It is a communication technology that makes use of electromagnetic waves to send signals across long distances (Butler, 2013). When connected to an existing network, it can serve in various capacities, from a simple Ethernet extension that serves a few kilometers to a distribution hub that reaches out to many. In the context of this study, however, Wireless communication is primarily used in the capacity of a mesh network. A mesh network is a local network topology where the data routing happens through infrastructure nodes that connect directly, dynamically or non-hierarchically to one another.

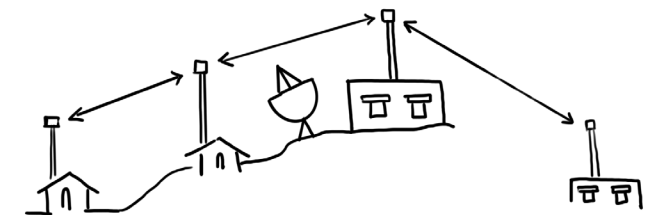
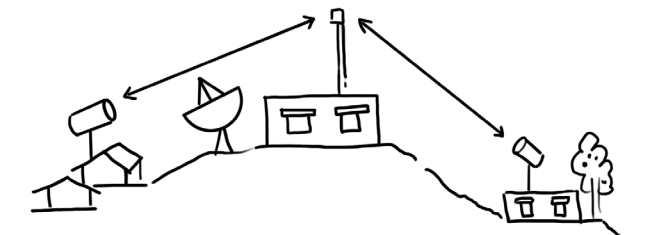
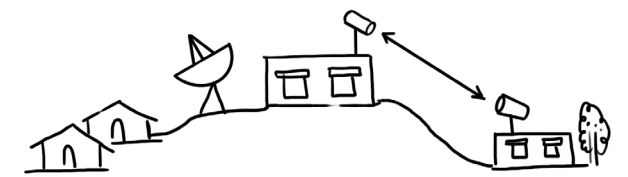
Illustration (right):

Point-to-Point networking (top) where data is transferred from one point to the other.

Point-to-Multipoint networking (middle) where several nodes communicate to single access point.

Multipoint-to-Multipoint (bottom) which is referred to as an ad-hoc or mesh network.

(Butler, 2013).



## HARDWARE

The main hardware components of the mesh network designed are :

1) Power supply: Since this is aimed for deployment in remote communities and geographical locations, it was a priority to design an off-grid battery powered system that was reliant on a renewable source of energy. The components utilized to power the system were:

- a. Solar Panel (10W for each node)
- b. Lithium-ion cells retrieved from e-waste laptop batteries
- c. Battery protection module,
- d. MPPT solar charging module,
- e. Boost module to stabilize the output supply into 5 Volt

2) Mesh nodes: The mesh nodes are the infrastructure nodes that route and relay data from one place to another. In the earlier prototype, GLi-ar150 router was used as a mesh node. However, in the latest prototype, the mesh nodes were made with GLiNet domino core module, that was configured with a customized version of the openSECN (Small Enterprise / Campus Network) mesh firmware, based on the popular open source openWRT project developed by Village Telco community.

The wireless module is mounted on Cantennas that are made from recycled Tin cans and refurbished satellite TV antennas.

3) Knowledge server: The most important component of the system was the server that provides access to content, connectivity services and network management capabilities. The device used as a knowledge server, is a "low-cost small sized commodity computer system" called an Intel NUC mini-PC with an IIAB software installed in it.

One of the most important aspects of this hardware deployment was that it was made of low-cost, recycled and handmade electronics. This DIY culture of developing a product raises its popularity amongst young learner in the community who in return wants to learn and manage it, further contributing to the system.



## SOFTWARE

The user interface envisioned for the mesh network in this case, is inspired by the Sugar OX operating system of the OLPC's. However, the firmware used in the mesh nodes only support the browser version of the Sugar operating system called "Sugarizer". Since Sugarizer is highly customizable it serves as a reliable framework for developing a new User Interface on the Mesh.

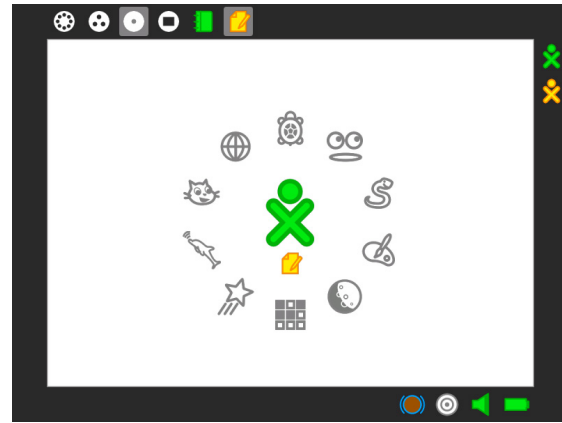
### The core qualities that are inherited from the Sugar OS, referenced from the Human Interface guidelines of OLPC ("OLPC Human Interface Guidelines/Design Fundamentals," 2010) are:

1. Tools of expression: The Mesh being the backbone of the learning environment envisions learners to use the interface as a platform of expressing their knowledge. The idea is to maintain a balance between consumption of knowledge and production of knowledge. Production of knowledge can be stimulated by learner's ability to think, reflect on the information they have learnt, make meaning out of it and share with other learners.

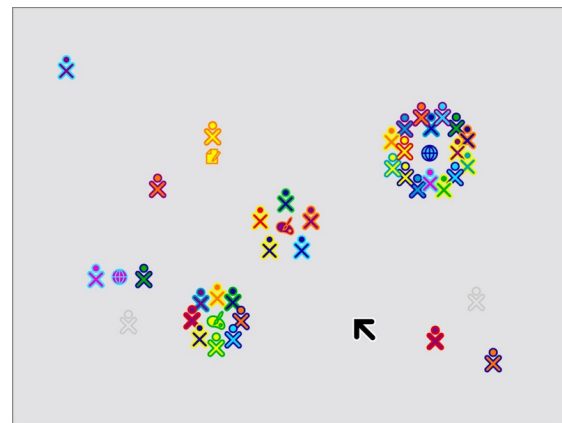
2. Presence within the network: The idea of collaboration demonstrated by the OLPC XO laptops resonates well with the goals of the Mesh network. Collaboration between peers help make learning processes more engaging and stimulating. The interface of the Mesh aims to foster the relationship between individuals (both learners and facilitators) and make their network and connectivity visible. The seamless integration of collaboration and sharing even without internet is a mark of Web 2.0 (Jeff Atwood, 2007).

