DESIGN OF TEACHING-LEARNING AIDS FOR BLIND CHILDREN

INDUSTRIAL DESIGN PROJECT - III

MDP - 450

SUBMITTED BY

PATRIC JOHN - 146130005

GUIDE : PROF. R SANDESH

INDUSTRIAL DESIGN CENTRE
INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY

2016

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Approval

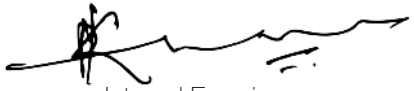
Industrial Design Project III

“Design of Teaching-Learning Aids for Blind Children”

By: **PATRIC JOHN** 146130005
M. Des Industrial Design 2014-2016

Is approved as a partial fulfillment of requirements of a post graduate Degree in Industrial Design at IDC, IIT-Bombay.

External Examiner



Internal Examiner

Project Guide

Chairperson

Declaration

I declare that this written submission represents my idea in my own words and where other ideas or words have been included, I have adequately selected and referred the original source.
I also declare that I have adhered to all principles of academic honesty and integrity and have not misinterpreted or fabricated or falsified any ideas / data / facts / sources in my submission.
I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources that have not been properly cited, or from whom proper permission has not been sought.

Signature: 

Name: PATRIC JOHN

Roll No: 146130005

Acknowledgments

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Mrs.Archana Joshi.HOD, Education Department
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Bhavik Grover , Akanksha Rathore for helping me with visits
All my classmates.
All my batchmates,

Abstract

A project which started with an objective of “Design Intervention for the blind”, progressed and specified with the objective “Help with design , the blind children to learn/make them teach about geometry in Mathematics”. This project investigates the existing/ current scenario and comes up with a few ideas which would help the blind children to learn about particular concepts of Geometry in maths.

The project initially started with study about blind and other related issues of being blind. With the help of two organizations which help and support the blind, the direction was chosen and focus area was determined. Problem solving was one of the major priorities of the project which remained since ideation and progressed along with conceptualization and evaluation.

Contents

First guide meeting. Asked to propose a topic, a small presentation about what, why, who etc. I proposed design of a smart pedestal fan. “Design of smart fan to enhance user experience and thermal comfort”. I did a quick study in two days about fans, Types of fans, mechanism, variations, possibilities for the product and project. Target users, problems etc. After two days I again presented the topic. Due to lack of complexity of structure for the project the topic was not appreciated by the guide. The other topics which I proposed for P3 were,

- “Transformable Cradle design”
- “Dustbin for car interiors”
- “Toy design for blind kids”
- “Experiential Furniture design for 5 senses”

From these topics “Toy design for the blind” was chosen by me for P3. Complexity of project(level of P3), social cause, possibilities for student to learn a new area and contribute, possibility of application of learnings etc were looked at while selection of the topic for project.

Toy & Game design for blind

That was the area I thought I will focus for the project 3. But toy design for blind denotes/explains about designing a toy for the blind kids. Now that is a solution or an answer or end product. How will I know that this is the required area for design. In this way the project will be biased towards toys. So in order to have neutral approach the project was started with an objective of Design intervention for the blind children. In this way the project could take a path along side of an actual need from the current scenario.

Before starting any project one need to find the direction in which the project needs to move ahead. A rigorous and wide “search” in different directions and related areas are required at the initial stage,to understand more about it, to avoid going in the same path which people already have gone & to avoid repetition. But that doesn’t mean to, not to go in those directions or areas. Because sometimes I might find something different which others couldn’t see, I could learn something which others couldn’t learn. So the Idea of initial background study is to have an summed up idea in the area, omit the obvious errors and mistakes and learn from them. Later I could decide whether to go or not to go in that area.

I started with studying about blind people, blindness, products, aids, things they use, why they use, advantages disadvantages etc. Areas which are related to the topic was also covered. Study about games, toys, activities, ways they learn, methods they used etc were also covered. The following portion of the report briefly mentions about the areas which I covered.

Secondary data collection

& Literature study

Blind

Definitions, basic terminology

Visual impairment, is usually referred to any damage or any problem or impairment to the proper functioning of the eye. It can be measured with tests like visual acuity, visual field, color vision, contrast sensitivity etc

Visual Disability, how a person functions (rather than function of the organ), measured in terms of reading performance & other activities.

Low vision, any bilateral loss of vision that cannot be corrected with eyeglasses or contact lenses, which interferes the person with his/her daily living activities.

Visual handicap, the disadvantage the person experiences because of vision loss. The person may require extra effort to perform tasks.

Types of blindness

Color blindness is the inability to perceive differences in various shades of colors, particularly green and red, that others can distinguish. It is most often inherited (genetic) and affects about 8% of males and under 1% of women. People who are color blind usually have normal vision otherwise and can function well visually. This is actually not true blindness.

Night blindness is a difficulty in seeing under situations of decreased illumination. It can be genetic or acquired. The majority of people who have night vision difficulties function well under normal lighting conditions; this is not a state of sightliness.

Snow blindness is loss of vision after exposure of the eyes to large amounts of ultraviolet light. Snow blindness is usually temporary and is due to swelling of cells of the corneal surface. Even in the most severe of cases of snow blindness, the individual is still able to see shapes and movement.

Levels of visual impairment

20/30 to 20/60 : is considered mild vision loss, or near-normal vision
20/70 to 20/160 : is considered moderate visual impairment, or moderate low vision
20/200 to 20/400 : is considered severe visual impairment, or severe low vision
20/500 to 20/1,000 : is considered profound visual impairment, or profound low vision
More than 20/1,000 : is considered near-total visual impairment, or near total blindness
No light perception : is considered total visual impairment, or total blindness

Further reading & study included

- Causes of blindness in infants
- Diagnosis of Blindness
- Symptoms and signs
- Treatment etc.
- Impact if visual impairment on development

Impact Of Visual Impairment On Development

For the infant born without sight, the other senses have intermittent input and may appear diminished. The child receives inconsistent, discrete, and generally unverified fragments of information.

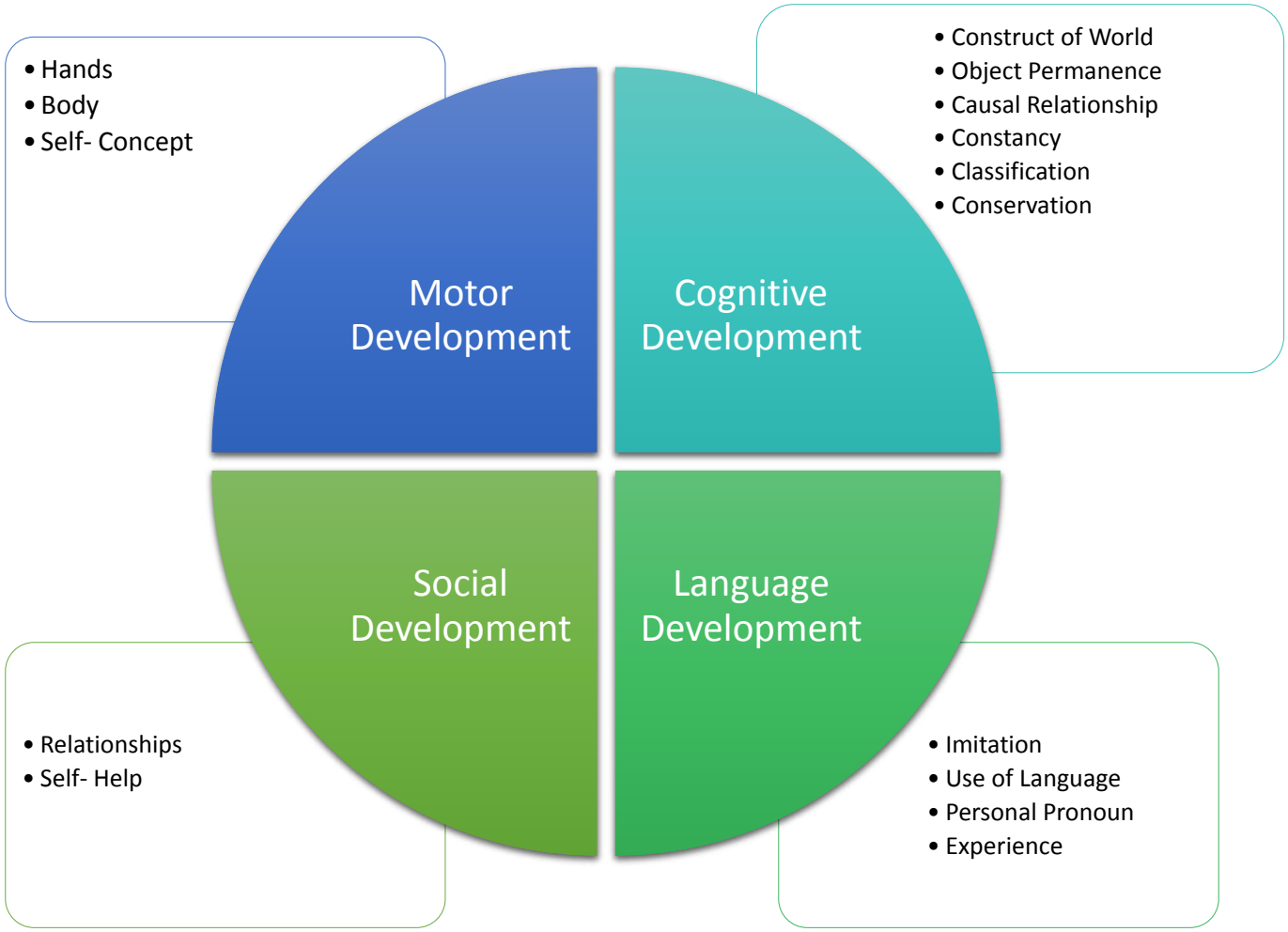
Hearing is the only distance sense available to the blind infant, but the infant has no control over the presence or absence of sound in his environment. Sound without visual verification is only noise coming from nowhere. Only after much tactual, motor, and auditory interaction does sound acquire meaning. Only then can sound provide information about location, cause, or source.

Sound is not the strong motivator that vision is. Not until approximately 12 months - will a blind child reach for an object based on sound cue alone. Environmental exploration. is usually delayed until the child reaches this point.

Normally the incentive for tactile exploration is supplied by visual dimensions: color, pattern, shape, location. These dimensions are unavailable to a blind infant; therefore, purposeful tactile activity is minimal because the environment remains unknown and uninviting.

Refer to : Impact Of Visual Impairment On Development. 2016. Impact Of Visual Impairment On Development. [ONLINE] Available at: http://www.tsbvi.edu/infants/3293-the-impact-of-visual-impairment-on-development. [Accessed 18 April 2016]

Diagram showing areas which are studied to understand more about blind



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Next step

Primary data collection

- To understand the current scenario, validate/know more about the findings from the secondary data collection, for better understanding of things.
- Find out problems/ difficulties, etc.
- Need to visit different places, understand how teaching-learning happens, analyze the existing products/aids/toys/games(methods of information delivery)
- Need to find the opportunity/direction for the project.
- Classify and categorize different directions and approaches and select one of them which is more important/required to work (critical analysis and justification)

We help the blind help themselves

We have endeavored to give detailed information about our activities and we hope you will enjoy reading the pages and would like to participate in whichever way you can to empower the visually challenged in India.

We have also provided links to the major laws that govern disability in this country. Through this, we wish to inform our readers about the changing scenario in the field.

The website is full of information and we will make all efforts to update it regularly. You will also be able to read our publications “Blind Welfare” and “NAB INDIA Newsletter”, on-line.

We have also provided the facility for on-line donation and we hope you would be quite keen on contributing towards making the visually challenged tax payers and self-sufficient individuals.

We have also provided our Annual Reports – including the financial statements; we believe in absolute transparency, accountability and credibility.

Finally, let me take this opportunity to welcome you all once again and hope you will keep coming to us for regular updates.

Vision

Empowered and well-informed visually challenged population of our country, thus enabling them to lead a life of dignity and productivity.

Mission

Prevention of preventable and cure of curable visual impairment.

Socio-economic rehabilitation of the visually challenged in mainstream, through education, training and employment.

To take up advocacy against all types of individual and structural discrimination and ensure full legal capacity.

Assure accessibility to the world of information.

nabindia | National Association for the Blind. 2016. nabindia | National Association for the Blind. [ONLINE] Available at: http://www.nabindia.org/. [Accessed 27 July 2016].

Visit to NAB (National association for the blind)

Had verbal interaction with HOD(Educational Department) Mrs. Archana Joshi and few faculty who works under NAB .
Initial discussion were about understanding about the organization, areas they are working. The, then discussion transposed into an inquiry , about areas requires more attention/intervention for a product designer. Help they requires from an Industrial Designer.

From the discussion, I got a quick understanding of the current scenario, then about products/teaching aids/ methods they use etc.
(pointing out requirement/ area of importance) Mathematics- teaching regular maths to blind children after 7th(Especially in high school)

Importance of education and skill development.
Role of skill development for a blind child. (NAB focuses on skill development/ extra effort towards blind/visually impaired children so that they can learn with and like the other students in the class. One of their mission is “To help the blind help themselves- Integrated Education”
Other products/areas where they require help (for faculty, for personal needs/requirements)

But to get more clarity and exactly pinpoint the area/direction they suggested to visit again.

People I met

Head of Department, Educational Department.(NAB)
Teachers who give support and assistance in learning for the Blind children.
Blind Children.

Areas for Design Intervention

(Need)Education - Teaching-Learning Aids for kids to understand/learn/ familiarize/concrete the concepts of Maths(especially in Geometry)

(Opportunity) Skill development - Toys/ Games/products/aids to develop various skills of children.

(Opportunity) Vocational training - Developing tools/products/aids/ for vocational training

The Xavier's Resource Centre for the Visually Challenged

Breaking Barriers... Achieving Access

About us

The Xavier's Resource Centre for the Visually Challenged (XRCVC) is an integral part and department of St. Xavier's College - Autonomous, Mumbai.

The XRCVC was started in 2003 as an effort to ensure an inclusive environment at St. Xavier's College, one of the most well-known educational institutions in the country, for its students with blindness and low vision. Having created an inclusive set-up for its own students, keeping with the college's long tradition of creating social impact within the larger community, the XRCVC has today become a national advocacy and support centre for the blind and low-vision across the city and the country.

Our Vision is to work towards creating an enabling environment to facilitate the development of an inclusive society, both at the micro as well as the macro levels, thereby providing equal opportunities for holistic growth for the visually challenged.

Visit to XRCVC

The Xavier's Resource Centre for the Visually Challenged (XRCVC) is an integral part and department of St. Xavier's College - Autonomous, Mumbai.

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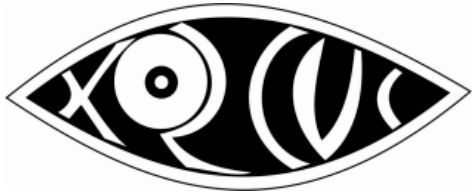


People I met

Teachers who give support and assistance in learning for the Blind children.

Areas for Design Intervention

(Opportunity)Education -
Teaching-Learning Aids for kids to understand/learn/familiarize/concrete the concepts of Maths & Science.

Selection of the area for the project

After the visits to two centers (NAB & XRCVC) , a discussion along with my project guide, we analyzed the possibilities of three directions and finally selected one to progress further. That is the area of Education - To develop products which will help to learn/teach the concepts of Maths for blind/Visually impaired children.

Three possible Directions(Topics) for the project

Education (Need)

This area was suggested by the Faculty of NAB, and they are actually in need of help in this area. One of their new objective is to help blind children continue with the regular maths. Right now most of the blind/visually impaired children drops regular maths and takes lower maths. So they asked if I could look into existing products and redesign if required or come up with completely new products which will help them to understand some of the concepts of Maths.

Skill Development (Opportunity)

This area has an opportunity for design intervention. Developing/designing Products for the blind children to develop their various skills which will help them to overcome various barriers in their life.

Vocational Training (Opportunity)

An area, in which developing products for children to develop skills related to vocational training, which will help them to earn for themselves.

Objective : To help blind children, to continue with regular maths after upper primary standard

To develop/design tools/aids/ games/products to "deliver"the ideas/concepts of Maths (Especially Geometry) to blind children.

8-15 age group
(Blind/Visually Impaired children)

Geometry syllabus - General for 6th standard student

(i) Basic geometrical ideas (2 -D): Introduction to geometry. Its linkage with and reflection in everyday experience.• Line, line segment, ray.• Open and closed figures.• Interior and exterior of closed figures. • Curvilinear and linear boundaries

• Angle — Vertex, arm, interior and exterior,

• Triangle — vertices, sides, angles,interior and exterior, altitude and median

• Quadrilateral — Sides, vertices, angles, diagonals, adjacent sides and opposite sides (only convex quadrilateral are to be discussed), interior and exterior of a quadrilateral.

