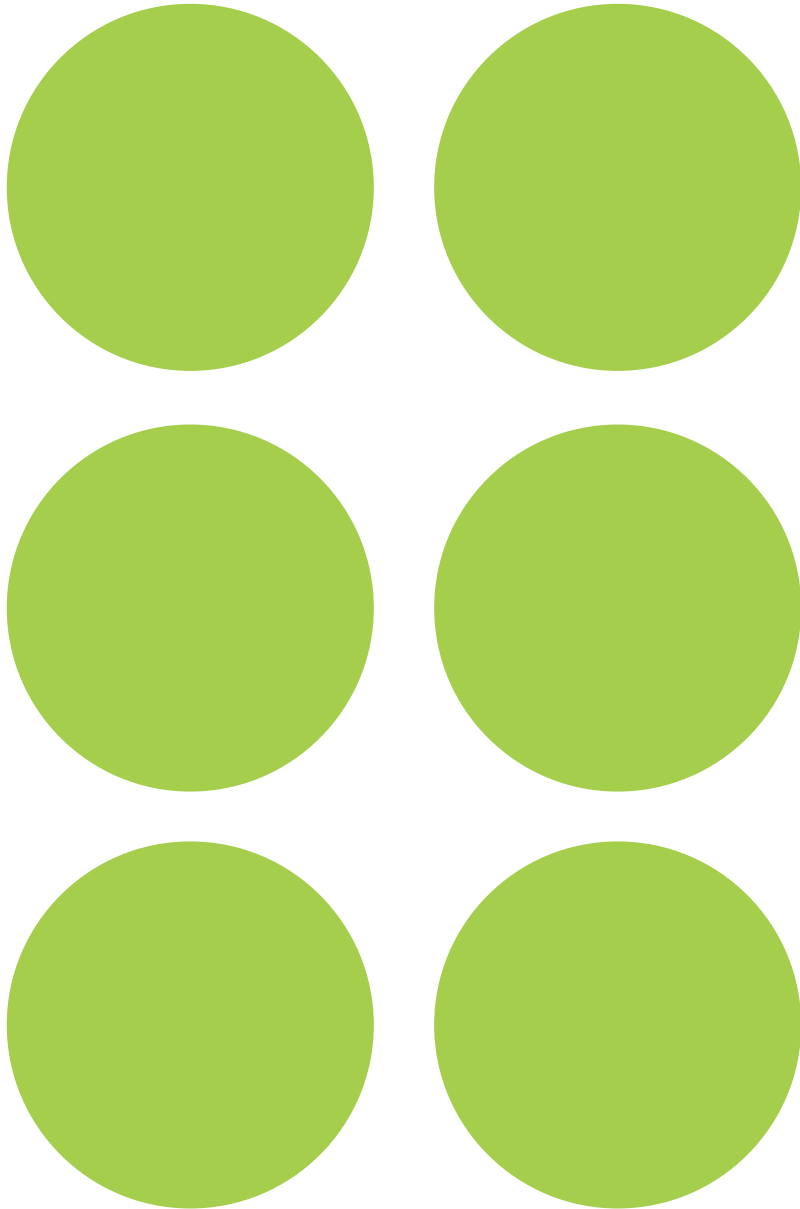

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This Project was a compilation of research, "Understanding and Tracing the Problem faced by the Visually Impaired while doing Mathematics" a Diploma project at the Srishti School of Art, Design and Technology, Bangalore, by Aarti Vashisht.

Do not be troubled by your difficulties with
Mathematics, I can assure you mine are much greater.

- Albert Einstein



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Project Proposal

The project, deals with gaps that exist for a visually impaired person while studying mathematics and using the tools and the techniques involved.

Brief

To recognize and document the problems faced by the visually impaired while they read, write and understand mathematics.

Introduction

At Srishti I have always contemplated over design elements that help in visual communication. It has also made me to look at communication that happens through various senses. Thus, I have learnt the importance of layers in communication. Information may travel through various layers of senses. One may use single or multiple sensorial devices to experience ideas, thoughts or concepts. As a designer especially in the field of visual communication design, I have always designed with an assumption that my audience experiences with all their senses.

- What intrigues me is to how the communication process changes when ones visual sense is not functional?
- In the case, what are the different modes of communication?

Visual Impairment in the Indian Context

Census of India 2001 identified five types of disabilities. The number of disabled in each type of disability is depicted in the table below, which shows a total number of disabled in India at 21,906,769 which constitutes more than 2 percent of the total population.

Disabled in India by types of Disabilities

Types of Disabilities	Number of Disabled	Percentage
Seeing	10634881	48.55
Speech	1640868	7.49
Hearing	1261722	5.76
Movement	6105477	27.87
Mental	2263821	10.33
Total	1906769	100.00