### Additionally the qualities that are attributed based on the findings of this research, are:

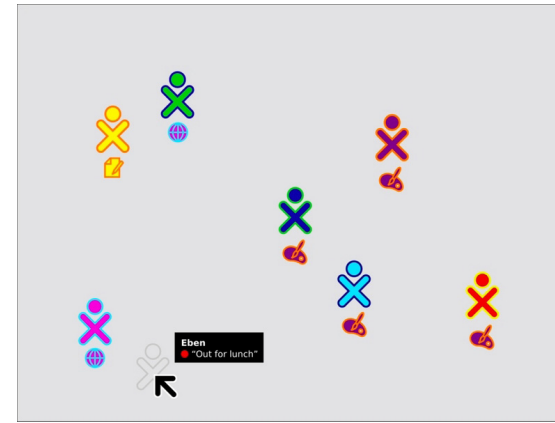
1. Equality of stakeholders: One key problem identified during this research is the gap amongst learners and the differences between the learners and the facilitator. In this environment, any individual can chose to be a learner



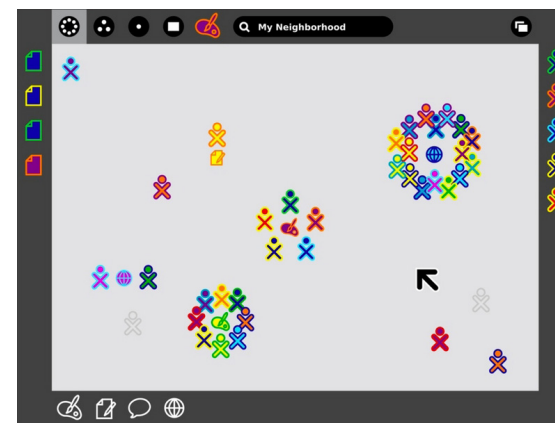
*Sugar OS focusses users around activities. There are various tools that users can use to express and learn by creating or constructing. The home view (above) has the user at the center with all the activities and tools arranged around it.*



*Another important feature of this User Interface is the Mesh view (above) where users connected to the mesh network can be viewed in clustered around their respective activities.*



*The Group view (above) allows users to stay connected with their contacts and maintain their peer network. The activities of the peers are visible to the user upon hovering over it.*



*The Frame view (above) helps users to access all the UI components in a single step interaction. The components running in the system are always available on the periphery.*

or a facilitator depending on their abilities and knowledge base. This helps bridge the gap between the stakeholders, changing the dynamics between them into a more productive one. Also, that makes each individual feel like an active contributor to the network, thereby increasing their confidence and productivity.

2. Local content and archives: Since the most important part of this project is the Open Educational Resources (OER) made available through the knowledge servers, it's necessary to promote contribution of data from local stakeholders. In India, there is already a huge repository of resources, ranging from all the schoolbooks and educational content ever published by government of India, under National Repository of Open Educational Resources (NROER). Instead of aiming at consuming global data, learners should be encouraged to create local content that brings a difference to their society.

3. Digital Literacy: Given that there is a rise in cyber crimes and fraud over the Internet, there has been an urgent call for digital literacy amongst youth in rural India. The mesh network cannot be a better ground to understand the workings of the Internet; to understand how package or data moves from one end to the other. Through the mesh learners can educate each other about their digital privacy rights before stepping into the heavily centralized World Wide Web.

4. Scope for tinkering: One of the most promising facet that makes this infrastructure so unique, is the DIY-ness of the product. This flexibility should be retained so that learners are open to develop the Mesh in future and extend it's hardware into various input devices and sensors that collect local data. For instance, if there is a need for a weather station, learners can build it themselves on the Mesh.

The various features envisioned under the broad infrastructure planning of the Mesh network are:

1. Content Search Engine: One of the main feature of the Mesh is the large repository of OER's like Wikipedia offline, Khan Academy Lite, Project Gutenberg, National Repository of Open Educational Resources (NROER), teachings of Arvind Gupta, TED video etc This feature clearly fills the void created by lack of internet access to remote communities.
2. Communication: The second most important feature of the Mesh is it's ability to connect people and enable people to share information with each other. In the first few prototypes, learners could communicate only through text messages but in the recent prototypes, services like telephony and video streaming has been incorporated.
3. Network and contacts: Through the mesh, it is expected to see more interaction between individuals, irrespective of genders, caste or any other social constructs. bein able to make contacts and preserve relations is a powerful aspect of the Mesh.
4. Feed: The biggest incentive for learners to use technology as a portal or a platform is the flux of fresh content. The number of updates would define the scope for learners, incentivizing them to create content themselves. News and feed play a key role at captivating the interest of the learners and keeping them engaged in the learning process.
5. Personal Archive: Personal archives like website, portfolio or learning diaries are very crucial at documenting progress in learning. Moreover, in this age of data driven world, documenting lives in the form of images and notes motivates learner.
6. Applications and Activities: Since this digital infrastructure is rooted in a Open Source development culture, it is very important to leave scope for external applications to run seamlessly in the Mesh. This can not only provide a wider range of services within the network but also provide support to software projects made by learners in the future.

From the User Experience point of view, the interface adapts the radical "Zoom Metaphor" of the Sugar OX. The User interface of OLPC breaks the

**SENSORY DATA UPDATES**  
*(weather data, agriculture data etc)*

**CONTENT**  
*Open Educational Resources (OER)*  
*- KhanAcademy*  
*Lite, Wikipedia offline,*  
*Project Gutenberg, TED talks,*  
*NROER etc*  
*Video tutorials and podcasts*

**APPLICATIONS & SERVICES**  
*Communication tools, Marketplace,*  
*websites, map, local business, backup,*  
*cloud drive etc*

**FEEDS & LIVE STREAMING**  
*Communication tools, Marketplace,*  
*websites, map, local business, backup,*  
*cloud drive etc*