• Circle — Centre, radius, diameter, arc, sector, chord, segment, semicircle, circumference, interior and exterior.

(ii) Understanding Elementary Shapes (2-D and 3-D):

• Measure of Line segment

• Measure of angles

• Pair of lines – Intersecting and perpendicular lines – Parallel lines

• Types of angles- acute, obtuse, right, straight, reflex, complete and zero angle

• Classification of triangles (on the basis of sides, and of angles)

• Types of quadrilaterals – Trapezium, parallelogram, rectangle, square, rhombus.

• Simple polygons (introduction) (Upto octagons regulars as well as non regular).

• Identification of 3-D shapes: Cubes, Cuboid, cylinder, sphere, cone, Prism (triangular), pyramid (triangular and square) Identification and locating in the surroundings
• Elements of 3-D figures. (Faces, Edges and vertices)
• Nets for cube, cuboid, cylinders, cones and tetrahedrons.

(iii) Symmetry: (reflection)
• Observation and identification of 2-D symmetrical objects for reflection symmetry
• Operation of reflection (taking mirror images) of simple 2-D objects
• Recognising reflection symmetry (identifying axes)

(iv) Constructions
(Using Straight edge Scale, protractor, compasses)
• Drawing of a line segment
• Construction of circle
• Perpendicular bisector
• Construction of angles (using protractor)
• Angle 60°, 120° (Using Compasses)
• Angle bisector- making angles of 30°, 45°, 90° etc. (using compasses)
• Angle equal to a given angle (using compass)
• Drawing a line perpendicular to a given line from a point a) on the line b) outside the line.

The syllabus is used as a “guideline” to the products which will be designed/developed.

Why an Industrial Designer?

For a blind child there is no 2D, all the shapes and diagrams in the text book doesn't exist for him/her. In the current scenario with the help of various groups and Organizations there is been a lot of effort to translate 2D shapes and diagrams into tactile embossed sheets. There are also few 3D/physical products to help them understand geometry. From the initial discussion with the organizations I found that there is requirement to develop more products/aids/physical entities for them.

To identify the **“Method”** for further progress, I need to

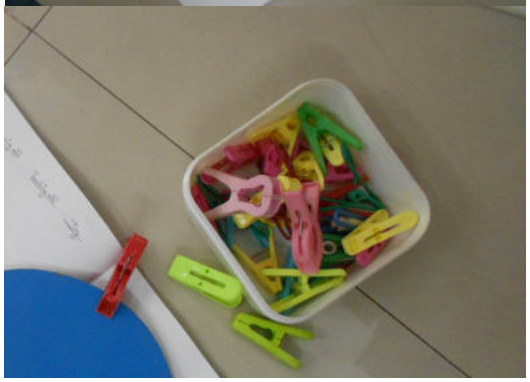
1.Study and a look at the existing methods such as Learning aids, Teaching aids and Games with the center.
2.Study and a look at the existing methods/ways of learning/understanding the Maths

Study and a look at the existing methods such as Learning aids, Teaching aids and Games with the center.

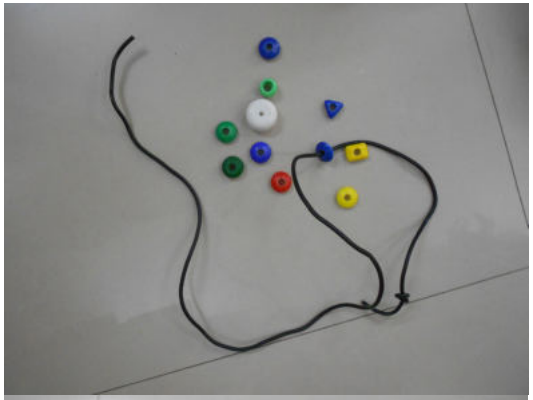
Beginning to learn

Before starting to learn about shapes, sizes, other attributes of objects the blind children have to develop good motor skills (gain good “tactile literacy”) to hold,use and “identify” objects using their hands.

1



Clips are used to develop hand co-ordination, different clips of different pressure sensitivity are used. Activities like place 3 clips , place 4 clips etc are done initially to develop motor skills and identification of numbers.



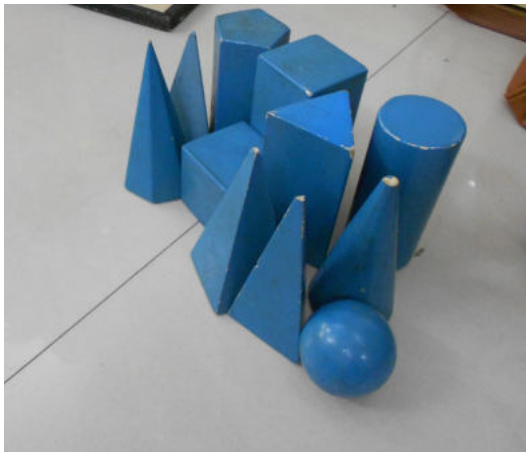
Threads and beads are used to join together into a chains. Tasks like join 3 beads, 10 beads etc. Different threads of varying stiffness and different beads with varying size of holes are given according to the level of the blind students.

1.1

Small plastic pins with hemispherical heads are used in this product. This is basically to develop fine motor skills of the child. Placing and removing of the pins along with simple mathematical problems are also given accordingly to children according to their level of skill set.

Cubes in which each side a particular number/alphabet and a related picture and other form of related representation is provided. The child could read if he is low vision with eyes or need to touch and feel the embossed script on the cube.

Numbers are embossed on one side of the chips and same numbers in braille is stuck on the other side. Children who have low vision and children whose sight gradually loosing are using these. These will help them to relate the numbers and their braille equivalent.



Description
Simple geometrical blocks made out of softwood and covered with paper mache.

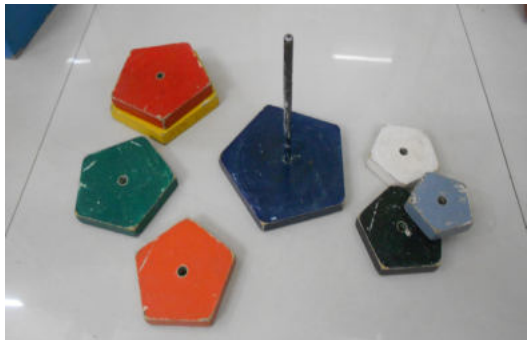
Uses
To understand/explain basic geometrical shapes, sides, vertices's, edges, mass of objects etc. The activity include identifying similar shapes, counting edges, vertices's, placing them on their base, orientations of different forms etc.

Advantages
Very Simple in construction(less complex)
Light weight
Low cost

Drawbacks
Takes lot of shelf space to store.
Cannot use to form complex shapes/ doesn't lead to further exploration.
Not multi-purpose in nature.
Doesn't have any point of interest/ element of surprise to use further.

Availability of Similar products/Better products
Similar products which can be used to explain basic geometrical ideas are available in market which are made up of Wood, plastic etc.

Further possibility of Design/ Re-design?
A product which is modular in nature, a unit which can be combined to form multiple forms and shapes would be good. First these shapes can be identified by blind children and then later he/she can DE-construct and reconstruct them back in the same manner or in different combinations.



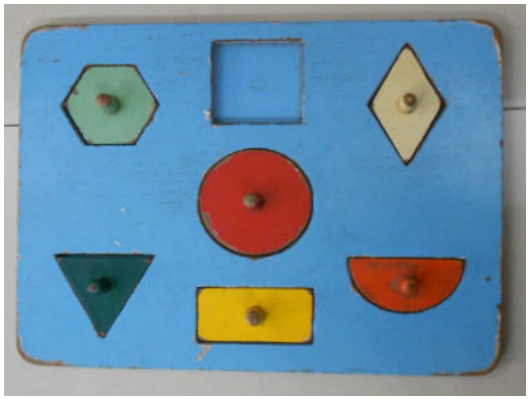
Description
Simple geometrical blocks sorter in the shape of varying pentagons made out of softwood.

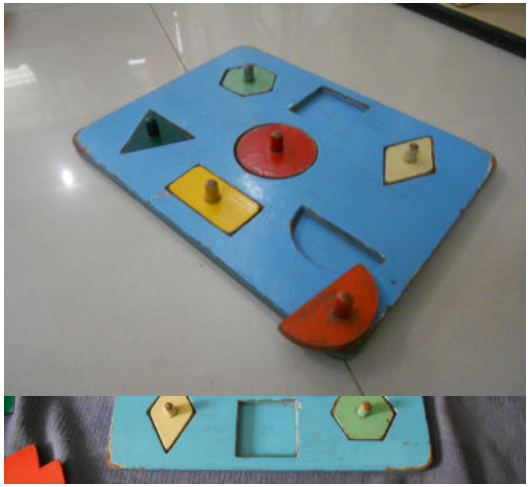
Uses
To touch and feel the shapes, edges, vertices's of pentagons.
To understand size differences- how shape changes in dimension according to varying size.
To identify and learn about ascending and descending order.
To sort and arrange the blocks in ascending and descending order.
To develop motor skills

Advantages
Very Simple in construction(less complex)
Wood - Eco friendly (comparatively heavier than plastic/softwood/paper mache)
Low cost
Easy to make

Drawbacks
Takes lot of shelf space to store.
Cannot use to form complex shapes/ doesn't lead to further exploration.
Not multi-purpose in nature.
Doesn't have any point of interest/ element of surprise to use further.
There is no way to understand himself/herself without the help of a parent/teacher/ guide.

Availability of Similar products/Better products
Similar products which can be used to explain basic geometrical ideas are available in market which are made up of Wood, plastic etc.





Description
Learning aid : Shape sorter

Uses
To identify different shapes and sort them into their slots accordingly.
To develop fine motor skills - hand co-or-dination
To get rough idea about colors only for low vision students.

Advantages
Very simple - easy to understand
Simple construction- low cost
Doesn't need much guidance/help to understand the product.

Drawbacks
Heavy -made out of wood
The pieces can fall out if tilted and shaken and can go missing since there is no fea-ture to remain in the slots.(In the process of touching and feeling the shapes some-times it goes out of the slots.
The small pegs on the shapes sometimes give a added meaning to shapes which can be confusing at times.
Not multi-purpose in nature.
Doesn't have any point of interest/ element of surprise to use further.
Even though the space between the shapes help them to understand the slots more easily it consumes a lot of space which might not actually require.

Further possibility of Design/ Re-design?
A product which is simple like this and yet can transform into more complex levels if required would be more accepted. It should be compact and affordable etc.

Availability of Similar products/Better products
Similar products which can be used to ex-plain basic geometrical ideas are available in market which are made up of Wood, plastic etc. There are different version which have different complexity levels. There are shape sorters which have mag-nets in them which will help stick easily.

Description
Simple geometrical blocks - shape of cubes of varying sizes

Uses
To touch and feel the shapes, edges, vertices's of Cubes
To understand size differences- how shape changes in dimension according to varying size.
To identify and learn about ascending and descending order.
To sort and arrange the blocks in ascending and descending order.
To develop gross motor skills

Advantages
Very Simple in construction(less complex)
Cardboard - material, Low cost
Easy to make
Easy to manufacture

Drawbacks
Takes lot of shelf space to store.
Cannot use to form complex shapes/ doesn't lead to further exploration.
Not multi-purpose in nature.
Apart from just identifying/feeling the product it Doesn't have any point of interest/ element of surprise to use further.

Availability of Similar products/Better products
Similar products which can be used to explain basic geometrical ideas are available in market which are made up of Wood, plastic etc.

Further possibility of Design/ Re-design?
A product which could collapse/transform and occupy lesser space would be more appreciated, but should not become costly or much complex. A tactile "guide" which will help the student to start from the first step to further will help more to learn herself/himself.

Description
Another version of simple Abacus

Uses
Counting numbers, addition, multiplication, division, subtraction.
To develop motor skills
To touch and feel the shapes of beads - develop fine motor skills.

Advantages
Simple in construction(less complex)
Plastic and stainless steel - Easy to make & manufacture.
Good design

Drawbacks
Takes a bit more of shelf space to store, compared to planar abacus

Availability of Similar products/Better products
Various kinds of abacus with different forms and having different types of beads are available. Most of them are good and affordable.

Further possibility of Design/ Re-design?
Even though there are not much draw-backs for the abacus, making it compact and collapsible without compromising any existing advantages would be good. Giving multi-purposefulness, making it more interesting in a way that creates a pull factor in child to use it again would be challenging.

Description
simple Abacus

Uses
Counting numbers, addition, multiplication, division, subtraction.
To develop motor skills
To touch and feel the shapes of beads - develop fine motor skills.

Advantages
Simple in construction(less complex)
Plastic - Easy to make & manufacture.
Good design

Drawbacks
Takes a less space, can fit in school bags and carry bags

Availability of Similar products/Better products
Various kinds of abacus with different forms and having different types of beads are available. Most of them are good and affordable.

Further possibility of Design/ Re-design?
Even though there are not much draw-backs for the abacus, any new innovative ideas are always welcomed.

Description
Cardboard cut pieces to explain the concepts of Liter and weight-kilogram

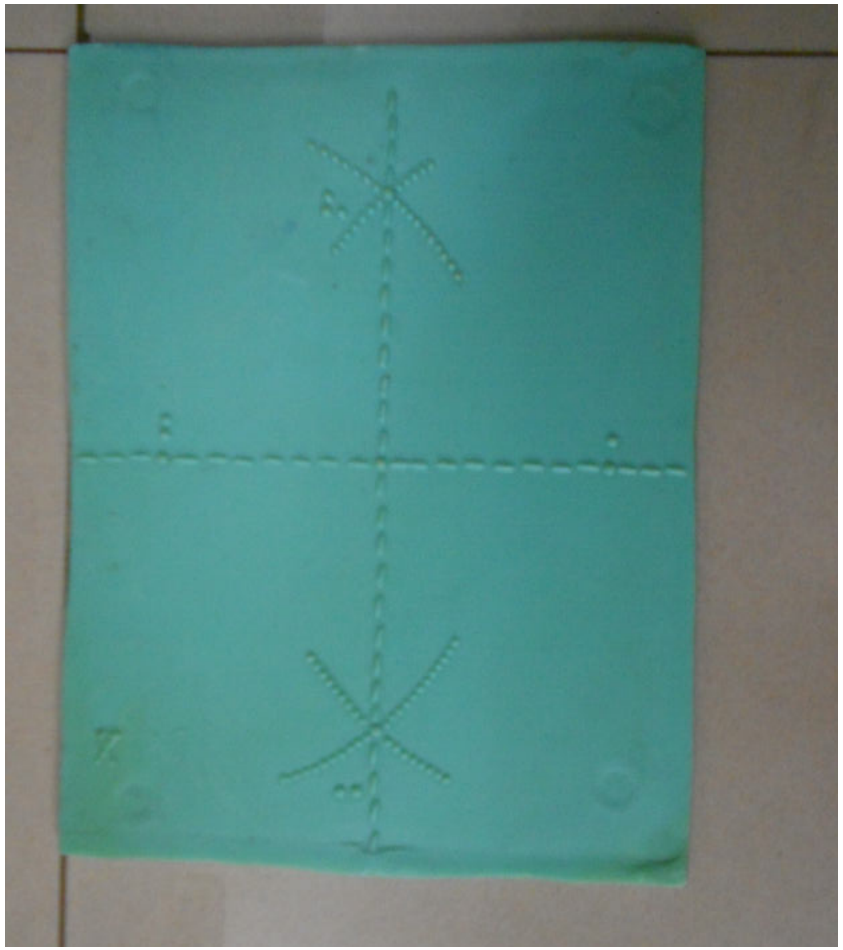
Uses
To teach/make understand the concept of liter and kilogram - to low vision students

Advantages
Very Simple in construction
Cardboard- can make at home too.
Very cheap

Drawbacks
Just an indication to the actual objects.
Doesn't really help blind children to grasp the idea completely.
Might cause confusion.

Availability of Similar products/Better products
Such cutouts from charts and cardboards are available but are only good for children with vision. Sometimes people actually use real world weights and measuring containers to explain the concept

Further possibility of Design/ Re-design?
There is a need for a teaching-learning aid to explain the concepts of liter, volume, weight etc. It should be compact and easy to handle and also easy to understand.



Description
Geometry construction embossed on plastic sheet

Uses
To teach/make understand the concept of equidistant points

Advantages
Very Simple in construction
Plastic- can last long, durable
Very cheap

Drawbacks
Takes a big thick sheet to make understand one concept.

Availability of Similar products/ Better products
There are embossed books which are specially printed for blind children. Also there are similar such items available.