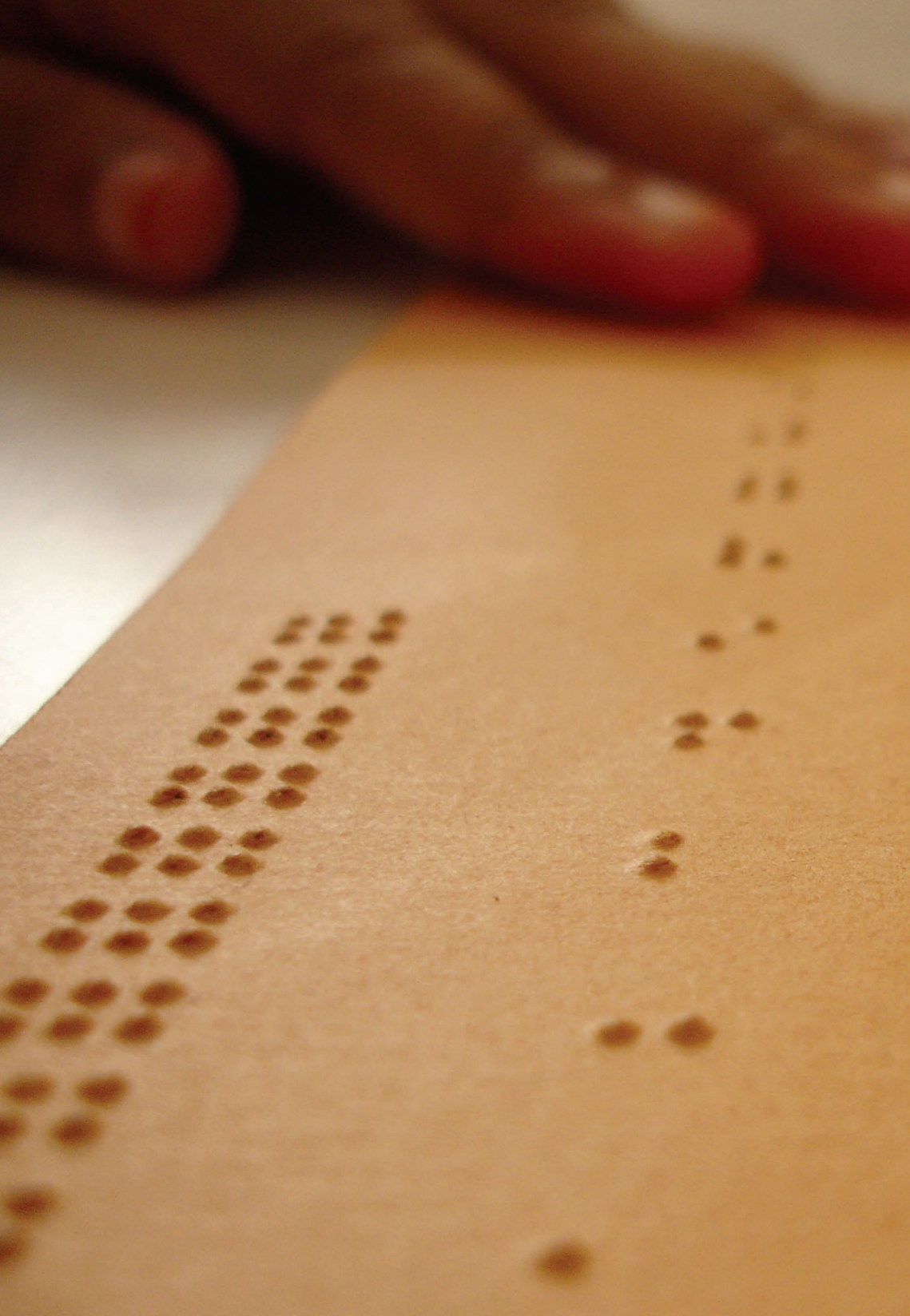
Source: Census of India 2001

The classification of disabled in India shows that nearly half the total of the disabled have visual disabilities (48.55 percent).

According to the statistics from the Blind Foundation in India, there are more than 13 million visually impaired people in India, which constitutes about one-third of the world's visually disabled population. Out of this, 2 million are children. Only 5 percent of these visually impaired children receive any kind of education. Besides, a large amount of the population of the visually impaired hails from economically backward classes.

From my own understanding I realized if we just take the numbers from the census of India's report, the visually impaired population is approximately 0.6 million less than the total population of India's capital city, New Delhi. The entire population of the disabled in India is almost equivalent to the population of the two largest cities in India i.e. Delhi and Mumbai put together. The mind-boggling part is that the population of the visually impaired can form an entire city like Delhi.





About the Script

Braille is a tactile language that was especially designed for the visually impaired people. It generally consists of cells of 6 raised dots arranged in a grid of two dots horizontally by three dots vertically. The coding for the symbol is recognized by the presence and absence of dots. Many languages across the world are coded in Braille for the convenience of it's users to read and write in these languages.



However there is a common concern in studying subjects like mathematics and sciences. It is perceived that there are many limitations in understanding and executing these subjects due to their practical nature. Therefore more than 90% of the literate population of the visually impaired hesitates in pursuing further studies in these subjects. The question that arises is

- What are these limitations that generates reluctance among the visually impaired students to study these subjects?
- Why is it that more than 90% of the visually impaired opt out of them at the first given opportunity?

Why do I choose to do research in problems in mathematics?

In today's competitive hi-tech information laden society, where disciplines like science, mathematics, engineering and technology are lucrative and in plenty, it is but natural that a people without a degree or a basic understanding of these subjects would find themselves at a disadvantage.

Even though education is being provided to the visually impaired, the lack of access to mathematics and science due to various reasons, limits their career options. This shortcoming in the system has led to a visible growth of unemployment and underemployment in this community.

Thereby as a designer I see a need to explore the problem areas that exist while learning subjects like mathematics and science. I feel my education in design could help me in finding ways to generate solutions to these problems.

Research questions

- I. What are the different kinds of learning systems for the visually impaired?
- II. To try and understand the way mathematics is written and read in Braille.
- III. What are the problems that are faced while doing mathematics?
- IV. What are the areas of need that require attention?
- V. What other work is done on the subject?
- VI. What are the ways by which we can arrive at possible solutions for the problems identified?
- VII. What will be my role as a communication designer in this scenario?

Methods and Approaches

The project involves users understanding whereby, they will play curcial role in the design process. There will be a need to learn the nuances of Braille and involvement in the activities of the visually impaired to understand their context.

The project has a three months time frame and thus has been divided into four phases.