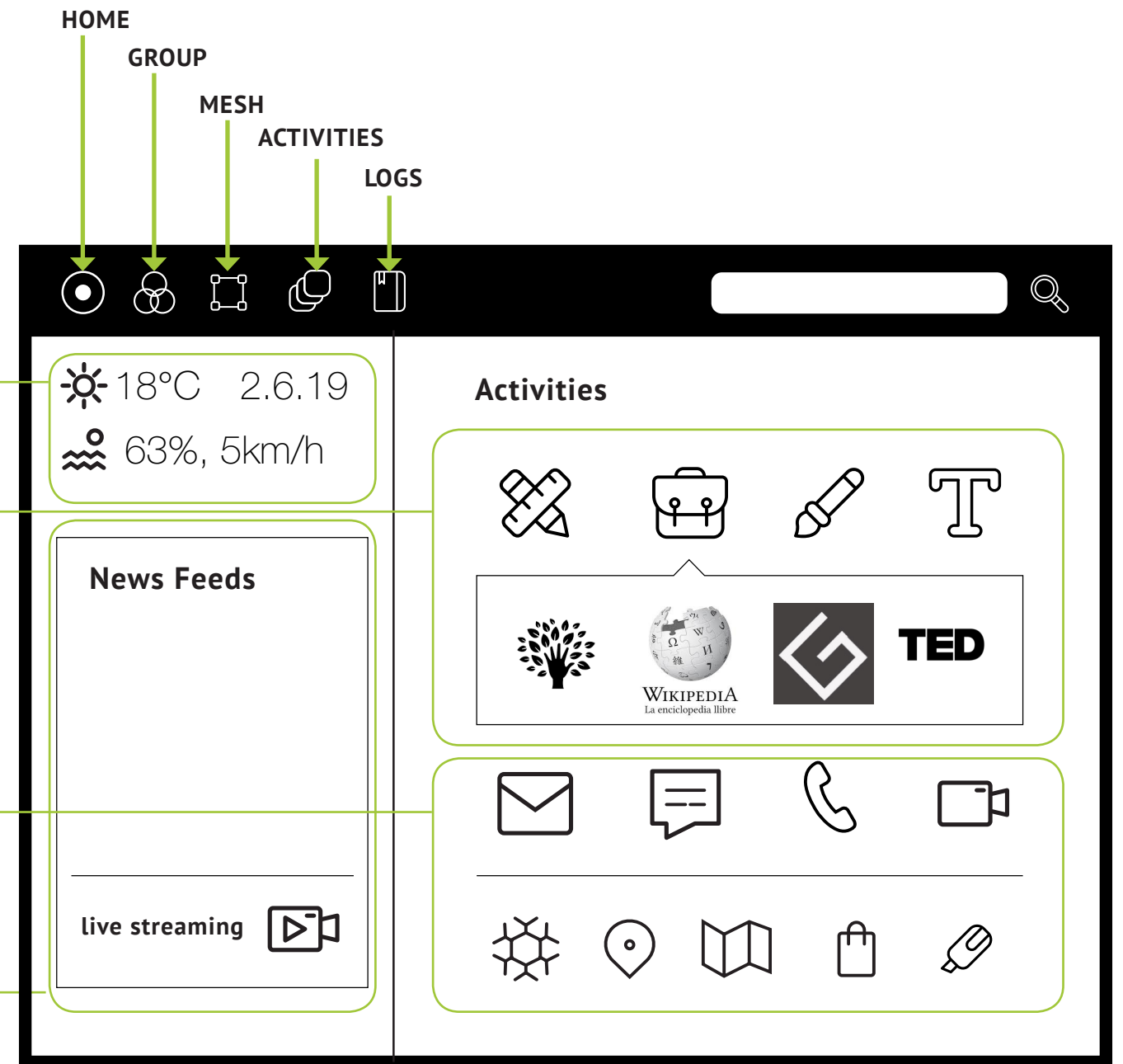
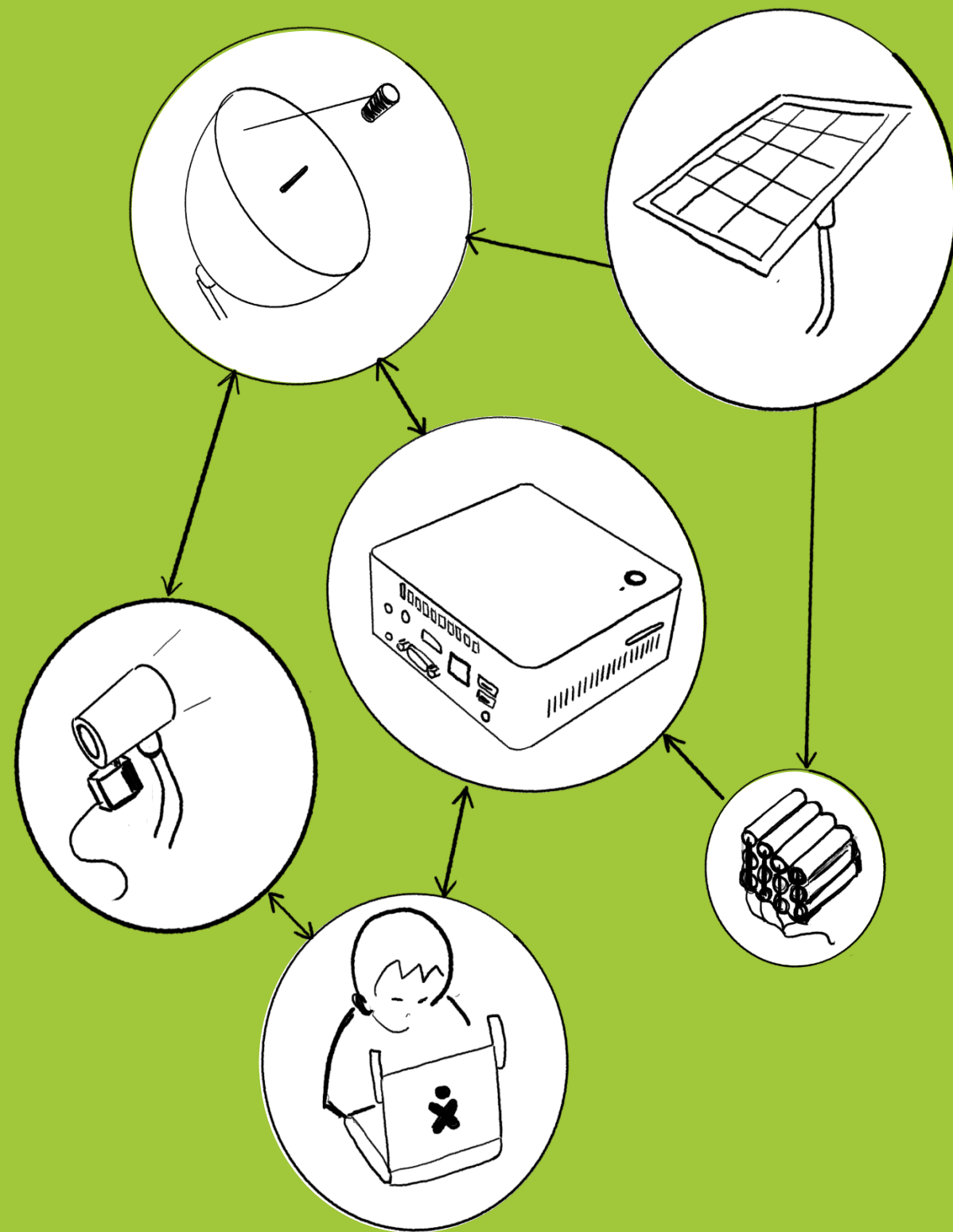


Figure: Mockup draft of the UI specs in a homepage/landing page of the Mesh Interface .