Further possibility of Design/ Re-design?
To make the constructions easily will help to make custom diagrams.

Description
Custom made cube for counting. (This version is made by one of the faculty of NAB, out of paper and wire similar to an existing product). Small plastic square beads are used with this for simple addition and subtraction.

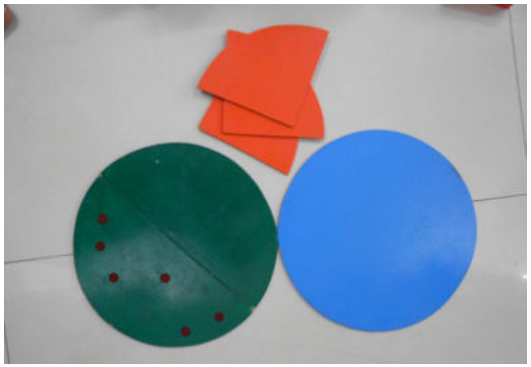
Uses
To learn counting

Advantages
Self made- less/low cost

Drawbacks
Accuracy is lacking -which might create confusion in understanding shapes and lines.

Availability of Similar products/Better products
The actual cube consists of small modular pieces which can be combined to form a bigger cube.

Further possibility of Design/ Re-design?
Modular units which can combined to form a cube and something more will be more useful.



Description
Geometry set - circle, semicircle and quarter circle

Uses
To teach/make understand the concept of simple fractions
Understand the size and shape of circle, semi-circle, quarter circle etc.

Advantages
Very Simple - to understand
Made out of wood- locally available & Eco-friendly material

Drawbacks
The shapes doesn't stay together while putting together -while touching and identifying each part move separately - which creates problems.
Apart from the shapes given, there is nor further level of learning.
Not multi-purpose in nature.
Apart from just identifying/feeling the product it Doesn't have any point of interest/ element of surprise to use further.

Availability of Similar products/Better products
There are few similar products available . made out of wood and plastic, but ability to make custom shapes are Lacking. (Means apart from the given pieces further arrangement of pieces are not really possible)

Further possibility of Design/ Re-design?
Aids/products which can stay when arranged together (should not move with small push/pull/tilt/shake of set). Multi-purposefulness will be a great idea.

Description
Set - to develop motor skills, addition and subtraction

Uses
To hold and put the pegs properly, in place
- develop fine motor skills
Simple counting, addition and s
4 in a Row Game- Tactile.

Advantages
Very Simple - to understand
Made out of wood- locally available & eco- friendly material
Good for beginners

Drawbacks
Heavy weight
There is nor further level of learning.
Not multi-purpose in nature.
The pegs, gets removed from the slots while identifying/checking with hands.

Availability of Similar products/Better products
There are similar products available in the market made out of wood and plastic.

Further possibility of Design/ Re-design?
A similar product with more function would be good

Description
Small wooden thick panels with numbers and slots.

Uses
To learn numbers from 1-9, develop fine motor skills

Advantages
Very Simple - to understand
Made out of wood & plastic,
Good for beginners - low vision students

Drawbacks
Takes more space

Availability of Similar products/Better products
There are similar products available in the market made out of wood and plastic.

Further possibility of Design/ Re-design?
A similar product with more function would be good.

Description
4 in a Row Game- Tactile
A product for playing game

Uses
To learn and play simple games
Interact with product and other payers

Advantages
Uses the learning of simple addition of maths
Made out of plastic, - durable & long lasting
Good for beginners

Drawbacks
The stand of the product broke due to rough use
Hard to take the chips at the end of activity

Availability of Similar products/Better products
There are similar products available in the market made out of plastic. There are different versions available. Products with other functions are also available.

Further possibility of Design/ Re-design?
The product is already designed and developed with many iterations and variations. If designing/developing this product, a real innovation would be required.

Description
Toy set -Construction set

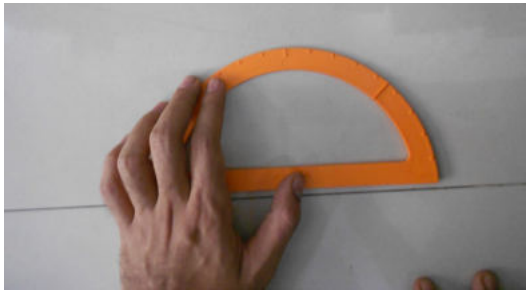
Uses
To identify basic geometric shapes and their construction and use of nuts, bolts and other simple fasteners.

Advantages
Bit complex- yet can learn different skills
Made out of plastic -long lasting and durable, lightweight
Good for advanced learning

Drawbacks
Cannot be given to beginners,
The guide/sheet is either missing/not provided to tell/direct what to do.
Requires another person to help in validating the construction.
Small parts can go fixing.

Availability of Similar products/Better products
There are similar products available in the market made out of plastic. Lego and other construction sets are also available.

Further possibility of Design/ Re-design?
A similar product with different levels of complexity would be good. So that beginners can continue with simple ways and then gradually get into complex levels.
Should be light weight, durable, the parts should not go missing/ should be easy to find.



Description
Geometry set -for construction

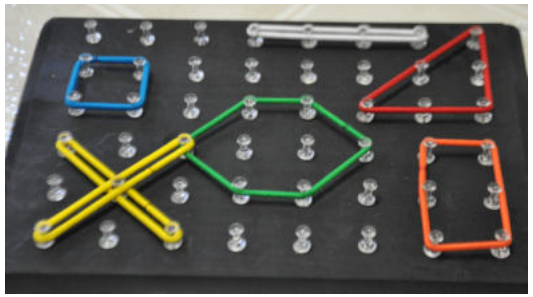
Uses
To draw custom shapes onto braille sheet, plastic sheets, other sheets - for blind children

Advantages
Very similar to the existing geometry set for sighted.
Small and compact
Made out of plastic- durable, long lasting.

Drawbacks
Can only be used after developing fine motor skills and
Advanced level learning in maths

Availability of Similar products/Better products
These products are available in market, different level sets are also available.

Further possibility of Design/ Re-design?
There is much less opportunity for designing/re-designing this product, since a new design might create extra learning curve which is not really required right now.



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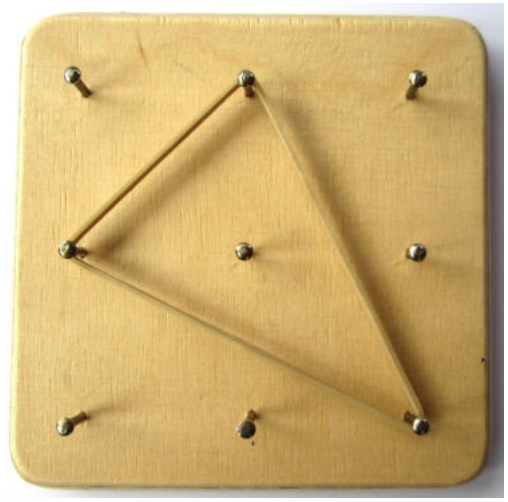
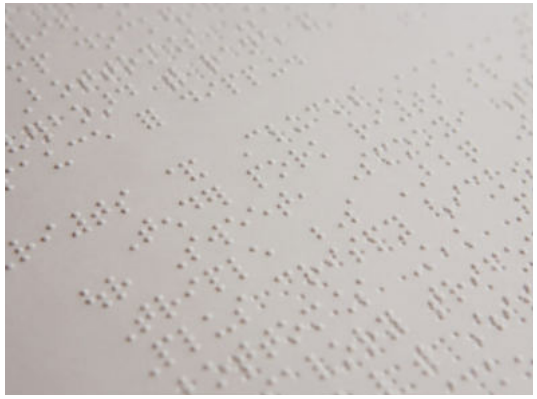


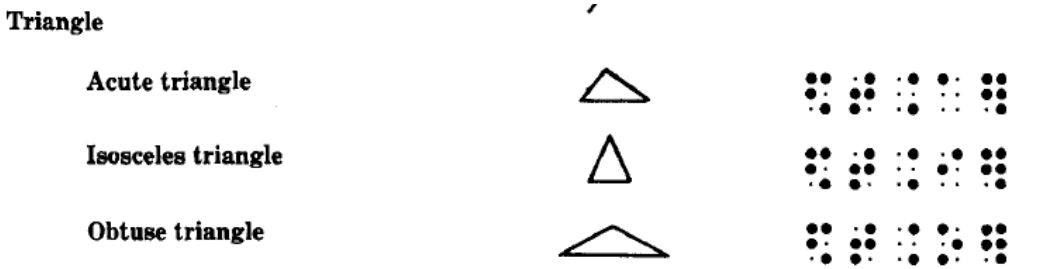
https://www.google.co.in/imgres?imgurl=https://upload.wikimedia.org/wikipedia/commons/4/4c/Geoboard.JPG&imgrefurl=https://en.wikipedia.org/wiki/Geoboard&h=2756&w=2777&tbnid=jD9PAfSos-6FeM:&docid=uje5ex-Jpx5LXtM&ei=a83mVp2gJIO10gTf35rQCg&tbm=isch&ved=0ahUKEwjdgdyft-MDLAhWDmpQKHd-vBqoQMwg0KAMwAw

Geo-Board

The geo-board is a multi-purpose board. This can be used for showing geometrical figures and graphs. It is a peg board, square or rectangular in shape with nails at equal distance, both lengthwise and width wise. The distance between the nails can be determined according to the levels of the students. For example, the distance can be brought down even to one centimeter in the case of children of higher classes, whereas it should be at least one inch in the case of primary school children. This geo-board is a wonderful companion to the teacher of visually impaired children, especially in the teaching of mathematical concepts. Rubber bands can be used to show various shapes. When the distance between the nails is smaller, even circles can be shown. A Magnetic Board with magnetic strips and magnetic pieces pasted with braille symbols may also be useful for presenting learning materials in a spatial format.



The Nemeth Braille Code for Mathematics is a Braille code for encoding mathematical and scientific notation linearly using standard six-dot Braille cells for tactile reading by the visually impaired.



An example of how triangles are depicted in nemeth code (Above)

Construction

Construction activities for visually impaired children are of **two types**. **Firstly**, making three-dimensional objects out of small pieces and **secondly**, construction of a two-dimensional tactile figure based on the given measurements. In the first case, small blocks can be used to construct three-dimensional figures. Cut-outs can be prepared and used for explaining certain concepts. For example, the Pythagorean theorem can be explained very effectively with the use of cut-outs and the child himself can be oriented to measure the area of the squares on the base and the opposite side and compare their sum total with the area of the square of the hypotenuse. This develops the discovery skill of the visually impaired child. The circumference of a circle can be measured using a thread and the volume of the globe can be measured by filling it with water and so on. There are many 20 activities which can be made more meaningful for the visually impaired child by a creative teacher.

The second type of construction is the actual drawing of the diagram by the child. Even though this is complicated to some extent, there is no doubt that the visually impaired child can understand the procedures and draw figures if necessary equipment are provided. Suppose the child is expected to draw a straight line, a tactile scale can be used and the child can draw the line with the use of wax or crayon pencils. The wax can be felt later to trace the line. A wax pencil instead of a normal pencil can be used in a normal compass to draw a circle.

It is very essential that the child receives adequate training in these areas before he/she uses these equipment independently. Relief papers are also used in schools for drawing diagrams in mathematics. The relief papers which provide upward embossed impressions straightaway assist visually impaired children as well as the teacher to deal with geometry effectively. At each and every stage of the construction of the diagram, the child will be able to assimilate ideas. When relief papers are not available, the tracing wheel can be used to draw the embossed diagrams. Since this type provides downward impression, the entire diagram has to be mirrored while drawing.

The above principles highlight the importance of teaching aids which can make the learning of mathematics more interesting to the visually impaired child. Even with all available resources, a teacher who is less creative may not derive maximum benefit for visually impaired children from the teaching aids. Therefore, it is vital that the teacher tries to be more creative so that he can bring utmost variety to the education of the child.

Classroom Difficulties

Understanding/solving custom & new problems- takes time to understand
Creating new problems/questions
Slight/minute differences
Translating activities and actions into mathematical language
Generalizing-finding similarities in different activities in everyday life.
Translating 3D into 2D

General Inferences after the study

Most of the TLA/TLMs (teaching-learning aids/materials) used can deliver the idea/concept/learning which it is indented to. But after that there is no further interaction with them.
There is less interest among children start using it and also less interest to go back and use again.
Concreting of concepts happen very less and at a slow rate.
Doesn't happen much interaction among kids with the current TLA.
Names are not given /forgotten.
Tasks for each products are not available/ the sheets are missing/ - requires a trained/experienced person nearby to demonstrate each step
Requires a person/teacher/guide to validate each steps.

Multi-purposefulness is lacking in most of the products
The volume of products are sometimes very large and occupies lot of space.
The products/aids doesn't leads to another level of learning.
Element of surprise is lacking in most of the products.

Next step

A look at the existing methods/ways of learning/understanding the concepts of Maths-Geometry

A study globally about the various methods to teach/learn maths- geometry was done. Also a look the products which are used in another organization XRCVC is also done.

Learning aid

Learning aids enhance one's learning abilities and help to increase one's learning potential. Learning aids help individuals grasp the concept of learning new skills and techniques by seeing, hearing and touching, smelling and tasting but most of all by exploring the environment around them.

Pros

Doesn't need much external help to understand/learn.
Interaction between the person and object/aid.
Doesn't need other children/person to enable learning.
Enables self learning

Cons

Since the child can learn himself, if he makes some mistakes and no one corrects it, then it will be a problem.
Less interaction between individuals
No push/pull factors to learn/understand.
No/less possibility of learning involvement.
No/less validation of learning/understanding. (computers/smartphones/other smart devices are exceptional cases)

Teaching aid

Any device, object, or machine used by a teacher to clarify or enliven a subject/concept

Pros

The teacher can deliver and alter/modify/develop information according to context.
Varied teacher roles, from information deliverer to architect of educative experiences
Interaction between the child, teacher and object/aid.
The teacher/instructor can validate the learning.
Teacher can push/pull child into learning

Cons

Might need an expert/instructor to explain the concepts.(Need an external help)
The further development of learning happens linked to the instructor.
Sometimes complex aids/products beyond the grasping capacity of child.
Depend on the skill/knowledge base of faculty

Games

a physical or mental activity or contest that has rules and that people do for pleasure (one of the definitions)

Pros

Helps With Fast Strategic Thinking & Problem-Solving
Can evolve skills and other learnings with time with push/pull factors
Interaction between aids/products/objects and player/players
Beneficial Specifically For Children With Attention Disorders
Can create interest in child/person to come back for further interaction/learning.

Cons

Creates a series of developmental challenges for the learners.
Game culture and play could be a disadvantage to the learner if not designed correctly.
May loose focus on learning and might directed to other directions.
Might require new reward strategies (other than visual)

Selection of "**Method**"

After analyzing the possibilities of Teaching-Learning Aids and Games, With guide , we found out that taking/going by the method of developing teaching learning aids are more appropriate for the context. Even though Games with physical entities are good medium to teach blind children it is more appropriate to develop the aids/products to teach and learn, then develop/design games if required.

Selected method

"Teaching-Learning Aids for delivering the concepts of Geometry / to make understand/learn/teach the geometrical concepts to blind children."