1st Phase (Collecting and Understanding the Subject and the User's Characteristics and Needs)

- Learning to read and write basic Braille script, the way mathematics is written in Braille.
- Interview the experts who are involved with visually impairment, academicians who teach mathematics in Braille and student who study mathematics in Braille.

- Understanding the structure of mathematics as a discipline.

- Visit to the local education institutes and other institutes for the visually impaired, also, If time permits visit to the National Institute for Visually Handicapped in Dehradun.

- Constant interaction with my guide and review panel, various experts on visual impairment, interaction with visually impaired individuals, institution dealing with persons with visual impairment and mathematics professors.

2nd Phase (Exploring and Defining the Design Opportunities)

- Compilation and analysis of the research conducted.

- To design and prepare for the workshop that will be conducted in the next phase.

- During this phase I will need constant feedback from the guides and the review panel. It will also involve seeking help and suggestions of the experts who conduct such studies.

Before stepping into the third phase there will be a buffer period. This period is to work at the feedback received by the review panel.

3rd Phase (Analysing and Conducting the workshop)

- Conducting a workshop.

- Analyzing the tools with which Braille is written.

4th Phase (Design Development and Detailing)

- Collating the understanding and analysis from the research and workshop.

- Designing and producing a deliverable product.

- Concluding the project

If the time permits the final product with be taken back to the participant of the research for enhancement.

Expected Learning outcomes

- Towards the end of this project I hope to grasp, how to communicate with communities with disabilities.
- During this project I will be taking a journey through research data, users, experts and guides. This will be the first time I will be going beyond hypothetical to a real world problem. Thus, I hope to gain an ability and understanding of how to manage a real time project within a time constraint. I hope to learn how to extract useful and relevant data.
- As this is my first time taking on a research based project, I see it as a personal challenge of compiling and communicating the research material effectively.
- This will also be the ground where I will travel through a rigorous design process. This should make me conscious of its use in my future design practices.
- In this project I will be closely involved with the users. I am hoping to learn a lot from these close interactions.

Introduction

In the beginning of this project, I questioned myself, why am I choosing this project as my final diploma project. I realized that I had to step away and fundamental a question has my training given me the bandwidth to conduct a design research-based study?

Upon reflection of the four years in design education and training, I realized that my most important lessons were elements of design thinking and process; which has often made contemplate about the role of Design and my role as a Designer.

In this ongoing debate, I conclude that; design is perhaps the link between human beings and their needs and the designer is the facilitator trying to fill this gap. The process of a designer begins by questioning the existing scenarios and hence locating the gaps.

As a visually communication designer in training I have always been coaxed to dwell on the design elements that aid communication visually and otherwise. However, all my efforts hovered around the layering the visual communication and question the elements of the same and as a designer especially in the field of visual communication design, I had always designed with an assumption that my audience experiences with all their senses. Well now was giving me the opportunity to explore and expand my ideas and scope of design. I knew that my learning was going to be invaluable I was going to explore another dimension of communication giving me the confidence to take the challenge and learn on project how to conduct design research.

For me, innovation begins with a query.

The project query occurred while I was looking at the various scripts and I stumbled upon Braille. My curiosity as a visual communication designer aroused and I began to wonder what how is the script is structured to aids communication through tactile medium.

From here on came the questions to which I sought answers.

What is the structure of communication where visual medium is absent?

What can be the equivalentents of order and nuances of the script?

My immediate action was to open the Yellow pages and look for addresses of the blind schools. A simple query over the telephone gave me a list of blind schools and institutions and I choose to visit National Association for Blind (NAB). I fixed an appointment with the director of the Institution. At NAB I was introduced to a girl called Kameshwari, who later became a reference point for the understanding the details of the world of visually imparied. Kameshwari was enthusiastic, encouraging and answered most of my queries. Together we and few other visually impaired student at NAB analyzed the script, the tools and the problems. They also started teaching me how read and write the basic alphabets. This led to regular visits to

the NAB and gave me an initial start off point. From this analysis I was able to shape project proposal stating the line of enquiry and the design development.

Being exposed to inter-disciplinary ideas at Srishti, I chose to take up the challenge of solving the problem of the of the most basic Braille tool. However, I did not understand the magnitude of the task that I had to individually accomplish. As suggested by my external guide Mr. Mahendra Patel, I re-drafted my proposal keeping in mind feasibility, time constraint, personal skills etc. This helped me draft a proposal that focused on the problems of the visually impaired facing while studying with Mathematics. Kameshwari and I derived an area of study through the analysis that was drawn during my frequent visits to the NAB.

My initial research made me see the ocean that I had decided to cross. My meeting with Mrs. Narayan, a Math teacher and also a Design educationist helped in reshaping my project into a design research based project. I began my research on the problems that are faced by the visually impaired while studying Mathematics. The content of the research was to highlight the insights from stories that would provoke and trigger the minds of the reader. It was also to provide the background and understanding of the problem.

Upon reflection, I see this as a turning point and an education on how design development processes are initiated. I learnt that good designs and solutions develop only after a thorough understanding of the problem, its context and identifying areas where design can assist. Design education made me aware and recognize the importance of the design process but the knowledge of how essential it is to identify an appropriate approach came while working on the project.

I set out to gather data that would help in facilitating a solution or change. Having very little experience in design research methodologies and approaches, I applied all learning of the years at Srishti. Besides this I started reading about various research methodologies and seeking help from my faculties and senior graduates.

I started with the natural process of interaction with various categories of people related to the subject and observing visually impaired in their context

- I began by tapping into the Kameshwari’s network of friends at various other schools and training centers. I interviewed the institutional heads and faculty members. Initially the structure of the interview was fluid and at the same time I maintained the focus on mathematics. Gradually with deeper understanding of the challenges and context my questions became more and more focused.