Connecting the components of the Mesh network

## TESTS, EXPERIMENTS & RESULTS

### Testing the Hardware Assembly

The hardware assembly of the first prototype was done through a workshop that was conducted to a) teach locals\* about fundamentals of wireless communication, b) train locals to fabricate the hardware infrastructure from scratch and c) to test and maintain the network. The fact that it is a grassroots intervention, also calls for local participants to take a lead at launching and maintaining the Mesh network.

The chronological steps involved in hardware deployment of the first prototype are described in the table ahead(next page):

In current prototypes, there are certain new features implemented like a community radio station and a cloud drive that runs locally. There were consecutive training plans made to educate the locals about it.

\* this includes the educated youth of the community, young educators, school going children or local technicians.

components	description	significance
<b>Basic Electronics and Electricals</b>	What is a circuit? Understanding basic laws of Electrical.	This is to educate facilitators interested in developing the Mesh from scratch.
	Understanding of Power consumption Vs Energy consumption.	To make the system efficient and sustainable.
	What are cells and batteries? Selecting right kind of batteries and solar panels.	To assure long life of batteries.
	Introduction to electronic modules used in the design like GLiNet Domino core, GLi-ar150 etc.	To be able to troubleshoot and replace components.
	How to use a Multimeter to test the electronic components?	To check the functionality of the hardware system
<b>Networking</b>	What is radio communication?	To understand the technology behind the Mesh.
	What are different types of frequency bands?	To adjust the signal in future.
	What are the different types of network?	To deploy better connectivity.
	What are basic concepts of frequency channels and wireless spectrum?	To find range of mesh hardware.
	What are different types of antennas? (omnidirectional, tincan, satellite tv antennas etc)	To find the best kind of antenna for the required range.

components	description	significance
<b>Software settings</b>	How to measure signal strength?	To solve signal related issues.
	How to plan a network deployment?	To deploy network successfully
	Installing software on the mesh node. Configuring the mesh nodes according to the number of nodes.	To setup a fully functional mesh node.
<b>Maintenance &amp; support</b>	What is a good signal?	To find the best signal strength
	How to use mechanical tools to fabricate hardware parts?	To train locals to repair their own network.
	What are the electrical tools and resources necessary to grow the network? (power supply, soldering station, hot air station etc)	To repair and build more nodes.
	How to connect the various components and launch the Mesh?	To launch and maintain the overall Mesh network.
	How to access the Mesh? (Checking content, text messaging, trying voice calling etc)	Training locals to use and access various services on the Mesh. E.g: Making calls, accessing content, sharing files etc.

## Testing the User Interface

The User Interface of Sugar OS of OLPC laptop served as the first prototype for this research. The OLPC's were connected to the knowledge server using a couple of mesh nodes and the setup was used to understand how children of that community approached and interacted with it. The experiment report is written in the style of an anecdotal note, transcribed as below:

### Treasure Hunt under the Tree House

*One summer, the kids of Rakkar built a beautiful tree house. On 15th April 2018, several kids from the three adjacent villages got together under this tree house for an occasion that they were yet to discover. They were stoked about this get-together and that we were going to install a solar-powered mesh network in and around their tree house; perhaps the only place in the village where they have the freedom to express what they want and confidence to collectively make it happen. On the occasion of inaugurating and testing the mesh, we decided to organize a treasure hunt game for them. As we announced it to them, they couldn't wait to hunt for treasures across their own village. One of them exclaimed, "Oh but our village is so big. How can we ever find it?" while another curiously enquired "what kind of treasure? Are there bulbs and wires in the treasure box? We need that for our tree-house."*

*Since they were all very accustomed with the OLPC laptops, there was no better client-end device to be used for this purpose. The moment they saw the brilliantly green laptops stacked up together, they knew something fun was up.*

*There were about 22 children and 4 OLPC laptops, so we grouped them into three teams. We handed one laptop to each team, leaving behind the fourth laptop as a standby.*

*Like all other treasure hunt games, the aim was to use a certain set of*



*given clues to find the main treasure box. But, the participants were not allowed to vocally communicate with any individual from the other teams and the clues were distributed amongst the three teams in such a way that without communication they wouldn't be able to solve the puzzle. The underlining idea was to get them to use the Mesh to communicate these clues to each other and collectively find the treasure.*

*Coming from a User Interaction standpoint, this was set out to be a participatory activity to study the following key research questions:*

- 1. How do kids access and use the mesh network? Is it qualitatively different from adults? What aspect of it are they most happy with?*
- 2. How do kids interact with the Sugar OS User interface in group activities and how do they communicate using the OLPC on mesh network?*
- 3. How do children perceive the mesh network and Internet?*
- 4. Do kids express a different persona when they're online?*

*As Nelson Mandela said, children are our greatest treasure. It was nothing short of a treasure hunt for us at trying to understand how children acquire knowledge through the new tools that they are rewarded with. And here we had a gathering of twenty-two children from three villages eagerly waiting to explore this village using a relatively new technology. As we began understanding each other, introducing one another turn by turn, the kids began to play with the laptops freely as though it was a very personal tool. Children from the neighboring villages were however still consumed at appreciating the treehouse. They were inspired to build one on their own, back in their own village. The kids who built the treehouse were discussing how a solar charger would be a revolutionary contribution and they could actually live in there if they had a few solar lamps. And the conversations went on. The kids who already used an OLPC before started teaching the other kids how to operate it, as we discussed about the devices, the Mesh, the chatroom, the wireless routers and so on. In the meantime, a few of them volunteered to climb a tree close by and fix a router. Once everyone happily made their new worlds in their teams and*

was comfortable with the new friendships they made, we started the game.

Each team was provided with one facilitator to explain the basic rules and help with technical problems. They were also responsible for keeping the decibels of the children within their teams low. The treasure was categorized into one major treasure box and five mini treasures; each of which had a clue. There were about 20 clues that all together tell a story that leads to the final hint. Each team was provided with 4 to 5 clues and rest of the clues were in the mini treasures. The clues were given to the kids one at a time, based on the sequence.

Since the clues were split between the three teams, the kids were faced with the challenge of seeking clues from the other groups without revealing too much about the clues they themselves had. They caught on quite quickly. However, it was natural for them to shout out or run over to the others to speak with each other. Isolating the teams out in a way that they were no longer audible to each other came handy in solving this problem.