Age group
8-15 years of age (blind children)

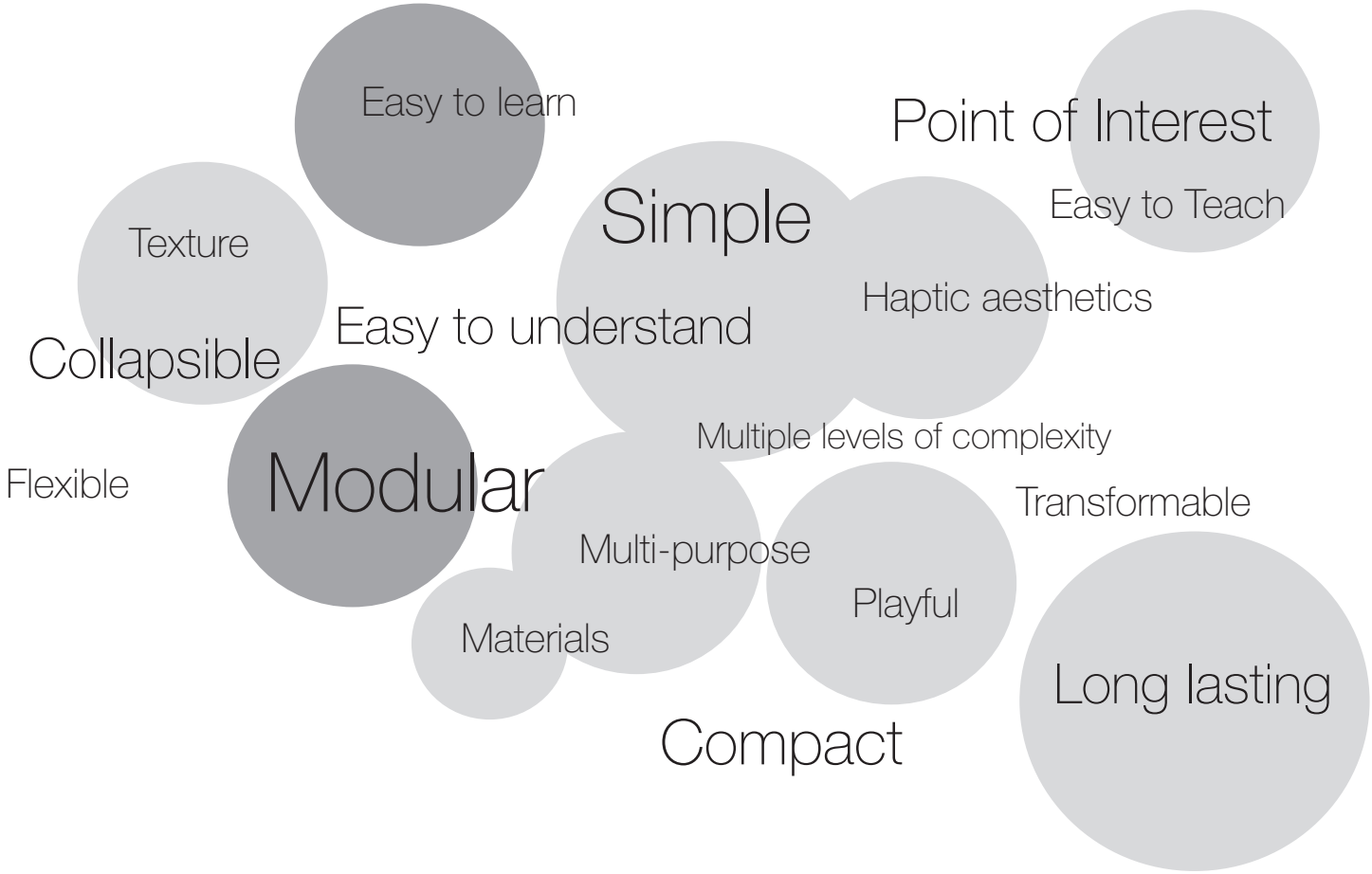
Design Brief

To design/develop Teaching-Learning aids for the concepts of Geometry in Mathematics for the blind children.

The cost should be very low as possible and should be a good value-for-money product. The product is aimed at lower middle class and middle class.
There is no constraint for the materials as long as it will be durable, long-lasting, easy to manufacture and low cost.

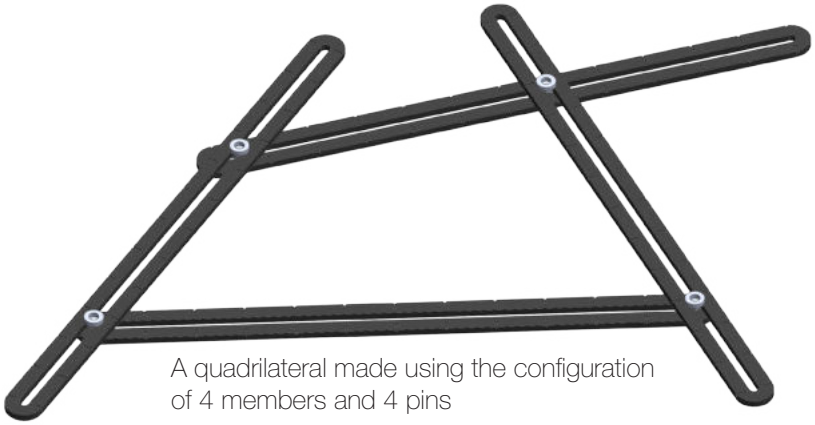
Other considerations
i. It should be strong and sturdy so as to withstand the manipulation of the visually impaired child.
ii. As far as possible, sharp edges should be avoided in three-dimensional aids for visually impaired children. Sharp edges may be made blunt to avoid injuries to the Braille reading fingers.

WORDCLOUD

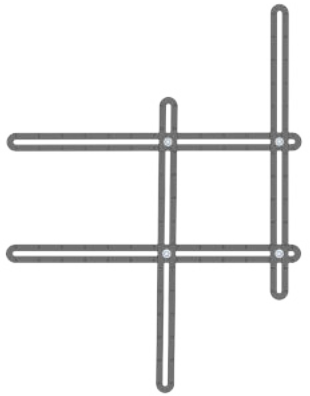

Easy to learn
Point of Interest
Simple
Easy to Teach
Texture
Haptic aesthetics
Easy to understand
Collapsible
Multiple levels of complexity
Flexible
Modular
Transformable
Multi-purpose
Playful
Materials
Long lasting
Compact

Ideation

There were a few ideas I came up with for the context. First of all it was a bit hard to come up with ideas since the product has definite purpose to cater to and cannot be made in different manner. The usability of product in a feasible way, was also an aspect which reduced the rate of generated ideas. Ideas which were having complex joinery and other details were omitted while going to concept stage. Integration of electronics was thought in the initial stage but later kept aside since it might over complicate the learning curve.



A quadrilateral made using the configuration of 4 members and 4 pins

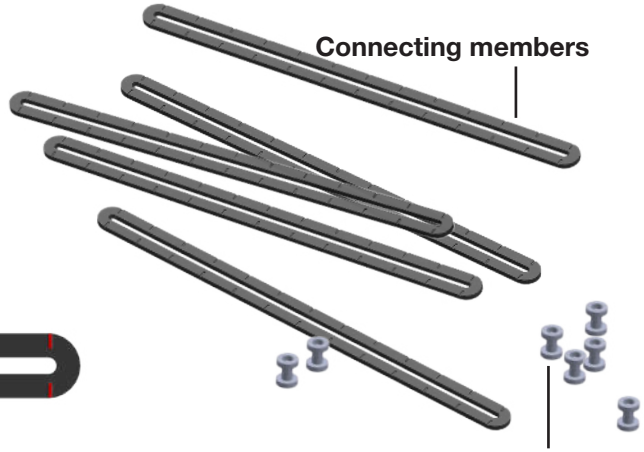


A Square made using the configuration of 4 members and 4 pins

Geometry Flexi-frame

This idea is for constructing 2D shapes. There will be long connecting members with slot in the centre. The members will be joined using two sided pins, in which one can detach the head and attach it like a screw. Tightening the screw will fix the joint.

Such an arrangement can be used to create any 2D shape, of any angle and any length of side(depending on the length of the members).



There will be marking debossed on the scale at the interval of 1 centimetre.
(embossing/protruding markings will effect the movement of members.)

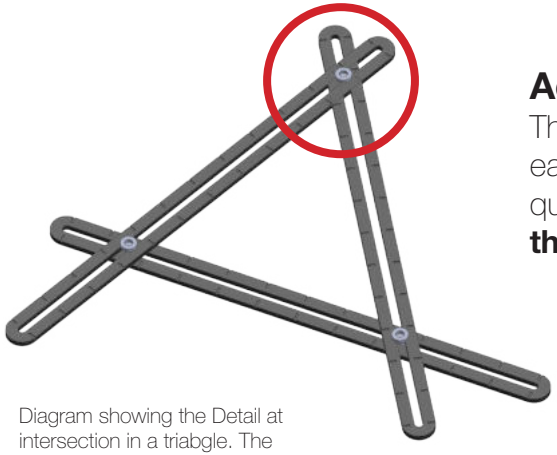
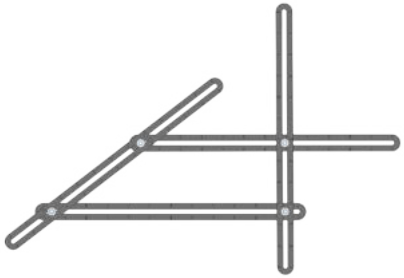


Diagram showing the Detail at intersection in a triabgle. The members have to be at an angle to be joined.

Advantages

The major advantage is that one can easily make any 2D shape easily and quickly with the **loosening-adjusting the mebers-tightening.**



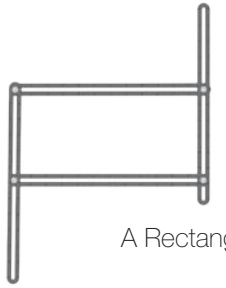
A Trapezoid made using the configuration of 4 members and 4 pins

Diagram showing the height level of members in a quadrilateral (4 members) **: EVEN members**

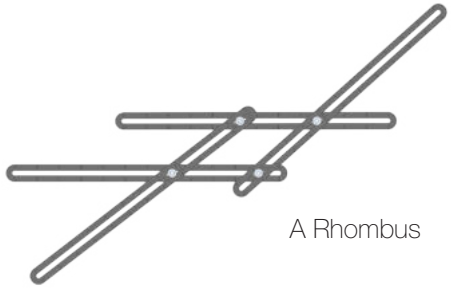
Diagram showing the height level of members in a triangle (3 members) **: ODD members**

DisAdvantages

The major dis-advantage with the idea is shapes which have odd number of sides will be difficult to make. It has to either flex or need to use a special joinery for odd-numbered shapes.



A Rectangle



A Rhombus

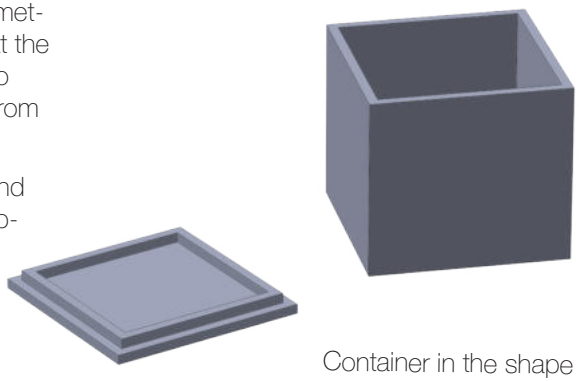
Dabba/Container - idea

A cylindrical container which has lids

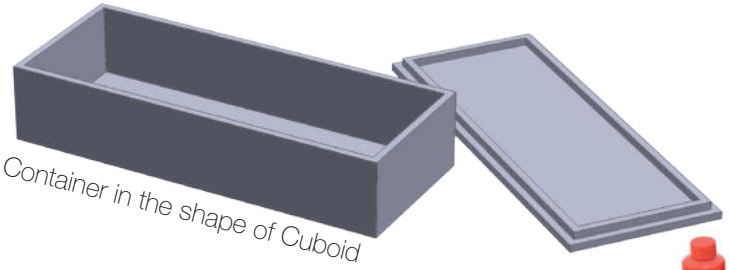
Advantages

The idea is that, the user can use the geometric containers to teach the geometry and at the same time the user is getting a container to use for storage. An additional value apart from teaching/learning.

The idea of using as a storage container and using for teaching/learning, was not well appreciated.



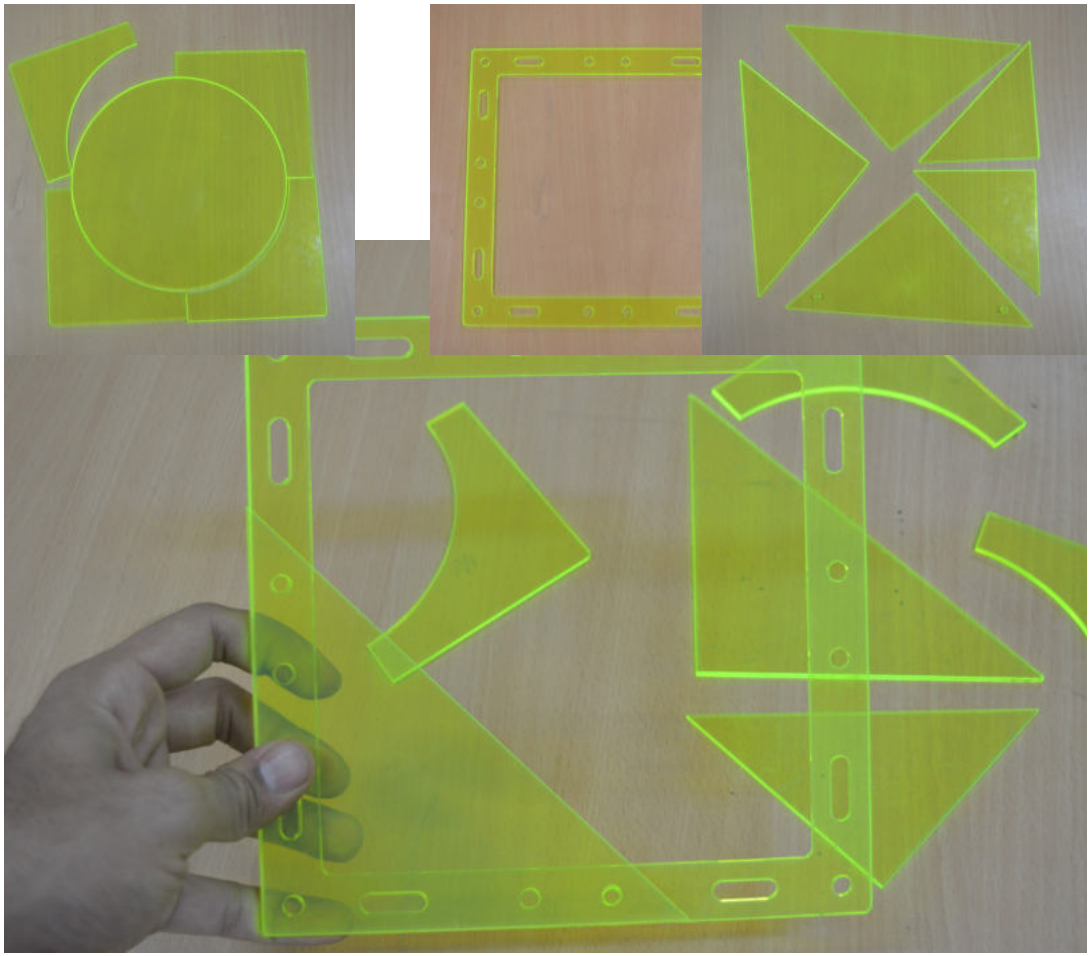
Container in the shape of Cube



Container in the shape of Cuboid

http://g-ecx.images-amazon.com/images/G/01/aplusautomation/vendorimages/724779da-b416-48b6-9bf5-cea54003afe6.jpg._CB293119299_.jpg

Concepts



Concept 1

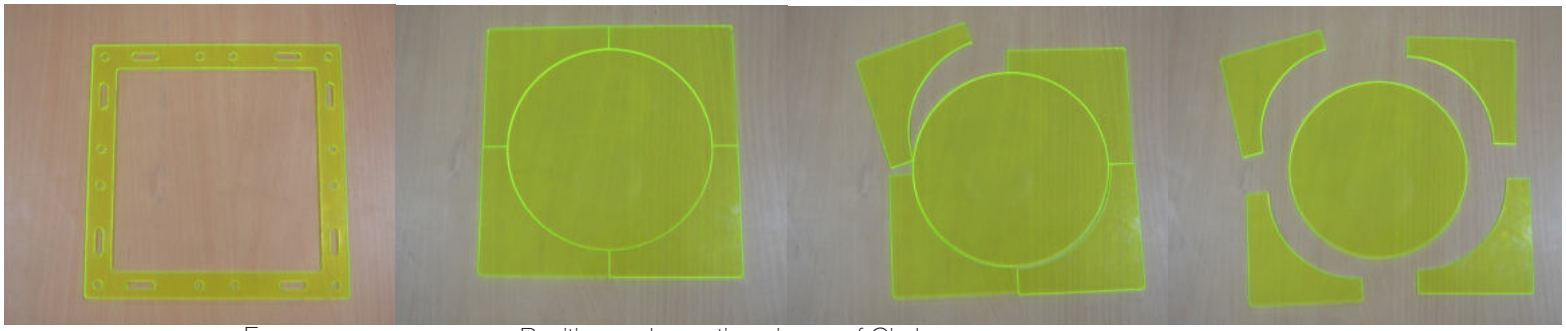
(For teaching Understanding Elementary Shapes 2-D)
Classification & types of triangles (on the basis of sides, and of angles)
• Types of quadrilaterals – Trapezium, parallelogram, rectangle, square, rhombus.
• Simple polygons (introduction) (Up-to octagons regulars as well as non regular).

Geo-frame

What is the product?
The product includes a slotted square frame in which one can fix/put different shapes and can get different resulting shapes.
What will be given?
As part of this concept, A frame made up of plastic which has slots will be given. Like in the picture given below. In addition to that in the kit others shapes like, triangles and negatives and positives of circle will be given.