- To get specific insights a written questionnaire to was sent to some selected people.

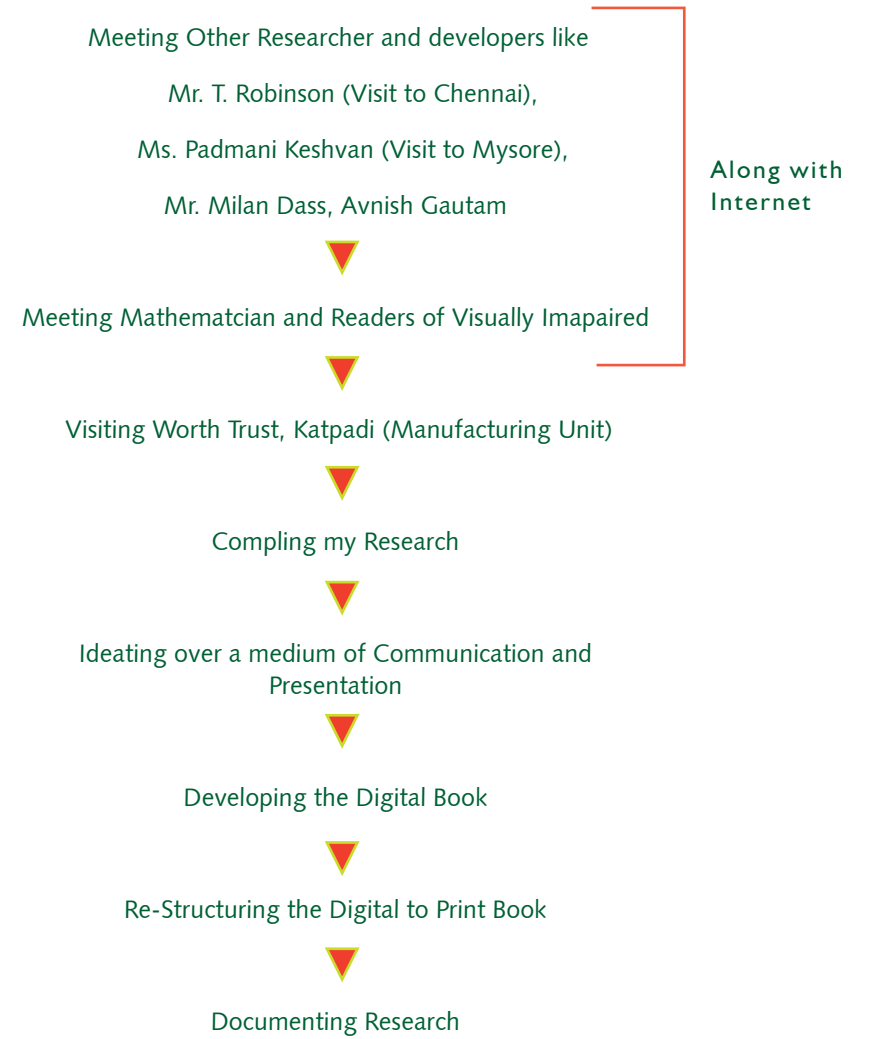
The results of my interaction with Kameshwari also got me thinking as to what will be the output if two extreme users were brought to discuss the problem and provide exploratory ideas for the solution. This developed into the content of the workshop. The workshop invited 4 visually impaired professionals and 4 sighted people.

The bigger challenge is extraction of useful data and compiling and analyzing the data gathered. This data also had to be communicated through an appropriate medium. My most desired medium through a visually disabled friendly interface on the internet and an interactive medium. The reasons are that the internet allows transaction of data and knowledge and it is an easy medium for exchange however, it is not easily accessible to all. Interactive digital mediums build an impression and show how things work, how ever digital mediums are again not always accessible and people still prefer to read printed text rather than text online. Due to constraints of appropriate skills and time I chose to compile my research in form of a printed book. In the book, I carefully and consciously document the resources that helped in understanding the subject. In a minor way it should act as a resource bank for people who have an interest in the subject. It should help them to take my research or a part of my research forward and not begin afresh. Therefore, now as a designer I see my self as a link that connects.

Isn't that what communication is all about?

Stages prior to Proposal



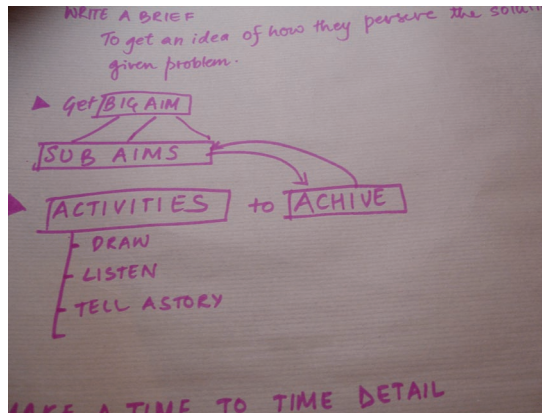


Research

I interacted with following categories of people during my research

- Institutional heads and faculty across the primary, middle and high school (with and without visual impairment)
- Visually Impaired students from across primary, middle, high school and college
- Visually Impaired professionals who have finished started working.
- Volunteers who help Visually Impaired complete their studies.
- Professors and design students who are working for development of educational tools for visual impairment.
- Professionals from the field of Mathematics
- Design professionals.