Starting with the first clue, they started revealing almost everything about the clue to each other. From the second clue they started reserving and thinking and making guesses. One kid from Team 1 couldn't hold himself together with his team and started running around instinctively, so they appointed him to run around with possible guesses in order to find any mini treasures, somewhat like a proactive runner of the team. Team 2 spent a lot of time discussing what to reveal. They decided to reveal one word from each clue. Team 3 decided to be honest with sharing the clues with others and focused on the chat.

After sharing the first three clues with each other, the Team 2 identified the first mini treasure location but before they could find the treasure, the proactive runner from Team 1 found it. The other teams waited for them to reveal the next clue from the mini treasure. By then, they were very



cautious about how to reveal any information and indication to the others. Team 2 and 3 began to catch up by appointing a proactive runner in their own teams. This got them on their toes. Every time there was possible hint, they'd run to a possible treasure site and report back immediately.

This went on for a few minutes until the next mini treasure was found. This time it was again the Group 1 who found the treasure. The other groups started to get a bit frustrated. Group 2 started to discuss more and chat less. Group 3 decided not to share too much and responded mostly with short replies. The next few clues were activity based. They had to use the OER of the network to find the meaning of terms that was presented as a clue. They had to cross-verify with the other groups if the meaning was correct. Upon which they got the next clue; which led to the third mini treasure. At this stage they were slightly confused because they were supposed to find Didi Contractor's mud colony and they were completely unaware of her or her presence in the village. The facilitators came handy at giving them directions at this point. Group 2 however was proactive at asking around and communicating with the villagers. They ended up finding the third mini treasure.

In between, some activity clues got the kids to use in-built softwares on the OLPC's like calculator, astronomy activities, etc. However, they were constantly communicating with each other on the chat thread. This is how they finally arrived to the last set of clues. Group 3 ended up with the last clue of the set. It was a math problem and they had to derive a number from it; which was the key to the lock of the main treasure box. Before they could share the clue on the chat thread the other group had identified the treasure box location and all the kids rushed there to find it. While they realized they needed the number to open the lock, Group 4 had already solved the math problem and found the key to it. This is the way they collectively solved the quest for the hidden treasure.

There are many take-aways from this experiment. Firstly, the children were



very fluent with the overall UI. It is very intuitive for children of that age. However, they were neither aware nor interested to learn how it connected to Mesh. This highlights the need for a more seamless hardware assembly. The children were very interested and excited about the stand-alone mesh nodes (Cantennas) and many volunteered to set it up across the village. Very surprisingly, the learners paid equal attention to the games and the collaboration platforms. They were thrilled to see each other on the wireless neighborhood view of the laptop. Their curiosity didn't end there. Soon after they got their hands on the OLPC laptops they started running away from each other over the vast open field to test the range of the in-built wifi receivers in the laptop. This indicates that children are not intimidated by the technology of wireless communication. They were able to follow up on the idea of remote access and communication through wireless device.

From the observation, it can be established that learners like to be very personal with the devices rather than sharing their devices. They were often seen fighting over the laptops. However, once each learner were on their own client-end device, they were actively collaborating with each other through the wireless neighborhood view of the laptops. Regarding personal online image, there were not many instances seen in the children (until the age of 11) in emphasizing on having their own profile. Overall, children viewed this device more like a tool to communicate, access offline internet, draw and have fun while learning.

## Testing the knowledge server

There was another experiment made, with some adolescent girls preparing for the 10th standard examination. This experiment was however focused around the use of the knowledge server it's massive Open Educational Resources and educational content. The four girls of Rakkar Government Schools were tutored for their board examination through a month-long crash course facilitated by the content in the Mesh. They belonged to

the poorest of the families in the village and had to walk miles everyday to reach their schools. The girls never earlier had the chance to use a computer as most of the learning centers and computer classes were male dominated. They were liberated by the idea of using the computer to learn for their exams. However, they couldn't believe that they could do it without an access to the Internet.

The first instance that delighted them was to find their Mathematics textbooks in the NROER section of the knowledge server. More so, when they found the same textbook in many different languages. This was good to kick start their curiosity. The first topic that they picked was "Trigonometry". They went through the knowledge server, searching for resources on "Trigonometry". Using Wikipedia reference and a few educational videos they started with basic fundamentals. Occasionally, they also required facilitation, like explaining the concepts, testing them on their learning outcomes etc. Similarly, for other topics they were trained by solely using the content on the server. At the end of the course, the feedback received from them were highly insightful. Few of the most interesting suggestions included :

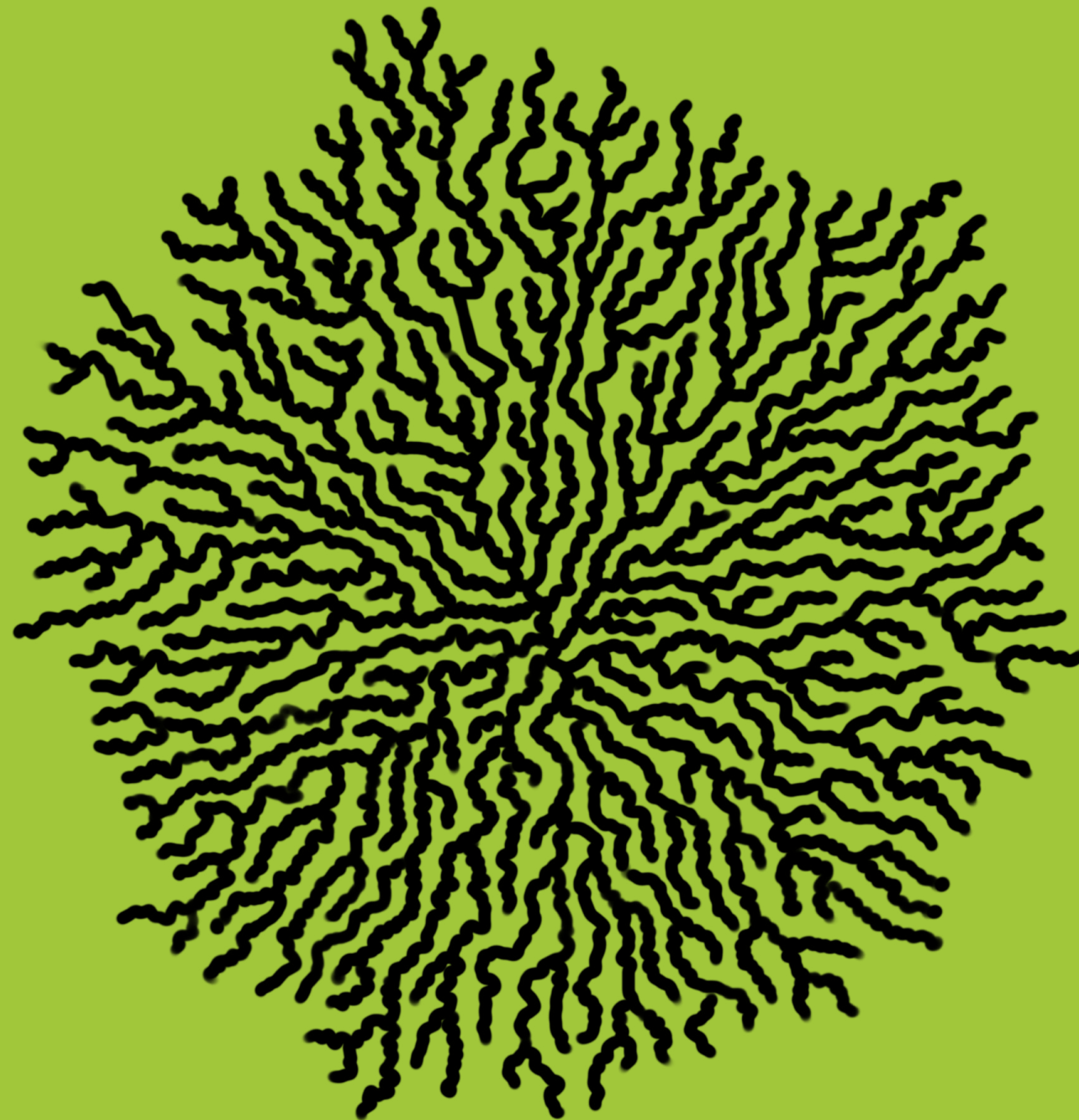
\_learners creating their own podcasts as a method to asses their learning outcomes,