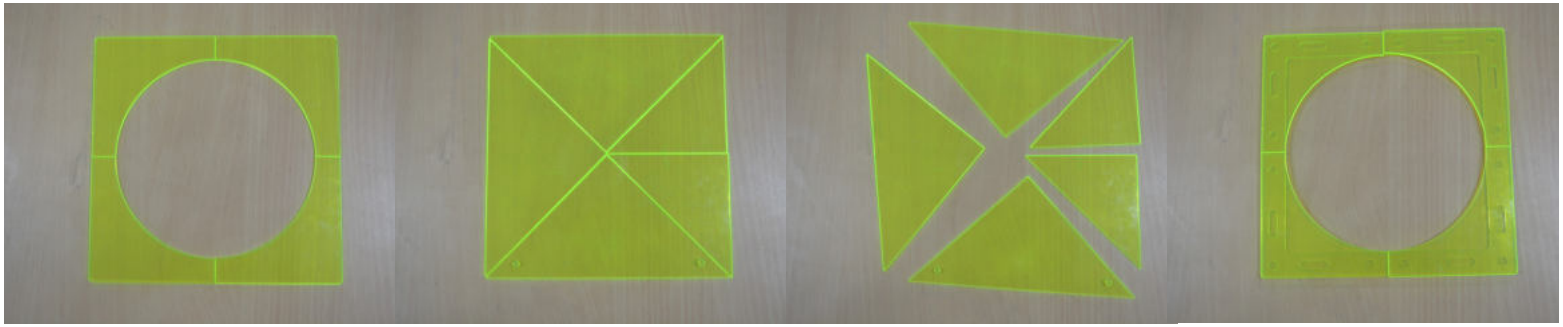
Who will teach/show how to use?
Initially the parents/teachers/other adults can arrange in particular orders and teach/make them learn. Once they understand about the basic shapes then the set can be used to create complex shapes and they can understand and give problems according to it.
But that is optional

What all content can be taught?
How does a triangle look like(feel like based on touch), how 2D shapes is like. How different triangles different, how basic shapes like square, rectangle and other shapes like trapezoid, etc. look like.

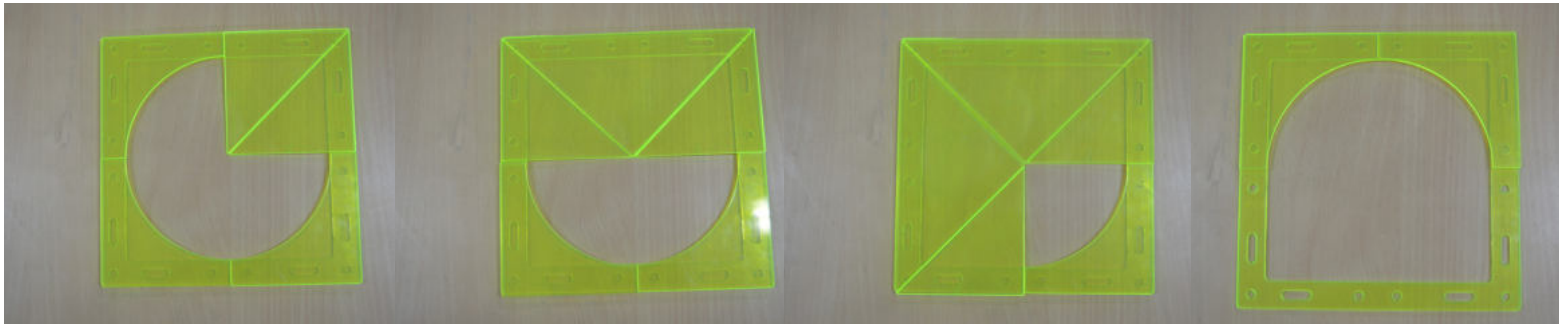


Frame

Positive and negative pieces of Circle.

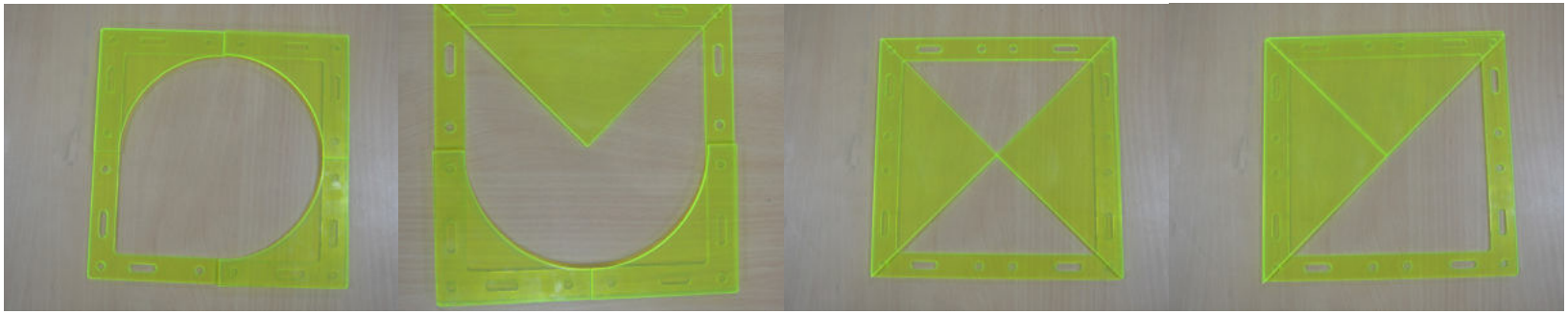


A square made up of triangles

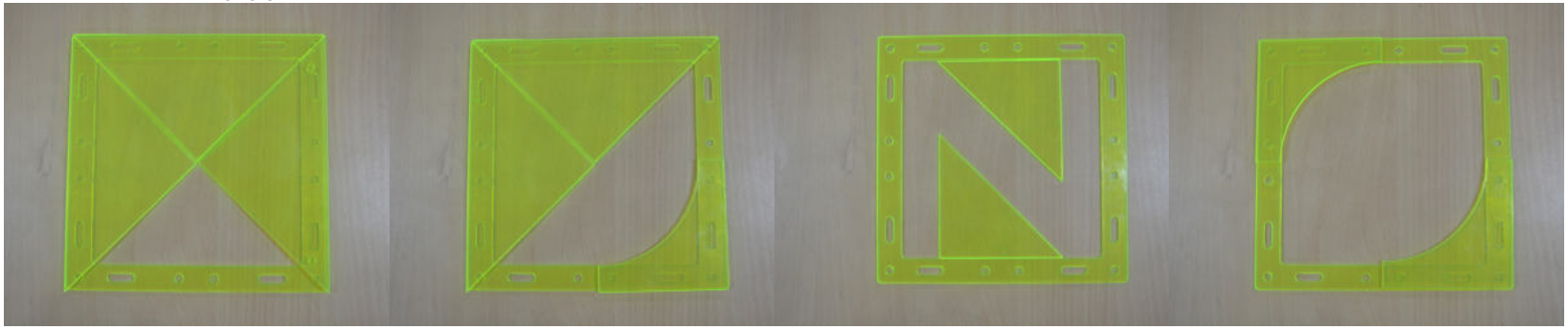


some of the possible configurations of Geo-frame

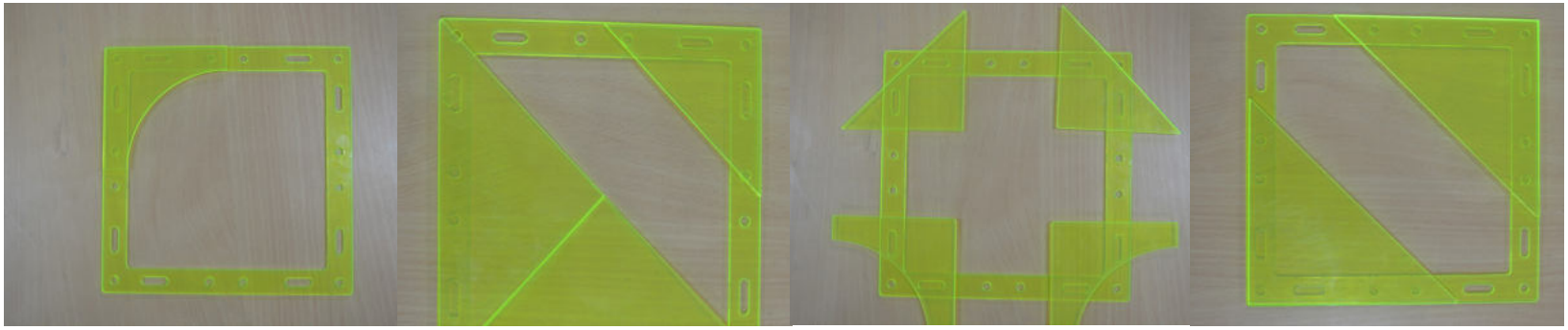
A quarter circle made up of
triangles and negative of circle



Custom shapes made using the combination of triangles and negative of circle



some of the custom shapes made using Geo-frame



some of the possible configurations of Geo-frame

Advantages of Geo-frame

The pieces will now sit exactly on the frame. With the different arrangement of pieces various resultant shapes can be made. The linear slots will allow to move the shapes slightly to fit in the frame.
A standard size frame can be used for various shapes.

Dis-advantages of Geo-frame

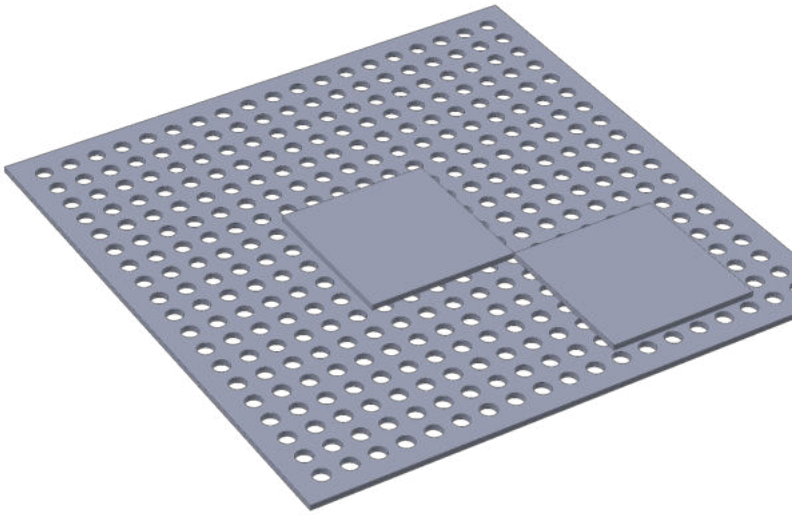
The major dis-advantages of Geo frame is, that any shape constructed will be on the frame and hence size is constrained, also there is no support towards the centre. It is less stable towards the centre.

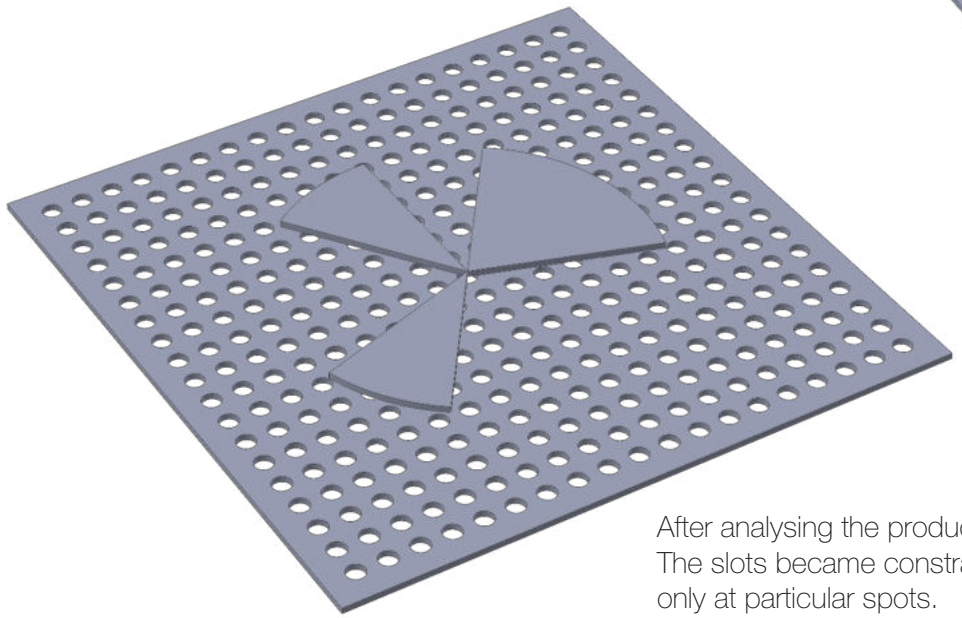
The Dis-advantages of Geo-frame **led to the modification** of frame to solid base with slots/holes.

Now the full base will act as a holder for the shapes to put on it. Shapes like square, rectangle etc. can easily be put.

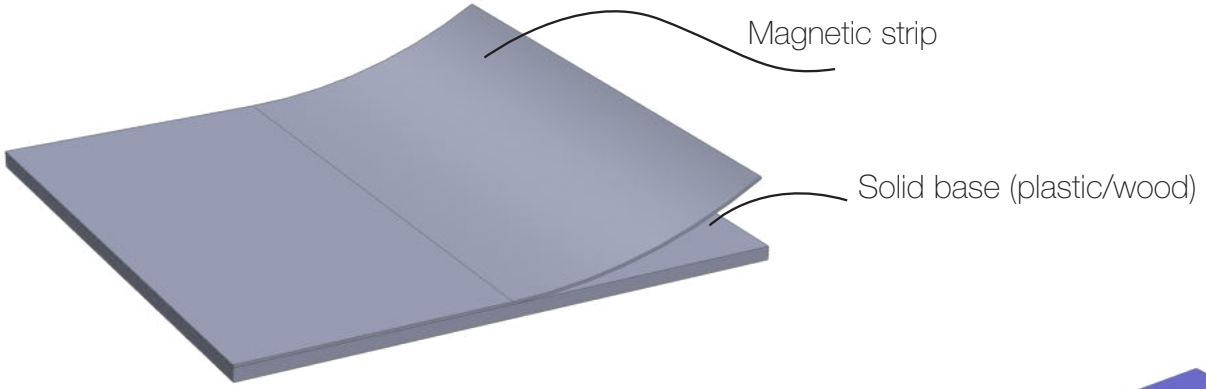
Modified Geoframe

The advantages over previous concept is that now size of shapes are not constrained. Any where can be shapes kept as long as their joining detail is in grid format.



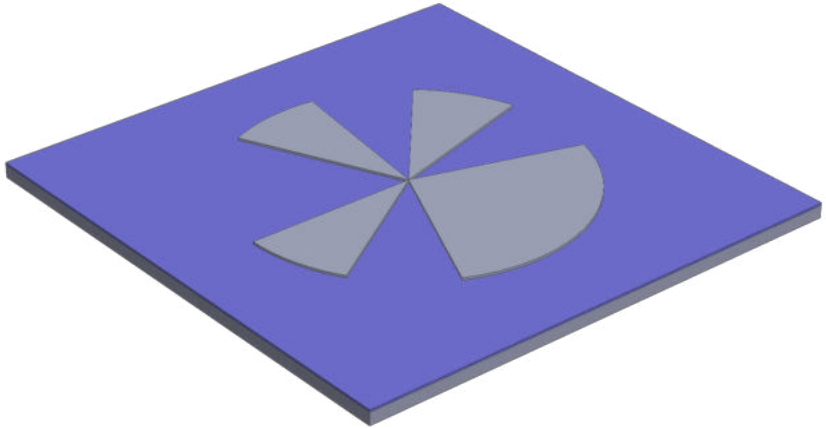


After analysing the product,There were still some laccuanes with the product. The slots became constraint at sometimes restricting the positioning of shapes only at particular spots.



What is the product?
The product will be a solid base, with a magnetic sheet on top layer to which the different shapes will be attached.

Who will teach/show how to use?
Initially the parents/teachers/other adults can arrange the shapes in basic forms and orders and teach/make them learn. Once they understand about the basic shapes then the set can be used to create complex shapes and they can understand and give problems according to it.
But that is something which is dependent on the learner/child.