(Analysing and conducting the workshop)

- Starting to ideate over the workshop and presenting the idea of digital book.
- Understanding of workshop
- Conducting a workshop

In the third stage of my research, I conducted a workshop. The idea of a group interaction had germinated in my proposal itself. I had intended earlier to bring in various people that I would come across while my research and hold a discussion on the scenario and look for common problems their perception and ideas. However this took a final shape in form of a workshop where I started looking at the extreme users and the results with their interaction.

Questions

What happens when two people at the extreme end of a problem come and discuss it?

What is this problem going to be?

Who are the extreme users?

In my case the user can be determined from

- Physical impairment and non physical impairment
- 1. The non physically impaired can be further divided in to
- 2. Connected to the problem and not connected to the problem
- Mathematical background and non mathematical background
- Existing users and old users
- Professionals and children

From the above I decided to take the visually impaired and non-visually impaired related closely with either the subject of mathematic, children and education, related to visually impaired as a volunteer or doctor or teacher etc. With this group i felt the workshop would be more.

- Concentrated
- Exact
- More aware of the subject or user etc
- Would generate results

But then it was a very obvious group to create and since it was an experiment in itself with the encouragement and suggestion of my review panel I took the challenge of an extreme user group with following qualifications

The visually impaired participants

- Should be related to mathematics or sciences
- They should have minimum passed their 12th standard

The non visually impaired participants

- Related to education or mathematics
- A few of them should be unaware of the problems
- A few of them should at least interacted with the visually impaired

To understand the workshop searched internet and took the expert help of experienced workshop facilitators

Experts at help

Ms. Naga Nandini

Ms. Suchitra Narayan

Ms. Shweta Shettar

Aim of the workshop

- To analyze and enumerate the functions of the Tyler's frame or math board and Braille slate. Difficulties faced while solving and documenting an arithmetical problem through these tools.
- To get exploratory ideas that will bridge the gaps between the user and them learning mathematics through these tools.

Section 1

Aim: To get acquainted with each other and to put the participants at ease.

Aim: To provide a tactile experience of various shapes and textures. To try and recognize objects through the sense of touch.

Aim: To try and understand the communication gap that occurs when you have to rely only on sound and touch.

Aim: To understand the difficulty faced while working with mathematic problems.

Section 2

Aim: To understand how a product changes with the context, keeping the function the same.

Aim: To understand how the tools, the Braille slate and the Tyler frame work

Aim: To list the factors involved with the tools

Aim: To come up with creative solutions regarding the main issues and

problems faced

Aim: To brainstorm and come up with explorative ideas

Conclusion: what we have achieved and how it will be taken forward from here.

Feedback



People participating in the workshop

Mr Gautam Dayal a math teacher and his wife **Ms. Lavanya Dayal** who deals with innovative teaching methods and also a Toy Designer. **Mr. Peeyush Tibrewal** is a graduate of Math's Hons. and presently working in marketing department of a finance company. **Ms. Pavitra Padasalgi** is a computer software engineer working in Infosys she is also a volunteer for visually impaired.

Mr Ramana Polavarapu he is currently working for SAP Labs as a platinum developer (senior software engineer). **Mr Kiran Kaja** currently working for SAP Labs, Bangalore. He is also associated with Access India. **Mr Satyamurthy** works with Aztec Software and Technology Services Limited, Bangalore. **Ms. Kameshwari** is a graduate of B.com and is presently enrolled for a computer training program

Icebreaker

Aim: To get acquainted with each other and to put the participants at ease.

Material: Cloth for blindfolds and volunteers

Duration: 10 mins

Note: We remember people through the sense of sight and sound. Here we will be associating people only using the sense of sound. This will continue even after the introductory round.

Procedure:

- The participants are blindfolded and are made to sit around the table.
- The participants are asked to start counting odd numbers one by one in turn
- A volunteer will be there who will indicate whose turn it is by tapping them on their shoulder, since they will be blindfolded.
- The moment a person fumbles or hesitates, the game will be stopped and that participant will have to introduce themselves to the rest of the participants.
- The game continues till each member has introduced themselves.

Exercise 2

Aim: To provide a tactile experience of various shapes and textures. To try and recognize objects through the sense of touch.

Materials: Various materials which will provide different textures and shapes daily things from kitchen dal, spices, curry leaves, tulsi, leaves, cloth for the blindfolds, water, soap and towels.

Duration: 15mins

Procedure:

- The participants are blindfolded; a piece of newspaper and a bowl of water and towels are kept in front of them

- They are asked to outstretch their arms in front of them.

• Volunteers will be handing out materials to them, the participants have to make observations about the material handed to them and a volunteer will be recording these observations. Feel free to make guesses as to what the object could be.

• As an example, say you are handed a key, you would observe its shape, whether the feel is cold, metal, weight of the object and so on.

• After the materials are handed out, a discussion will be conducted regarding everyone's observations.

Key points for discussion

- What are the factors that you take into consideration while recognizing an object?
- Do the other senses also play a role in recognizing these objects?
- How difficult is it to recognize objects using only the sense of touch?

Exercise 3

Aim: To understand the difficulty faced while working with mathematic problems.

Material: paper, pencils, cloth for blindfolds

Duration: 10mins

Procedure:

- The participants will be blindfolded.
- Each participant will be given a paper and pencil.
- A simple arithmetic problem will be narrated to them.
- Each participant will be assigned a volunteer; the problem will be narrated to them as many times as the participant wishes.
- The participant has to solve the problem; the volunteers will act as their scribes.

Key points for discussion:

- What are the problems faced while doing this exercise?
- Discuss certain factors like time and bring it into today's context like jobs, exams?
- Have a brainstorming session regarding what changes can be brought about?
- Introduce the tools used for math by the visually impaired.

Exercise 4

Aim: To try and understand the communication gap that occurs when you have to rely only on sound and touch.