\_need for more educational videos in local languages,

\_a test score sharing feature where students can be accredited from,

\_need for video streaming and video tutorials to enable synchronous learning.

The experiment results of the various tests done under this research are being used as inputs for the future iterations of the digital infrastructure. There have been a few more versions of the prototype since these tests were carried out. Moreover, some prototypes were extended towards a different community with different context altogether. For instance, the Mesh network deployed in remote Himlayan region of Zanskar valley in Ladakh. Yet again, the context was derived through in-depth ethnographic researches and case studies. With every iteration, the product attains new definition.



## CONCLUSION

*“With relative certainty they predict the era of teaching machines. However, schools are not factories and their success depends not on equipment or technology but on ideas” (Sukhomlinsky, 1973, p. 6).*

Consequently, schooling and education has attracted a lot of attention in the past years. Many have expressed criticism and many have designed reforms. However, there are still many limitations of the educational systems surfacing up in our generation as we discover new complexities of mankind, evolution and dynamics between individuals. For a complex species as ours, designing an educational system requires a broader systems thinking approach and such can be achieved by recognition and implementation of principles followed by the ecosystems in nature.

The challenges highlighted (in page 100, 101) in this thesis signifies that there is a larger need of grassroots innovation that can improve the quality of education in remote communities, in order to bridge the gap of differences between urban and rural education in India. Grassroots interventions provide better understanding of people’s hard necessities by delving deep into the community that the intervention is built for. As opposed to top-down programs that marginalize local communities, grassroots intervention helps local participants to identify a sense of ownership and responsibility towards the social welfare that needs to be done in their community, which, in the long run, helps in sustaining the intervention without external influences.

The contextual research done through intensive field study during this thesis has established the first few fundamental challenges that could be addressed with the proposed digital infrastructure. However, that is just the tip of the iceberg. There are many grey areas that are too complex to be just dealt with a technological intervention. The people who until a decade

ago survived mostly through pastoral lifestyle and subsistence farming are now seen working as cheap labors under the upper crust of the society, in order to meet the needs of the modern consumerist economy. Moreover, introduction of government schemes like “Smart Cities Program” are often leading to mindless development and rapid economic shifts, transforming these rural areas into urban slums. In the midst of this, there is a dire need for a holistic learning environment comprising both physical and digital infrastructure that sustains the ecosystem of knowledge without posing a threat to the culture and values of the community of learners.

The concept of “Permaeduculture” can be refined and developed to set the fundamentals for a physical learning environment that can compliment the digital infrastructure. It could either be done through building a stand-alone alternative Learning Environment, in which the boundaries between teachers and students can be fluid and individuals can play both the role of a learner and a facilitator. Or, the concept can be built into existing learning spaces like “Anganwadi” that already promotes holistic learning but lacks in infrastructure planning and innovation. That is a larger quest for this project in the future.

Overall, this dissertation is more of a reminder that ecosystem of knowledge is a highly complex system and to design an environment that fosters it, one must rely on in-depth research, methodical iterations and sustainable deployments. The digital infrastructure designed during this study, is still in the process of iterating and reiterating. As per the trajectory of developments, the scope for future lies in blending the digital infrastructure with a suitable physical space and extending the arms of the Mesh network into other areas like real-time sensory data (climate related), community radio, career guidance for learners, mental health support and political discourse.

## ABBREVIATIONS

ASER- Annual Status Of Education Report  
BEd- Bachelor of Education  
CCE - Continuous Comprehensive Evaluation  
CCTV - Closed-Circuit Television  
CLC- Community Learning Center  
CBSE - The Central Board of Secondary Education  
DPEP - District Primary Education Programme  
HPBOSE – Himachal Pradesh Board of School Education  
IB- International Bachelorette  
ICDS- The Integrated Child Development Service  
ICT – Information And Communication Technologies  
JBT – Junior Basic Training  
MHRD- The Ministry of Human Resource Development  
NCERT- National Council of Educational Research and Training  
NDP- No Detention Policy  
NFE- Non-Formal Education  
NPE- National Policy on Education (1986)  
NROER - The National Repository of Open Educational Resources  
OER- Open Educational Resources  
P2P- Peer to Peer  
PTM- Parents Teacher Meeting  
RTE- Right To Education  
SMC – School Management Committee  
SSA- Sarva Shiksha Abhiyan  
TET- Teacher Eligibility Test  
TGT- Trained Graduate Teacher  
UDISE- Unified District Information System for Education  
ZPD- Zone of Proximal Development