The drawbacks of the Geo-base led to the thought of having a base in which the shapes can be kept at any place without any restriction and still hold in the place. Thus came up with the idea of having a magnetic sheet attached to the base which allows the pieces which will have metallic strips to keep in any place, the person wants

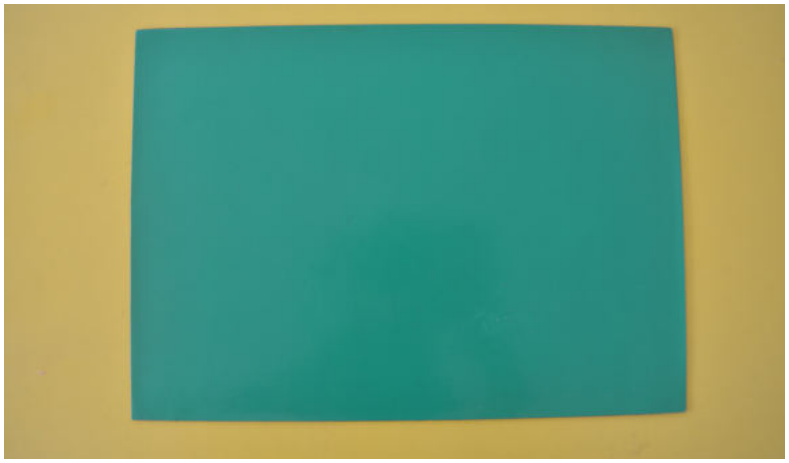
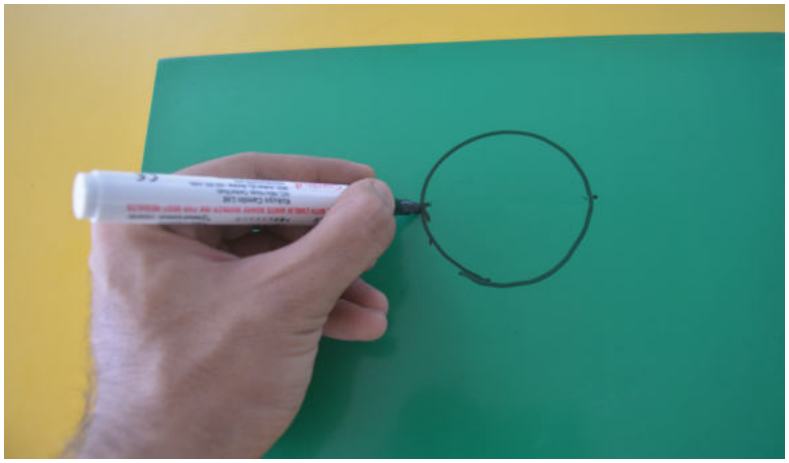
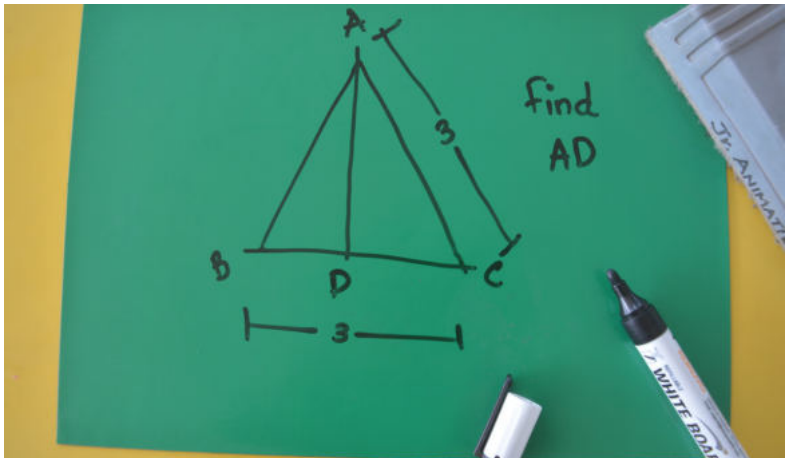


Photo of magnetic base



A circle shown with a white board marker



A diagram drawn on magnetic sheet

Marker and Eraser, (Use of whiteboard marker is only suggested to low vision students)

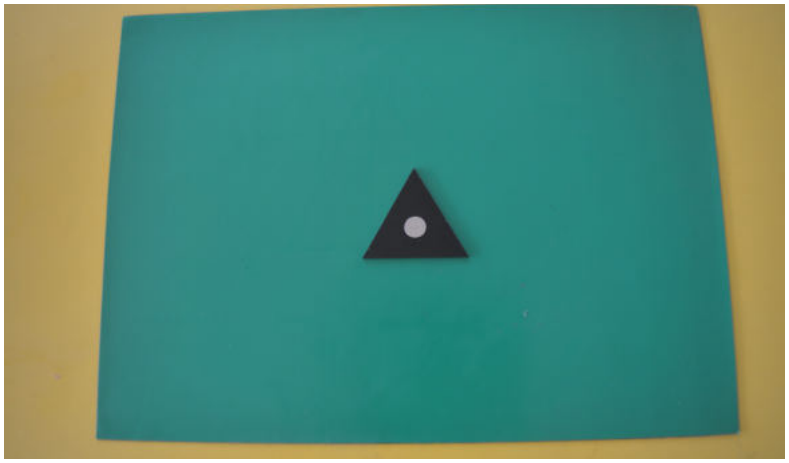


Photo of equilateral triangle put on the magnetic base

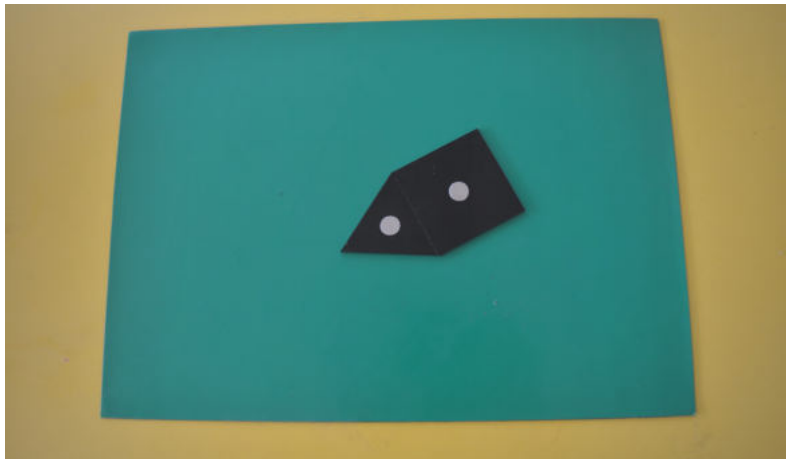
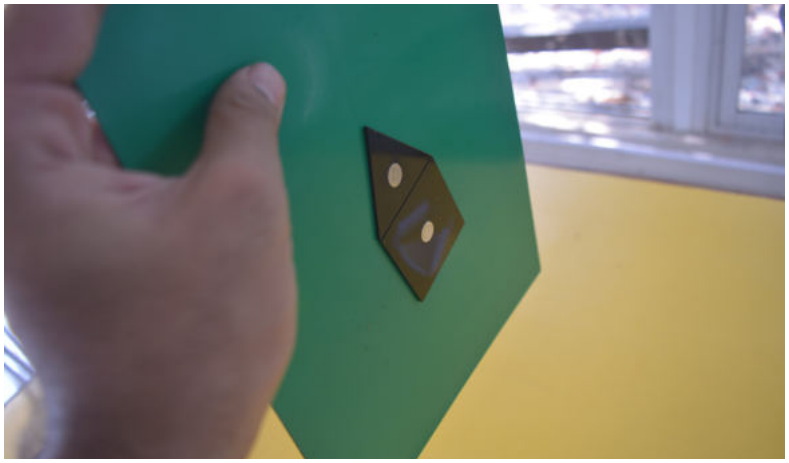


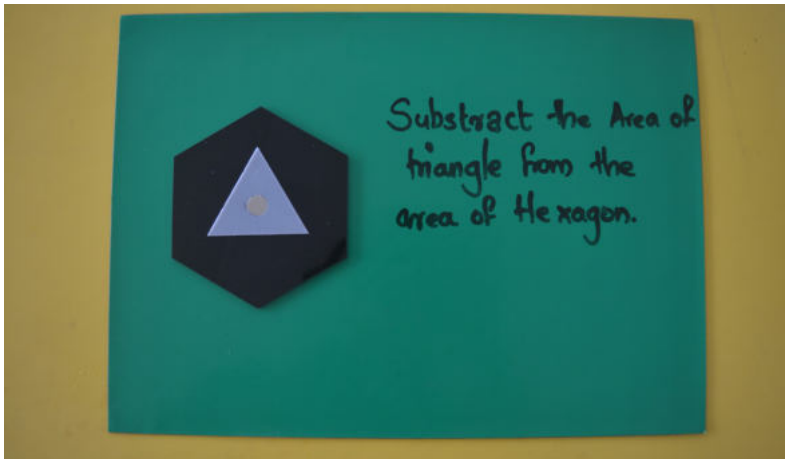
Photo of a composite shape made by joining a triangle and a square



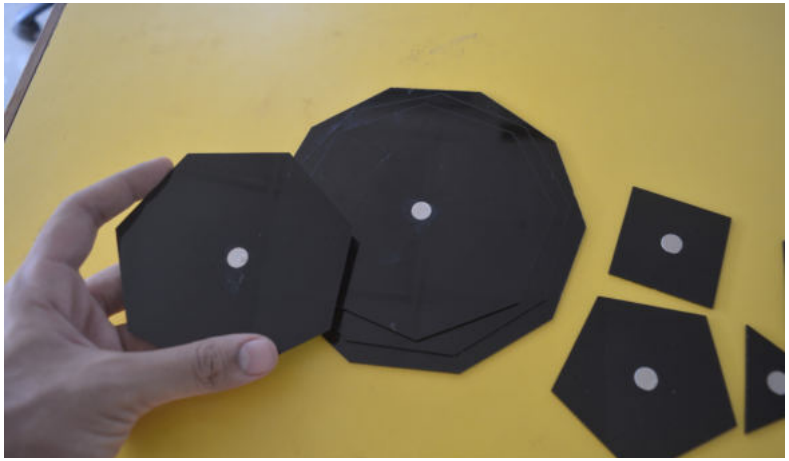
The pieces are stuck together even while the magnetic sheet is in vertical position

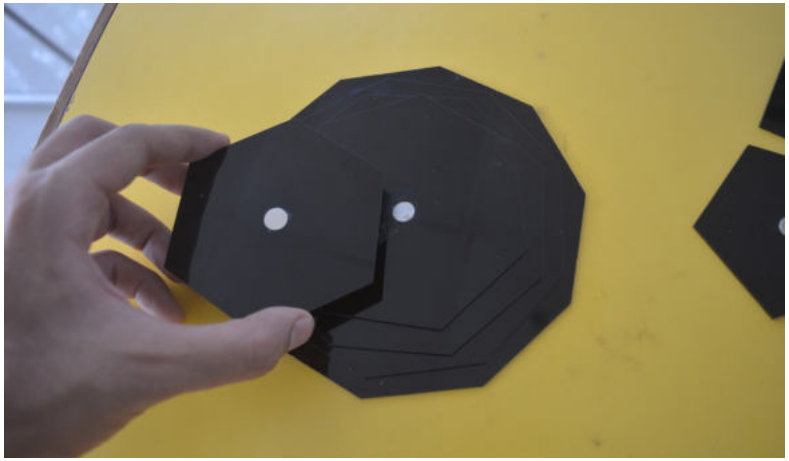
A photograph showing the flexibility of Magnetic sheet

A regular pentagon kept in hand

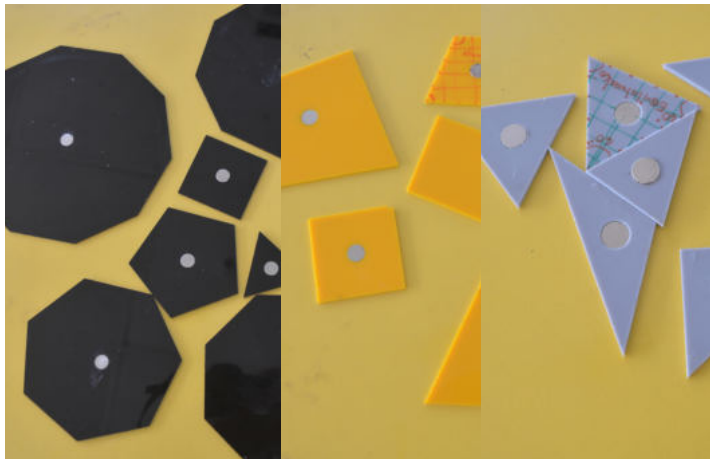


Shapes with problems given using whiteboard marker (suggested to low vision students.





Different pieces put together in ascending order



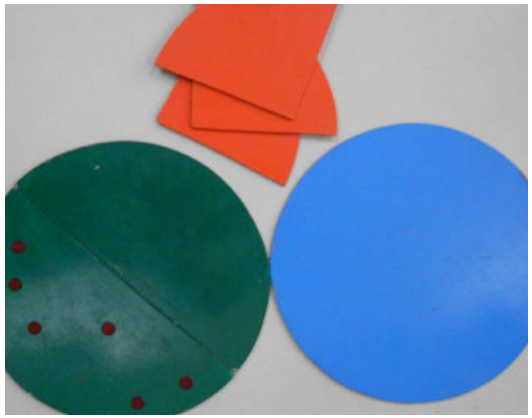
Photos of magnetic base and different pieces used with it.

GEO-BASE

Advantages of the proposed product for this purpose are
The magnetic base will hold together the shapes/pieces once kept on it. (While the blind child tries to recognize with his/her hands). It is particularly for the teaching-learning the concepts of geometry. One doesn't need to buy different sets. Once the child/learner is done with the basic shapes he/she can mix and match them to form. Complex shapes. These can also be used to give questions for solving.

Advantages of Magnets ?

Connecting member(between shapes). Keeps pieces together (wont get lost easily, wont get hurt, wont move while reading with hands)

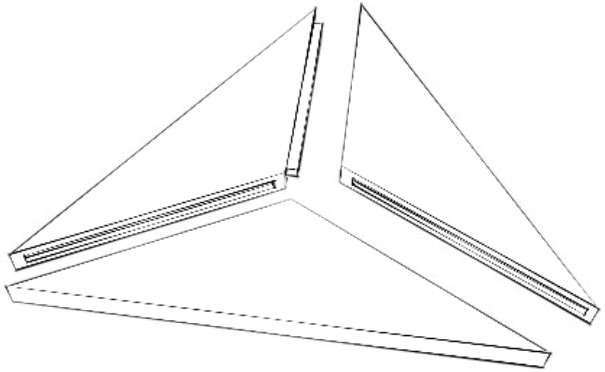


Advantages of existing products for this purpose are Simple and easy to understand.

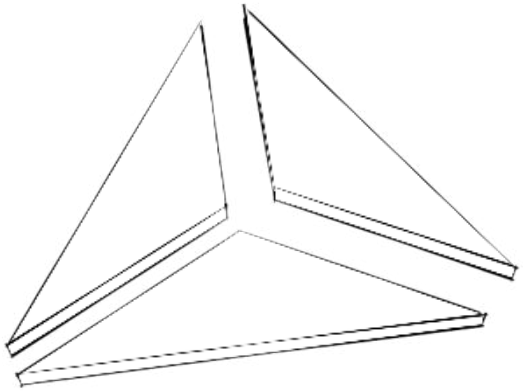
Dis-Advantages of existing products are there are no sets in particular. They doesn't really hold together once kept together. Limits to itself. Doesn't provide any additional opportunity to learn further even if the child wants.

Existing products for this purpose Even though there are no dedicated set for teaching the concepts of 2D geometry in maths (basic shapes), These are two among a few.