Materials: Slips of paper, a box, paper and pencils

Duration: 20mins

Procedure:

- The participants are split into pairs, one participant of each pair is blindfolded
- Slips of paper with object names are written and kept in a box. Each pair has to pick a slip of paper
- The participant who is not blindfolded reads the object name but cannot tell his /her partner about it.
- Then the participant who is not blindfolded has to try and explain this object to his/her partner by explaining this object by breaking it into basic geometric elements like lines, curves, dots etc either orally or by touch (this option will be given by the facilitator)
- For example, if the object given is a bird, then it can be explained as follows. It has an oval body and from the middle of it a curved line goes which has a zigzag line. If it is through touch then they can draw out the object on the blindfolded person's palm with their fingers.
- Have each pair present their observations of the exercise to the rest of

the group.

- A discussion will follow regarding the observations done by the groups

Key points for discussion:

- Is there a communication gap happening when you have to communicate using only sound and touch?
- Which form of communication is better, through sound or touch?
- Are there any other ways of communicating? (Have a brainstorming session)
- Discuss the problems involving a scribe as opposed to being able to do it yourself.

Exercise 5

Aim: To understand the difficulty faced while working with mathematic problems.

Material: paper, pencils, cloth for blindfolds

Duration: 15mins

Procedure:

- The participants will be blindfolded.
- Each participant will be given a paper and pencil.
- A simple arithmetic problem will be narrated to them.
- Each participant will be assigned a volunteer; the problem will be narrated to them as many times as the participant wishes.
- The participant has to solve the problem, the volunteers will act as their scribes
- A discussion will follow regarding the problems faced by the participants

Key points for discussion:

- What are the problems faced while doing this exercise?
- Introduce the tools used for math's by the visually impaired.
- Discuss how this problem can be solved by the tool? (Ideas of direct communication)
- Have a brainstorming session regarding what other changes can be brought about?

Exercise 6

Aim: To understand the working and concept of braille.

Material: paper, cloth for blindfolds

Duration: 15mins

Procedure:

- The participants will be blindfolded.
- Each participant will be given a paper on which alphabet/words will be written in an embossed manner in different font sizes.
- The participants have to feel them and try and recognize the alphabets/ words.
- The participant has to make an observation as to which of the font sizes is most readable and recognizable
- These observations will be told to the volunteers who will record it on their behalf.
- A discussion will follow regarding the Braille script

Key points for discussion:

- What are the problems faced while doing this exercise?
- Discuss the structure of the Braille script
- Have a brainstorming session regarding what changes can be brought

about in the script

- Introduce the tools used for Braille.

Exercise7

Aim: To understand how a product changes with the context, keeping the function the same.

Material: paper, pencils/markers

Duration: 15mins

Procedure:

- The participants will be split into groups of four
- Each group will be given a scenario to list the factors that go into the designing of a glass for children/the other group will do it for a cocktail glass
- Each group will record the reasons for their consideration while they were designing the glass.
- Both the groups will be given 5 mins to finish the exercise, a discussion will be held with both the groups regarding how the factors like material, color, style... etc change according to its context
- A discussion will follow regarding products and their contexts

Key points for discussion:

- How products change according to their context?
- What are the factors of the context that lead to change?
- Introduce the tools used by visually impaired people.

Exercise 8

Aim: To understand how the tools, the Braille slate and the Tyler frame work

Material: Cloth for blindfolds , Braille slate, Tyler's frame

Duration: 20mins

Procedure:

- The participants are split into groups of four
- The Tylors frame with which math is solved and the Braille slate are given to the respective groups.
- In each group the participant who knows Braille will try and explain to the others as to how the script works. They will also try and teach the other participants the basic numerals and a few alphabets and how the product is used.
- While they are learning the Braille, the participants are not blindfolded, once they have understood the concept, they will be blindfolded and asked to write what is told to them using the tool.
- At the end of the exercise each participant would have learnt or understood the basic concept as to how the tool works.
- A discussion will follow regarding the difficulties faced during the exercise

Key points for discussion:

- What were the difficulties faced during this exercise?
- What were the observations made by the participants during the exercise regarding the tools and their mechanisms?
- Do they feel that the tool itself is accommodating for the visually impaired?

Exercise 9

Aim: To list the factors involved with the tools

Material: Braille slate, Tyler's frame, paper and pencils

Duration: 20mins

Procedure:

- The participants are split into groups of four
- The observations made in the previous exercise are brought for discussion by each group
- Each group will analyze the product given to them, keeping in mind the difficulties and observations made by them in the previous exercise.
- Each group will list the factors of each tool both positive as well as negative.
- At the end of this exercise each group will present their observations and conclusions to the entire group
- A discussion will follow regarding the conclusions made by each group and the tools

Key points for discussion:

- The factors of each tool
- What were the difficulties faced due to the construction and structure of the tool?
- Do they feel that the tool itself is accommodating for the visually impaired?
- Do they think the tools have been designed according to the context it is being used in?
- List the main factors that can be taken for further brainstorming

Exercise 10

Aim: To come up with creative solutions regarding the main issues and problems faced.

Material: Braille slate, Tyler's frame, paper and pencils

Duration: 20mins

Procedure:

- The participants are given 5 mins to think of creative and out of the box solutions for the problems faced. Remember the points of brainstorming

to help you think.

- Do not hesitate assistance if you can't remember them or you need to revisit the points from previous exercise also if you want to ideate with some one.
- The participants are requested to feel free and think of ideas which they feel are farfetched and impractical.
- Here we are looking for creative solutions and not into the practicality factor
- After five minutes everyone gathers. Slips of paper with the participants name will be kept in a box. By random selection whoseever name comes from the box, that participant will have to give his or her idea regarding what they would like to offer as a solution.
- All these ideas are listed and recorded
- An open discussion will follow regarding these ideas and if possible try and refine them.