# BIBLIOGRAPHY

- Adams, A., Liyanagunawardena, T., Rassool, N., & Williams, S. (2013). Use of open educational resources in higher education. *British Journal of Educational Technology*, 44(5), E149–E150.
- Atkins, D. E., Brown, J. S., & Hammond, A. L. (2007). *A review of the open educational resources (OER) movement: Achievements, challenges, and new opportunities*. Creative common Mountain View.
- Björgvinsson, E., Ehn, P., & Hillgren, P.-A. (2012). Design things and design thinking: Contemporary participatory design challenges. *Design Issues*, 28(3), 101–116.
- Björgvinsson, E., Ehn, P., & Hillgren, P.-A. (2010). Participatory design and democratizing innovation. *Proceedings of the 11th Biennial Participatory Design Conference*, 41–50. ACM.
- Blackley, S., Sheffield, R., Maynard, N., Koul, R., & Walker, R. (2017). Makerspace and reflective practice: Advancing pre-service teachers in STEM education. *Australian Journal of Teacher Education (Online)*, 42(3), 22.
- Bramly, Serge; (1994). *Leonardo: the Artist and the Man*.
- Briscoe, G., Sadedin, S., & De Wilde, P. (2011). Digital ecosystems: Ecosystem-oriented architectures. *Natural Computing*, 10(3), 1143.
- Crain, W. (2014). *Theories of development: concepts and applications*. Pearson.
- Csikszentmihalyi, M. (2002). *Flow: The classic work on how to achieve happiness*. Random House.
- Daniels, H., Cole, M., & Wertsch, J. V. (Eds.). (2007). *The Cambridge companion to Vygotsky*. Cambridge ; New York: Cambridge University Press.
- Deployment Guide/School Server. (2011, January 4). Retrieved from [http://wiki.laptop.org/go/Deployment\\_Guide/School\\_Server](http://wiki.laptop.org/go/Deployment_Guide/School_Server)
- Dimitrov, V. (2002). Learning Ecology for Human and Machine Intelligence: A Soft Computing Approach. In V. Dimitrov & V. Korotkich (Eds.), *Fuzzy Logic* (Vol. 81, pp. 386–393). [https://doi.org/10.1007/978-3-7908-1806-2\\_28](https://doi.org/10.1007/978-3-7908-1806-2_28)
- Ehn, P. (1989). *Work-oriented design of computer artifacts* (2. ed). Stockholm: Arbetslivcentrum.
- Ehn, P. (2008). Participation in design things. *Proceedings of the Tenth Anniversary Conference on Participatory Design 2008*, 92–101. Indiana University.
- Guettl, C., & Chang, V. (2008). Ecosystem-based Theoretical Models for Learning in Environments of the 21st Century. *International Journal of Emerging Technologies in Learning (IJET)*, 3(1). <https://doi.org/10.3991/ijet.v3i1.742>
- Halverson, E. R., & Sheridan, K. (2014). The maker movement in education. *Harvard Educational Review*, 84(4), 495–504.
- Hatch, M. (2013). *Mark Hatch - The Maker Movement Manifesto\_ Rules for Innovation in the New World of Crafters, Hackers, and Tinkerers-McGraw-Hill (2013).epub*.
- Hemenway, T. (2009). *Gaia's Garden: A Guide to Home-Scale Permaculture* (2 Rev ed. edition). White River Junction, Vt: Chelsea Green Publishing Co.
- Hiltz, S. R., & Wellman, B. (1997). Asynchronous learning networks as a virtual classroom. *Communications of the ACM*, 40(9), 44–49.

- Holmgren, D. (2010). *Permaculture: principles & pathways beyond sustainability* (1st UK ed). East Meon: Permanent Publications.
- Hylén, J. (2006). Open educational resources: Opportunities and challenges. *Proceedings of Open Education*, 49–63.
- Jacobs, G., Hurley, M., & Unite, C. (2008). How learning theory creates a foundation for SI leader training. *Journal of Peer Learning*, 1(1), 6–12.
- Jeff Atwood. (2007, January 4). The Sugar UI. Retrieved from CODING HORROR programming and human factors website: <https://blog.codinghorror.com/the-sugar-ui/>
- Karvonen, E. (2001). *Informational societies: understanding the third industrial revolution*. Retrieved from <https://tampub.uta.fi/handle/10024/65316>
- Kozulin, A., Ageyev, V. S., Gindis, B., & Miller, S. M. (2003). *Vygotsky's educational theory in cultural context*. Cambridge University Press.
- Krippendorff, K. (2006). *The semantic turn: a new foundation for design*. Boca Raton: CRC/Taylor & Francis.
- Latour, B. (2005). From realpolitik to dingpolitik. *Making Things Public: Atmospheres of Democracy*, 1444.
- Leinonen, T., & Aalto-yliopisto. (2010). *Designing learning tools: methodological insights*.
- Martinez, S. L., & Stager, G. (2013). *Invent to learn: making, tinkering, and engineering in the classroom*.
- Mollison, B., Slay, R. M., Girard, J.-L., Gasnier, M., Bourguignon, C., & Bourguignon, L. (1991). *Introduction to permaculture*. Retrieved from [http://rucore.org.za/wp-content/uploads/2011/11/Mollison-PDC-manual\\_ALL.pdf](http://rucore.org.za/wp-content/uploads/2011/11/Mollison-PDC-manual_ALL.pdf)
- One Laptop per Child (OLPC)\_ Mission.html*. (1999).
- OpenContent License (OPL). (1998, July 14). Retrieved from <http://web.archive.org/web/20140709203845/http://www.opencontent.org/opl.shtml>
- Pandya, D. R. N. (2014). Indian education system—a historical journey. *Education*, 3(3).
- Piaget, J. (1973). *Jean Piaget - To Understand is to Invent\_ The Future of Education-Grossman Publishers (1973).pdf*.
- Pöldoja, H. (2016). *The Structure and Components for the Open Education Ecosystem-Constructive Design Research of Online Learning Tools*.
- Pournaras, E., & Miah, S. J. (2012). From metaphor towards paradigm—A computing roadmap of digital ecosystems. *2012 6th IEEE International Conference on Digital Ecosystems and Technologies (DEST)*, 1–6. IEEE.
- Pretika Khanna. (2014, December 1). 93% students in India access Internet everyday. Retrieved from <https://www.livemint.com/Politics/PSq0aCdEQtkbFa3LwghGSM/93-students-in-India-access-Internet-everyday.html>
- Reyna, J. (2011). Digital teaching and learning ecosystem (DTLE): a theoretical approach for online learning environments. *Changing Demands, Changing Directions. Proceedings Ascilite Hobart*, 1083–1088.
- Rosch, E., & Lloyd, B. B. (1978). *Cognition and categorization*.
- Siemens, G. (2008). Learning and knowing in networks: Changing roles for educators and designers. *ITFORUM for Discussion*, 27, 1–26.
- Skynet Foundation. (2016, September 7). Things I Learned Building the Skynet. Retrieved from <https://>

medium.com/eka-foundation/things-i-learned-building-skynet-3033a4ce8992

Tran, B. (2010, December 15). *Testing\_the\_OLPC\_School\_Server\_Benjamin\_Tran\_SFSU.pdf*. Retrieved from [http://wiki.laptop.org/images/4/46/Testing\\_the\\_OLPC\\_School\\_Server\\_Benjamin\\_Tran\\_SFSU.pdf](http://wiki.laptop.org/images/4/46/Testing_the_OLPC_School_Server_Benjamin_Tran_SFSU.pdf)

Virtič, M. P. (2012). The role of internet in education. *University of Maribor: Maribor*.