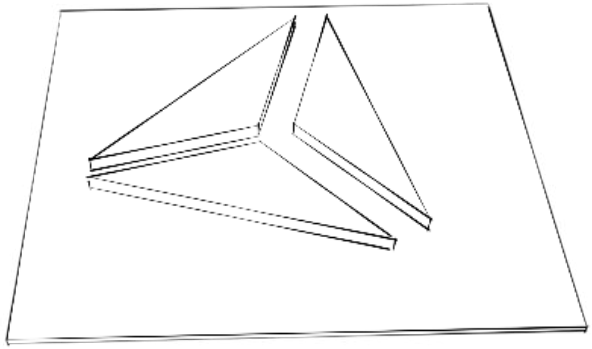
Exploration of joining details



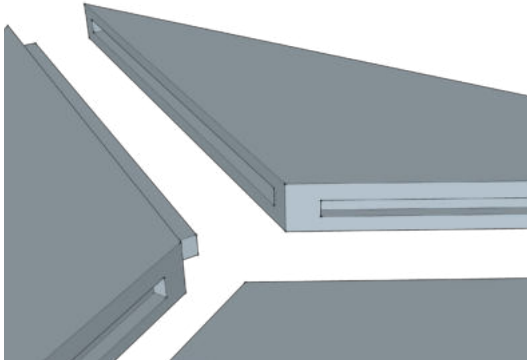
Attached each other with internal joinery (like tongue and groove/similar joinery)

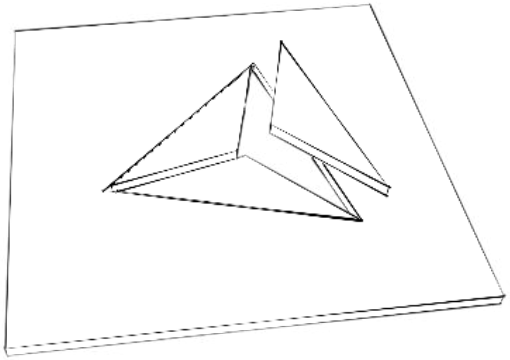


Just kept on any base



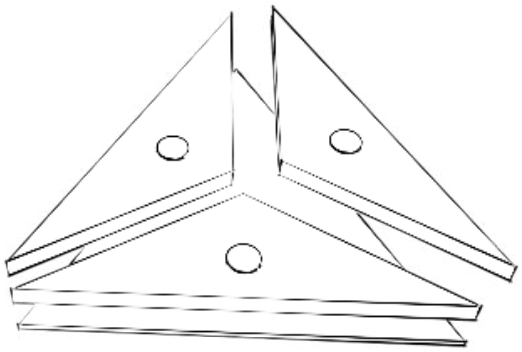
Attached to the base using Velcro.



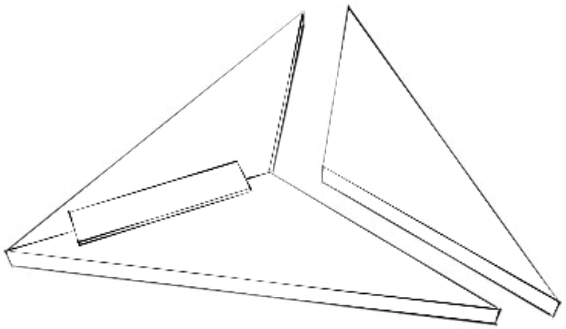


Slot in the base according to the shape

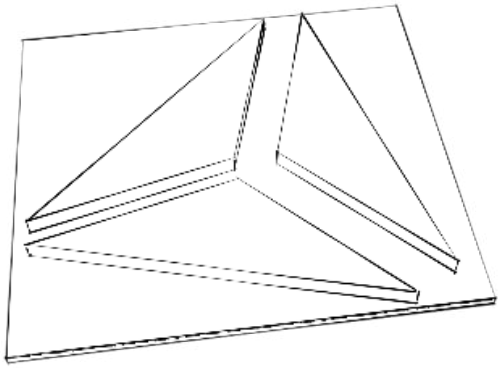
Exploration of joining details



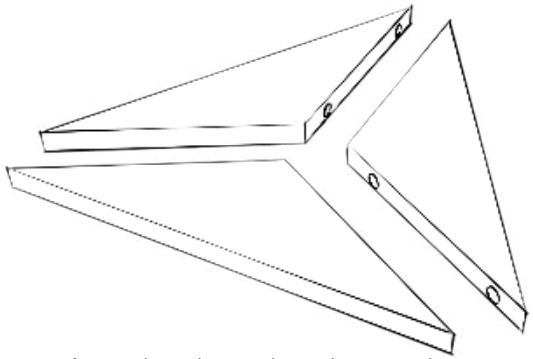
Attached to a metallic base, (each piece will have small magnets)



Attached each other with external joinery

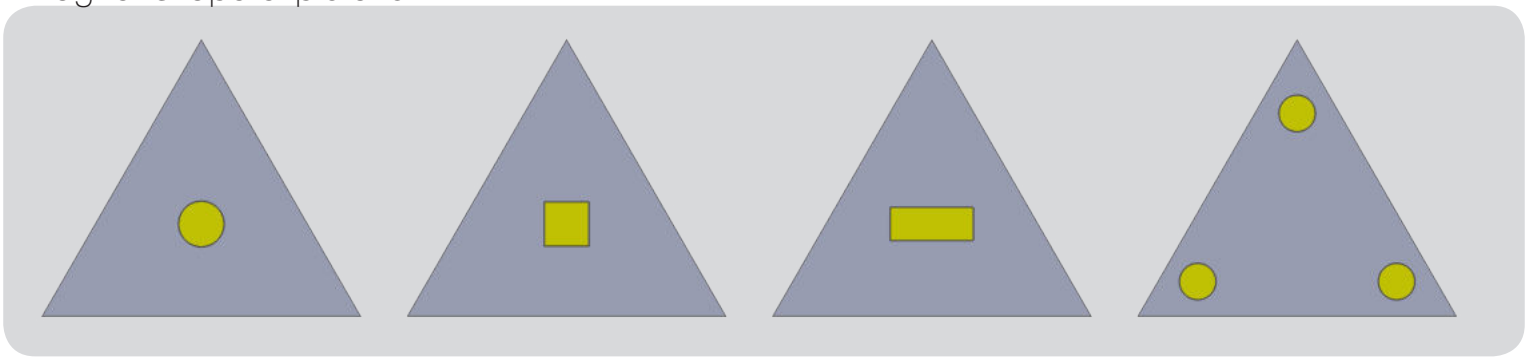


Attached to magnetic base.

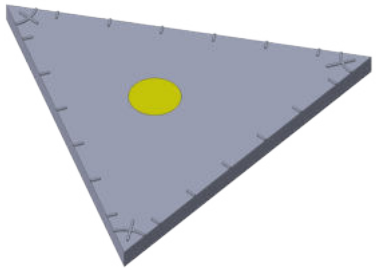


Attached each other using small magnets on the sides.

Magnet shape exploration

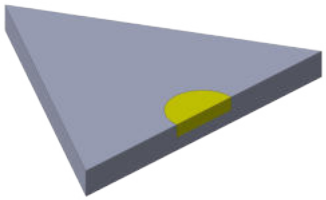


Exploration Details

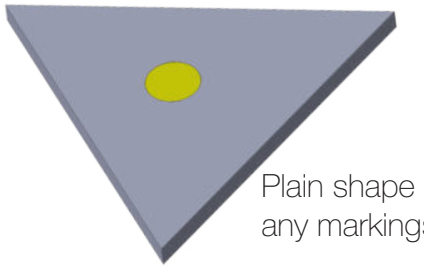


Shape marked with scale, angle and other details

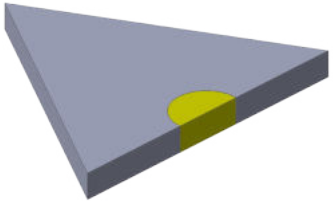
Magnet position



Magnet placed at half depth slot



Plain shape (without any markings)



Magnet placed at through hole

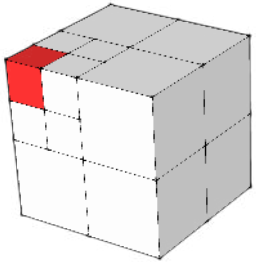
Concept 2

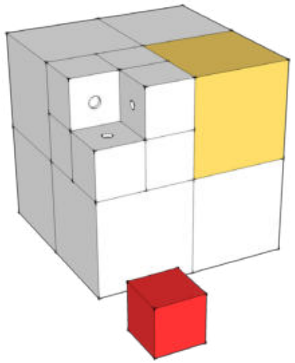
(for teaching/learning)
Identification of 3-D shapes:
Cubes, Cuboid, cylinder, sphere, cone,
Prism (triangular), pyramid (triangular and square) Identification and locating in the surroundings.
Elements of 3-D figures. (Faces, Edges and vertices)

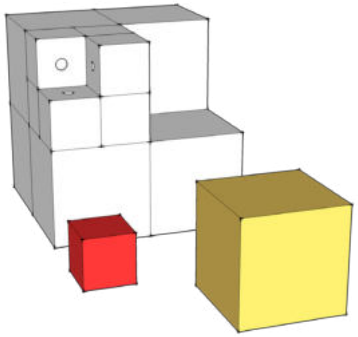
What is the product?
The product will be modular solids which can be formed to become a basic 3D form.

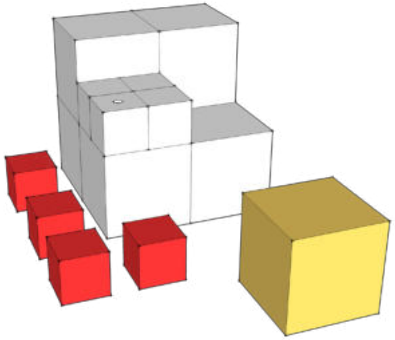
Who will teach/show how to use?
Initially in the assembled state teachers/parents/others can use it to teach/learn about basic forms. Once the initial phase of learning is done then the child can,with the help of parent/ teachers/others can disassemble it and engage in activities like assemble back, create another shapes and understand the constructions and other forms.

What all content can be taught?
Here a cube is taken as an example, the cube is made modular in different ways in different variations. When it is in the assembled state it can be used to teach about characteristics like edges, faces, vertices etc.

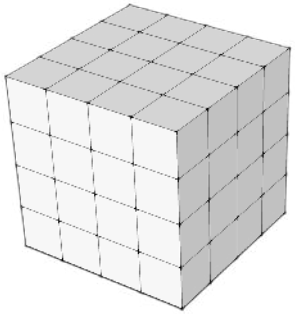


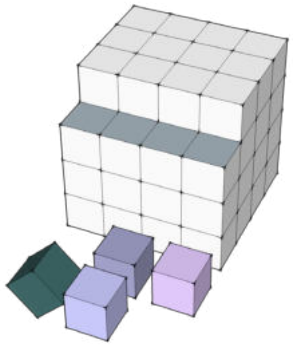


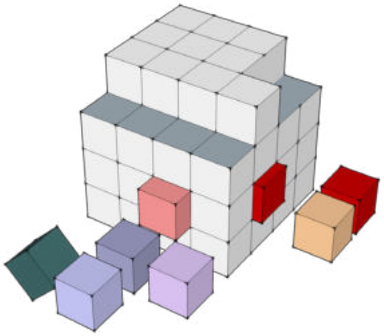


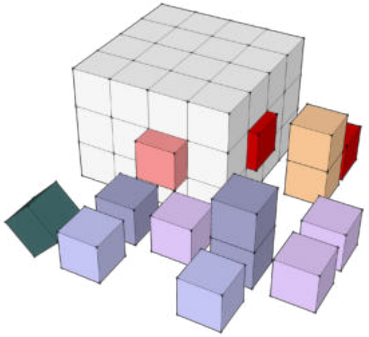


Variation 1

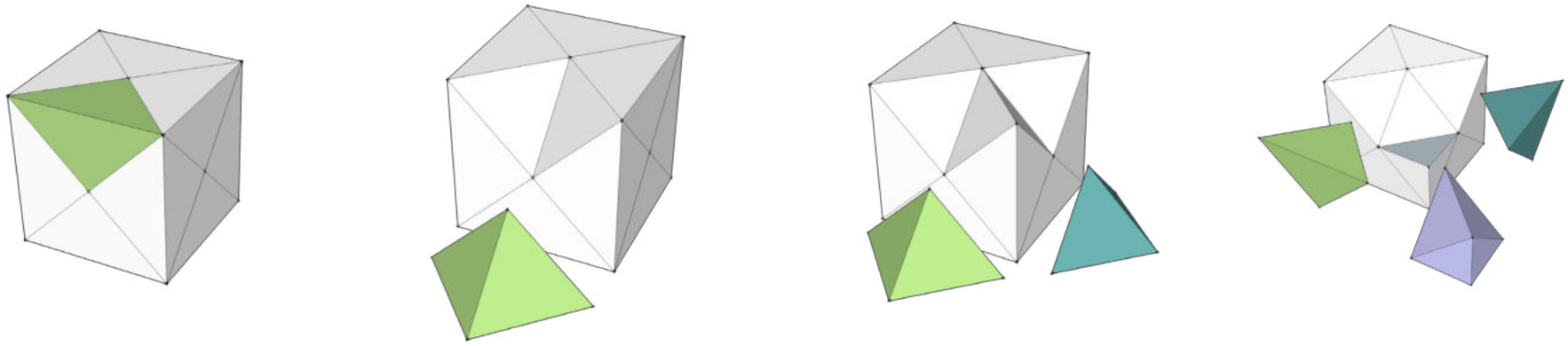




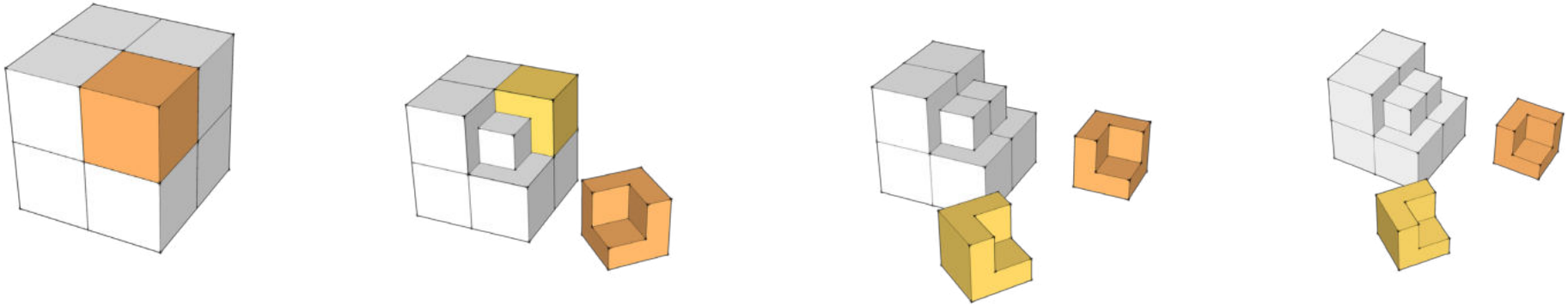




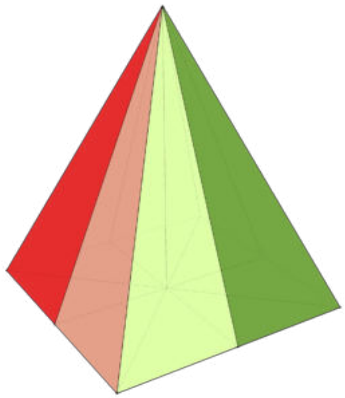
Variation 2

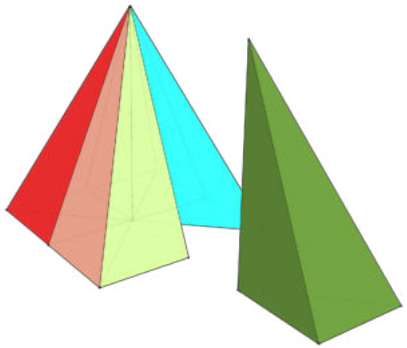


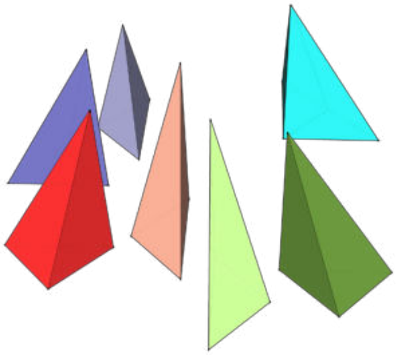
Variation 3

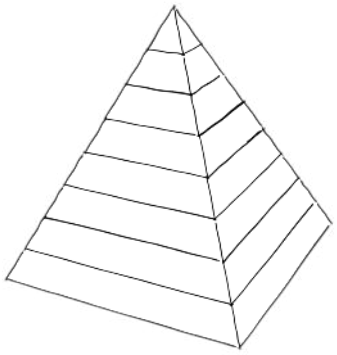


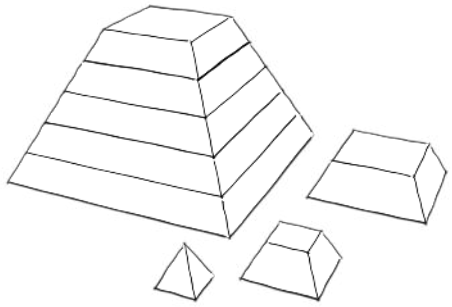
Variation 4

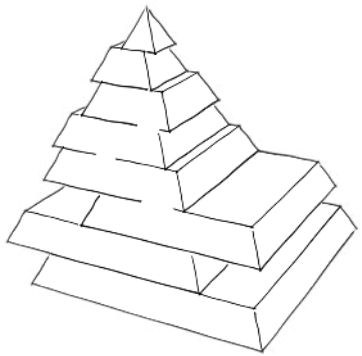




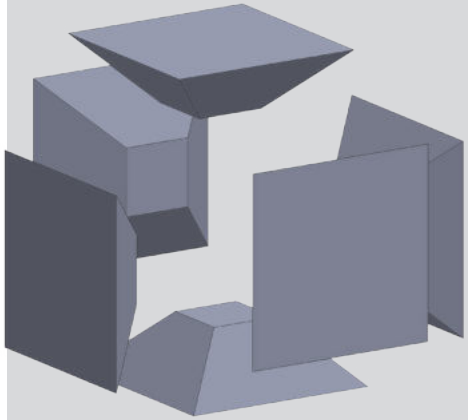




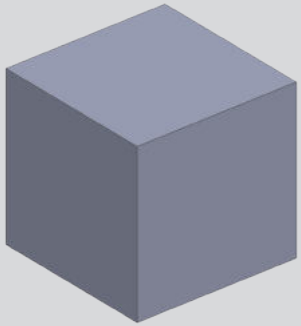




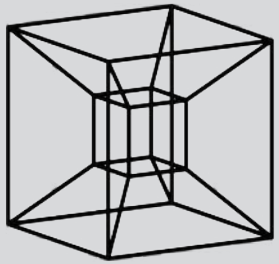
Picture of a square pyramid joined using further small parts Like cube the idea of making modular-like models was another concept.