Exercise 11

Aim: To brainstorm and come up with explorative ideas

Material: Braille slate, Tyler's frame, paper and pencils

Duration: 20mins

Procedure:

- The participants are split into groups of four
- Each group for 10 mins will be asked to brainstorm the factors/problems listed for the tools and come out with creative solutions for these factors.
- At the end of the exercise each group should have various creative ideas for the product as a whole.

- Each group has to try and refine the product to its maximum. One or more solutions are welcome.

- The groups will present their ideas to the entire group

- A discussion will follow with regard to the ideas presented

Key points for discussion:

- Since the participants are not being asked to think about factors like cost, practicality.Etc.Try and bring up these factors and see how each idea can be accommodated accordingly.

- Ask the participants if they were to think of creating a product with no restraints whatsoever, even in technology, what modifications would they make to their product?

From the Research and Workshop

There were certain points that I can conclude from the research and workshop. The most urgent need of the hour is the revision of the tools used by the visually impaired. There is dire need for innovation and incremental design regarding these tools. To achieve this goal people who are interested have to communicate, interact and discuss. Regionalization of ideas and innovations only leads to stagnation and repetition. This also limits the scope of invention.

Another point of concern is that mathematics is a subject that has taken shape over years and years of change and invention of newer concepts and means of representing these concepts. The limitation of math is not that it is a non-linear subject and that there is no other better way in which that same concept can be written. It is important to think of fresh way to represent these concepts such that it becomes accessible to a visually impaired without much trouble and also relive the stress on his memory. It may take time but it is not an idea worth disregarding.

Invention of a new tools or a script all together is debatable and until one is invented and tested nothing much can be said. Besides adaptability is the key issue of a script which may take years. Incrementing over the existing design of tools and script is safer, faster and more feasible an idea considering the existing infrastructure.

The Braille slate being the most important of all tools should be constructed in such a way that one can see the solutions of the mirror writing. This can probably be done by embossing the dot of the cell on the lower sheet. Thus the stylus will also have to be made up of such a material that will aid the embossing of the dot on the paper.

The upper sheet of the Braille slate should be made in such a way that it helps in feeling the dots punched. That way any mistake would be detected sooner. For this I suggest that there should be a single line of cells that can be used for punching which can be movable.

A simple idea of keeping the paper in place while opening the braille slate in the middle of writing is to have clips on the upper sheet which can be clipped to the paper before starting.

An auditory tool can be developed such that it can read what is being written by the visually impaired on the slate. This would help in detecting

the mistake immediately, reading what has been written and thus help a visually impaired person get an immediate reference to what he or she has written.

The interaction with the visually impaired and the workshop during my research yielded the ideas of combining the Braille slate, Taylor's frame and geometry tools. This can also be detachable. This is an interesting possibility that can be explored.

The workshop also suggested that the tools can incorporate a rough work sections.

The Taylor's frame can be developed in such a way that it can document what has been written.

In Process

While incrementing or reinventing the tools it is important to look at context. Perkin's Braille and computer besides being a non portable product they are also very expensive and non manual. Which is my prime concern when I look at the fact that most of the visually impaired population comes from the developing and underdeveloped countries where purchasing power and power to bear the cost of regular maintenance is weak. There by it is important to be conscious while designing that they solve the problem but it remains basic, manual and inexpensive.

Also it is important that the material used should keep the real users that are the children in mind. If metals and plastics or any other materials are being used they should be made in such a way that they enhance the tactile sense and simultaneously are not difficult, harmful or dangerous to handle.

Few Thought

Due to my lack of knowledge and background I am not in a position to comment on the system of education and it's failing but some thoughts that have developed.

There is a need for uniform education system for visually impaired that can bring homogeneity. Even though there is thoughtfulness in the provision of the options to do subjects like mathematics and science. The idea needs to be reconsidered in terms of its long term disadvantages and limitations. Also under the provisions the options and course material provided

needs to be paid attention as the material of study belongs to a higher understanding attained after the completion of 10th and not intended for the level of an eighth standard student.

- An Idea much debatable is that should there be a difference in teaching methodologies, structure of institutions, system of education and structuring of the syllabus for visually impaired. Well personally I support the difference the reason being that in both cases the receiving senses are very different and so will be the perceptions. This difference in perception is what the education system for the visually impaired has to be responsive to. The foundation of the proposal lies in the research that will aid a better understanding and help in execution.

- There is a need for awareness and counseling with respect to health education and professions that can be provided to the visually impaired children and their parents. Many times the lack of awareness leads to negligence and loss of important years in their growth.

- The options provided for vocational training are not lucrative and does not help in a good standard of self maintenance.

- It was mutually felt that communication, presentation and other important social skills are important and such programs must be encouraged and developed.

- An interesting field of research would be of various professional opportunities in various sectors for visually impaired. These opportunities should be such that the visually impaired people add to the production rather than compete with their sighted counterparts. Opportunities where their expertise and know how will act as a unique and valuable input. An instance of such an idea is employment of visual and hearing impaired people as coffee tasters. In this example their keen senses became an asset to the company.

(Design Development and Detailing and Conclusion)

Why a digital book?

- Digital is an inexpensive medium
- The textual material can be read by visually impaired via means of screen reading Softwares.
- Digital medium allowed the inclusion of video as a medium which I felt is an important due to
- Unfamiliarity of the subject among the non-visually impaired people.
- The nature of the subject: Better understanding of the tools and the script since these are action based.
- It also breaks monotony and a quick gist of the idea.
- May create interest for further reading.
- Book in Braille may be costly and also restricts the information to only Braille literate visually or partially visually impaired people.