Vittachi, S., Raghavan, N., & Raj, K. (Eds.). (2007). *Alternative schooling in India*. New Delhi ; Thousand Oaks, Calif: Sage Publications.

Volery, T., & Lord, D. (2000). Critical success factors in online education. *International Journal of Educational Management*, 14(5), 216–223.

Agarwal, P. (2006). *Higher education in India: The need for change*. Working paper.

Aggarwal, Y. (2000). Public and Private Partnership in Primary Education in India. *National Institute of Education Planning and Administration*.

Allerton, C. (Ed.). (2016). *Children: ethnographic encounters*. London Oxford New York, NY New Delhi Sydney: Bloomsbury Academic.

Chahal, N., & Dar, H. (2015). Higher Education Sector in India: Challenges of Sustainability. *International Journal of Management Research and Reviews*, 5(3), 159.

*Education and development in India*. (2018). New York, NY: Springer Berlin Heidelberg.

Govinda, R., Bandyopadhyay, M., Consortium for Research on Educational Access, T. and E., & National University of Educational Planning and Administration (India). (2008). *Access to elementary education in India: country analytical review*. Brighton: CREATE.

Kapur, Radhika; (n.d.). *ProblemsintheIndianEducationSystem.docx*.

Kingdon, G. G. (2007). The progress of school education in India. *Oxford Review of Economic Policy*, 23(2), 168–195.

Lall, M.-C., & House, C. (2005). *The challenges for India's education system*. Royal Institute of International Affairs London.

NIPCCD. (2006). *English Anganwadi Handbook-NIPCCD-2006.pdf*.

Nurrullah, Syed; Naik, JP; (1951). *A History of Education in India: During the British Period*. Macmillan.

Pinar, W. F. (Ed.). (2015). *Curriculum studies in India: intellectual histories, present circumstances* (First edition). New York, NY: Palgrave Macmillan.

Sandhyarani, M. C., & Rao, C. U. (2013). Role and responsibilities of anganwadi workers, with special reference to Mysore district. *Int J Sci Environ Tech*, 2(6), 1277–96.

Tankri, once the language of royals, is now dying in Himachal Pradesh. (2006, January 27). *Hindustan Times (New Delhi, India)*.

Tilak, Jandhyala BG; (2007). *Post-elementary education, poverty and development in India*. Elsevier.

Tooley, J. (2005). Private schools for the poor. *Education Next*, 5(4), 22–32.

Tooley, J. (2007). Educating Amaretech: private schools for the poor and the new frontier for investors. *Economic Affairs*, 27(2), 37–43.

Woodhead, M., Frostb, M., & Jamesb, Z. (2013). *Does growth in private schooling contribute to Education for All? Evidence from a longitudinal, two cohort study in Andhra Pradesh, India*. 65–73.

Anish Mangal. (2019, February 20). From the ashes of One Laptop Per Child.... Retrieved from <https://medium.com/eka-foundation/from-the-ashes-of-olpc-6aa3e3edfbae>

Arnold, R. D., & Wade, J. P. (2015). A definition of systems thinking: A systems approach. *Procedia Computer Science*, 44, 669–678.

Azim Premji Foundation. (2015, November 23). Assessments in school education: The current debate. Retrieved from <https://www.ideasforindia.in/topics/human-development/assessments-in-school-education-the-current-debate.html>

Entwistle, N. J. (1991). Approaches to learning and perceptions of the learning environment. *Higher Education*, 22(3), 201–204.

F Marton, R Säljö. (1976). On qualitative differences in learning: I - Outcome and process. *British Journal of Educational Psychology*. <https://doi.org/https://doi.org/10.1111/j.2044-8279.1976.tb02980.x>

Jeff Atwood. (2007, January 4). The Sugar UI. Retrieved from CODING HORROR programming and human factors website: <https://blog.codinghorror.com/the-sugar-ui/>

Jonassen, D. H., & Land, S. M. (Eds.). (2000). *Theoretical foundations of learning environments*. Mahwah, NJ: L. Erlbaum Associates.

Kozulin, A., Ageyev, V. S., Gindis, B., & Miller, S. M. (2003). *Vygotsky's educational theory in cultural context*. Cambridge University Press.

Matijević, M. (2012). The new learning environment and learner needs this century. *Procedia-Social and Behavioral Sciences*, 46, 3290–3295.

Miller-Williams, S. L., & Kritsonis, W. A. (2009). A Systems Approach to Comprehensive School Reform: Using the Realms of Meaning and the Baldrige Approach as a Systems Framework. *Online Submission*, 23.

Richmond, B. (1994). System dynamics/systems thinking: Let's just get on with it. *System Dynamics Review*, 10(2–3), 135–157.

Senge, Peter M; (2006). *The fifth discipline: The art and practice of the learning organization*. Broadway Business.

Shaked, H., & Schechter, C. (2017). Systems thinking among school middle leaders. *Educational Management Administration & Leadership*, 45(4), 699–718.

Skynet Foundation. (2016, September 7). Things I Learned Building the Skynet. Retrieved from <https://medium.com/eka-foundation/things-i-learned-building-skynet-3033a4ce8992>

Sukhomlinsky, V. (1973). *V.Sukhomlinsky on Education*. Progress Publisher Moscow.

Sweeney, L. B., & Serman, J. D. (2000). Bathtub dynamics: initial results of a systems thinking inventory. *System Dynamics Review: The Journal of the System Dynamics Society*, 16(4), 249–286.

Van den Akker, Jan; Gravemeijer, Koeno; McKenney, Susan; Nieveen, Nienke; (2006). *Educational design research*. Routledge.

Vasile, C. (n.d.). *Dewey and Vygotsky on social cognition and consciousness*.

Von Bertalanffy, L. (1972). The history and status of general systems theory. *Academy of Management Journal*, 15(4), 407–426.

Walker, D. (n.d.). *TOWARD PRODUCTIVE DESIGN STUDIES*.