How was the content structure?

The content was broken to cater two types of readers

- Quick glance

1. Overview is the section that highlights the important points of the book and simultaneously connects you to these sections of the book.

- Cover to cover readers

The readers may be perceived as follows

- Volunteers
- People with partial visual impairment
- People who acquired visual impairment late
- People who are starting research on the subject like I was doing some time back.
- People who are doing research In the subject (this book become compilation of my research material and the can tap into it for resources and information they did not stumble upon)

Information is introduced with Braille in general and about mathematics in a little more detail. And then it provided you with a brief idea on the government and their **role. it concluded with my thoughts and my resource list.**

Difficulties and hurdle while making the book

- This was the first time I was coming face to face with so much material
- Organizing it
- Categorizing it
- Writing it
- Editing it
- Was the most difficult job

Difficulties with the medium

Flash was familiar yet unfamiliar territory which I some how managed to grasp but not to a level of expertise but to attain a decent result. Film certainly was my most unfamiliar territory and therefore it required

dependency on expertise to the greatest level. With a few hurdles I have managed some success in it.

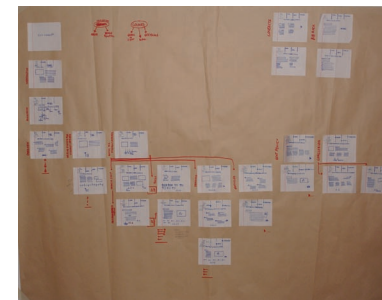
Lessons learnt

- How to Compress text and material yet achieve clarity.
- How to compile a huge book and manage resources.
- One important lesson was that good time management happens with good organization skills and ability to foresee things

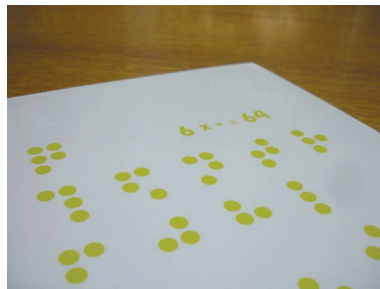
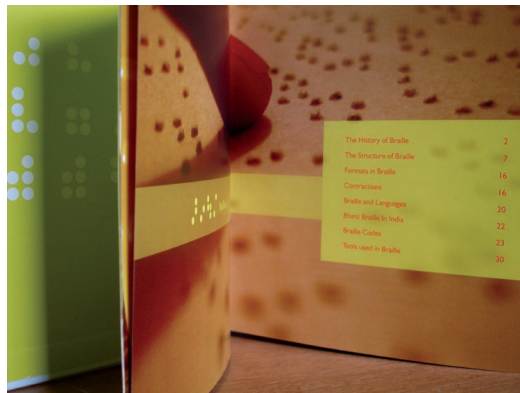
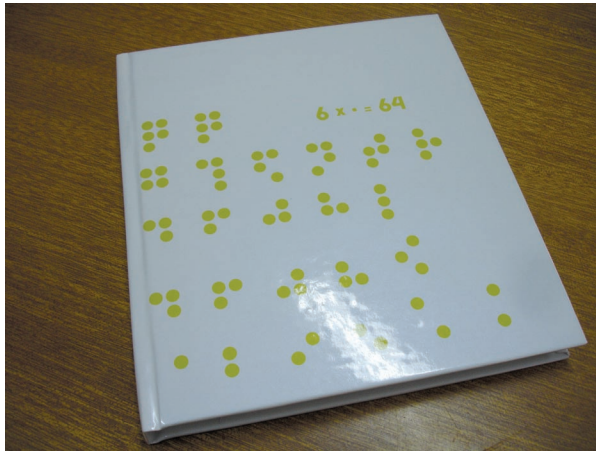
Print Book

However during my Internal Review my panel felt that due to my lack of experience with the medium I was not able to explore to the fullest. There fore I proceeded to design a print book.

Flash Book



Final Book



Learning and scope

Learning

- This experience helped me structure and organize my thoughts and ideas. It has also taught me to extract useful data that can be taken forward.
- The project gave me a peek into an exhaustive research and its compilation. The experienced of methods of research and structure and its usefulness in detecting the real design problems helped me understand the design process better.
- More than learning the nuances and sensitivities involved in communication; which came naturally due to the subject and the process I traveled. I truly learnt important lessons of design when alone, with people, in spaces, with constraints of time and ability.
- I now truly value my ability and disability as a designer and I can say confidently that next time I will know my tipping point much better.
- The last stage of production gave me an understanding of my own potential to stand strong and confident in the times of pressure and crisis. It taught me that good results sometimes need the ability to work under pressure which is perhaps how real times situations are.

Further scope

This project is meant as a data collection bank, a means by which I am sharing my research material; all that I have gathered from it so that it may connect people to further resources. Due to lack of knowledge and

time I thought this the most appropriate medium in which to share the information. Ideally, it would have been the World Wide Web. This is where I envision the most interaction of all who are interested in a project of this nature.

The difference in the two mediums as I see it will be that:

- It will be a site where individuals will be allowed to add and update the ongoing topics being researched.
- It will link to other websites.
- Provide a link to individuals and institutions who are working and using the information.
- The audience of the site will add to the content and become part of the content themselves.

The main aim of the website can be to

- Inform
- Trigger
- Share

Where by this resource bank will act as a starting point for new research ideas and queries.

- It will act as a platform that will connect existing developers and researchers.
- Help institutions to keep themselves abreast of the current state of affairs and perhaps allowing to them to contribute to the Research.
- It will also inform non-academics interested in the subject.