Half cut pyramid joined to form a cube



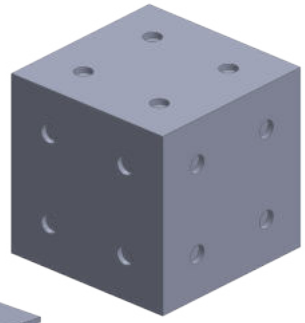
How the cube will look when joined together

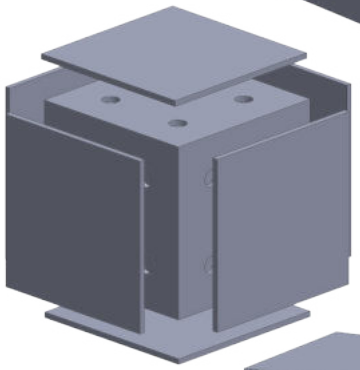


Picture showing x-ray image of joined cube

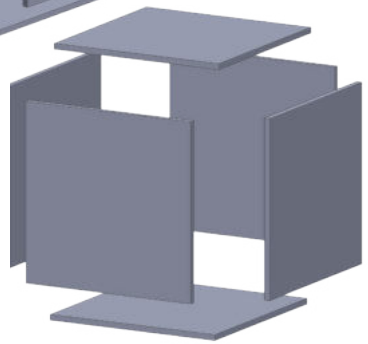
Ideation for modular cube

A solid cube





Square faces attached to solid cube



The faces can be joined by using, magnets or can also be joined with velcro .

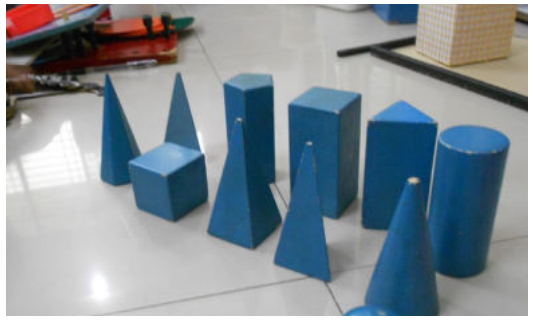
MODULAR SOLIDS

Advantages of the proposed product for this purpose, that it is modular. We could assemble and create complex shapes.

Dis-Advantages of the proposed product for this purpose, creating complex shapes might be confusing and not really required to do so.

Advantages of existing products for this purpose is that it is very simple.

Dis-Advantages
of existing products,
Takes lot of shelf space to store(bulky).Doesn't lead to further exploration. Not multi-purpose in nature. Doesn't have any point of interest/ element of surprise to use further.



Existing products/objects/aids for teaching/ learning 3D solids

Concept 3

Nets for constructing solids

What is the product? What will be given?

The nets are the products which will be given, and made into 3D shapes.

What all content can be taught?

Solids, surfaces, volumes, and other properties of most of basic geometric 3D shapes.

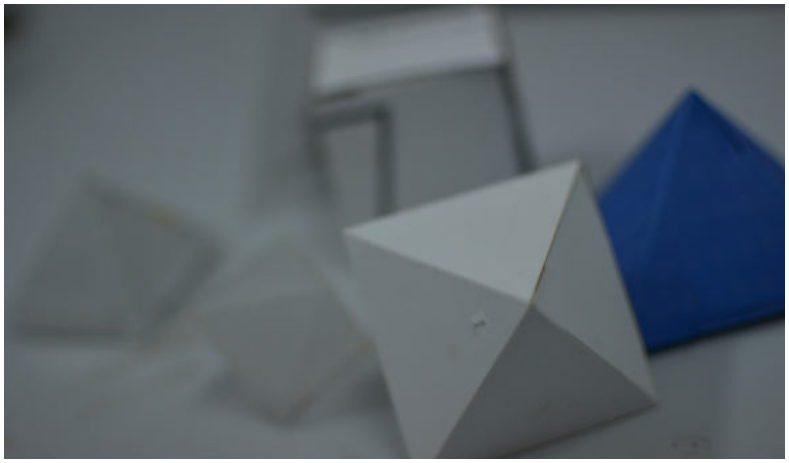
Open and closed figures.

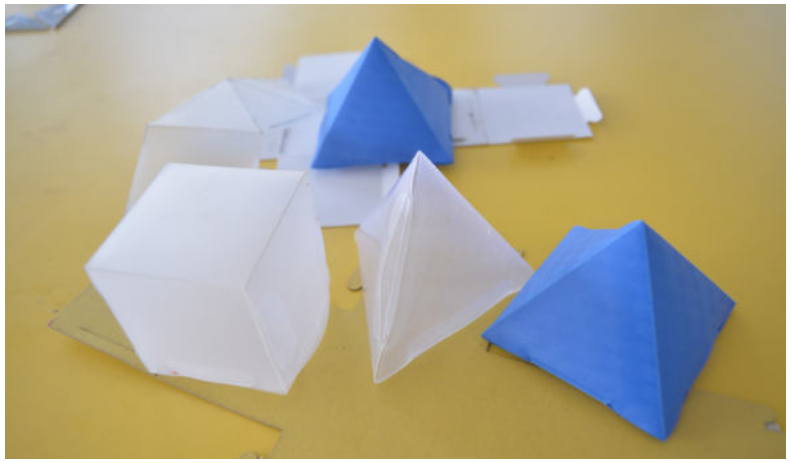
Identification of 3-D shapes: Cubes, Cuboid, cylinder, sphere, cone, Prism (triangular), pyramid (triangular and square) Identification and locating in the surroundings

- Elements of 3-D figures. (Faces, Edges and vertices)
- Nets for cube, cuboid, cylinders, cones and tetrahedrons.

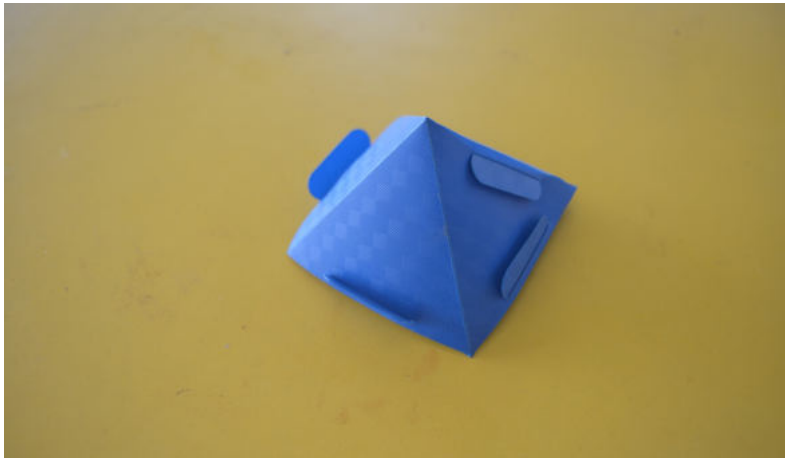
Who will teach/show how to use?

Initially parents/teachers/other adults, the nets can be made into 3D forms and used to teach and learn, different aspects. Later once the child is in a position to learn more, it can be opened up and learn about volumes and nets of the figures. Then The child himself/herself can open up and join back the nets.

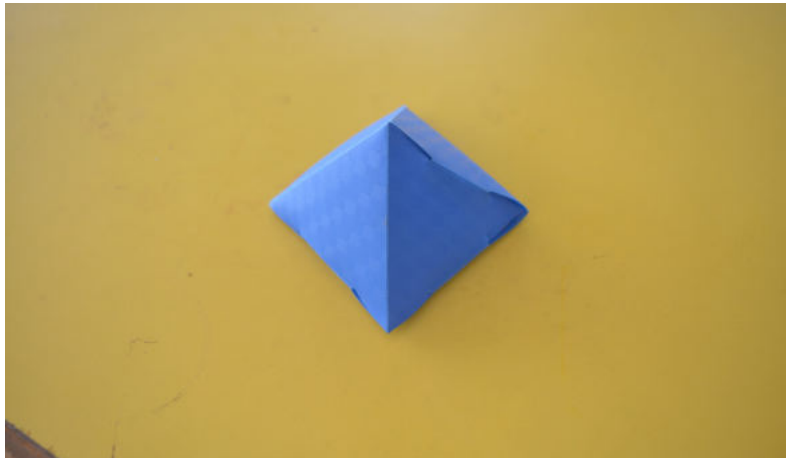




Photos of 3D models made using joining nets

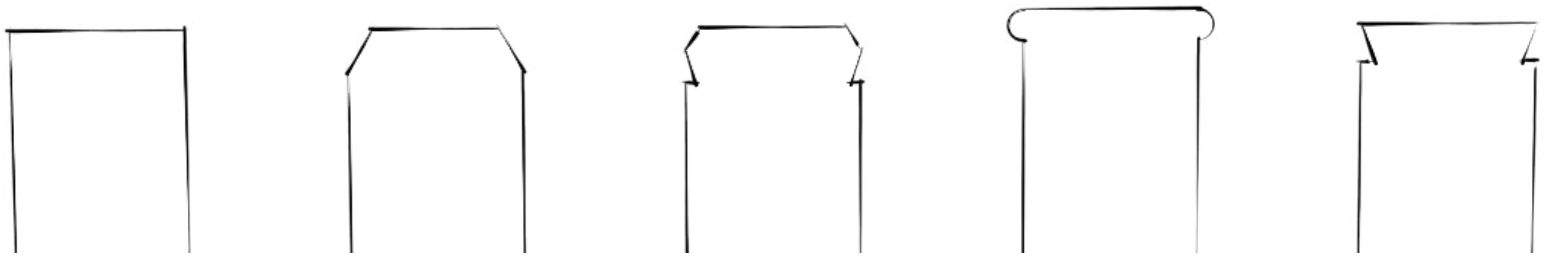


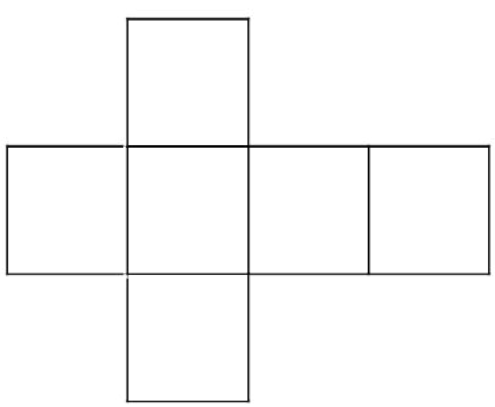
A pyramid made by inserting the flap **in-out**



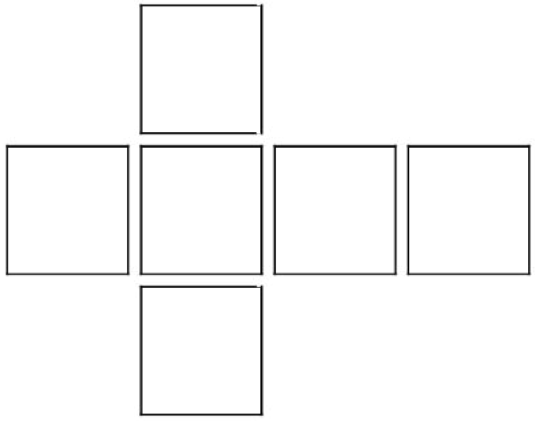
A pyramid made by inserting the flap **out-in**

Net – joining detail exploration

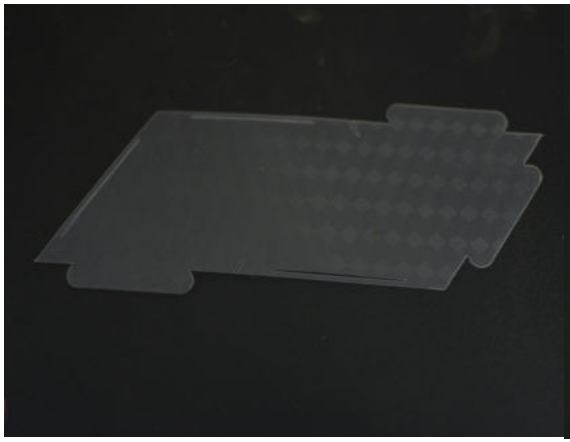




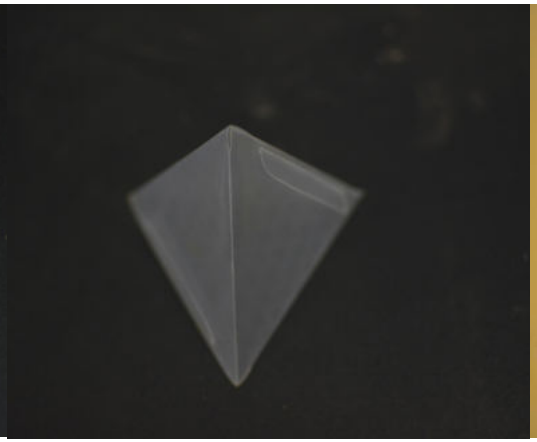
Net of cube single piece



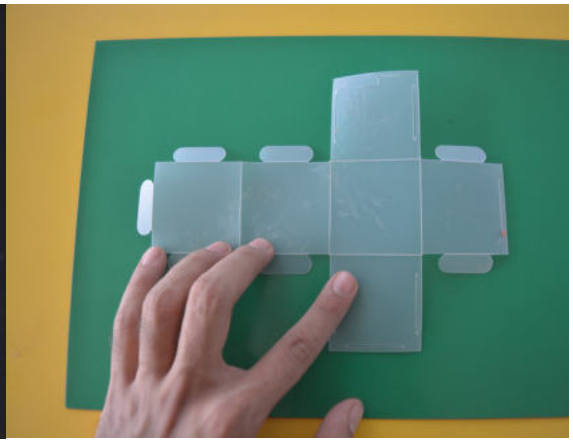
Net of cube, each face as separate pieces



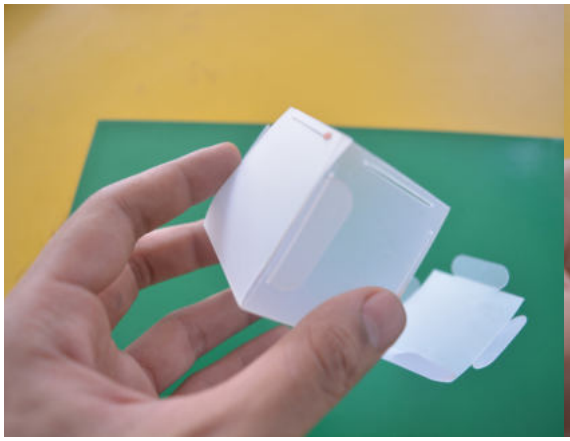
Net of Tetrahedron, open



Net of Tetrahedron, closed

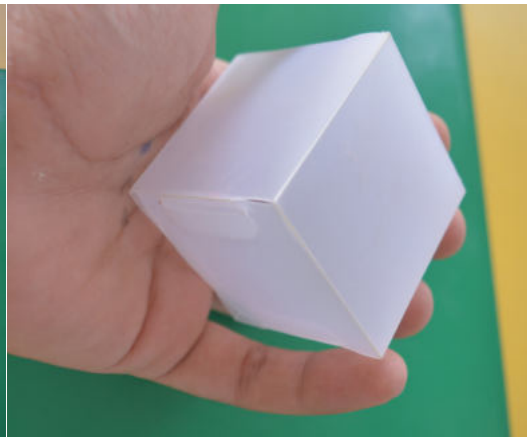


Net of Cube, open

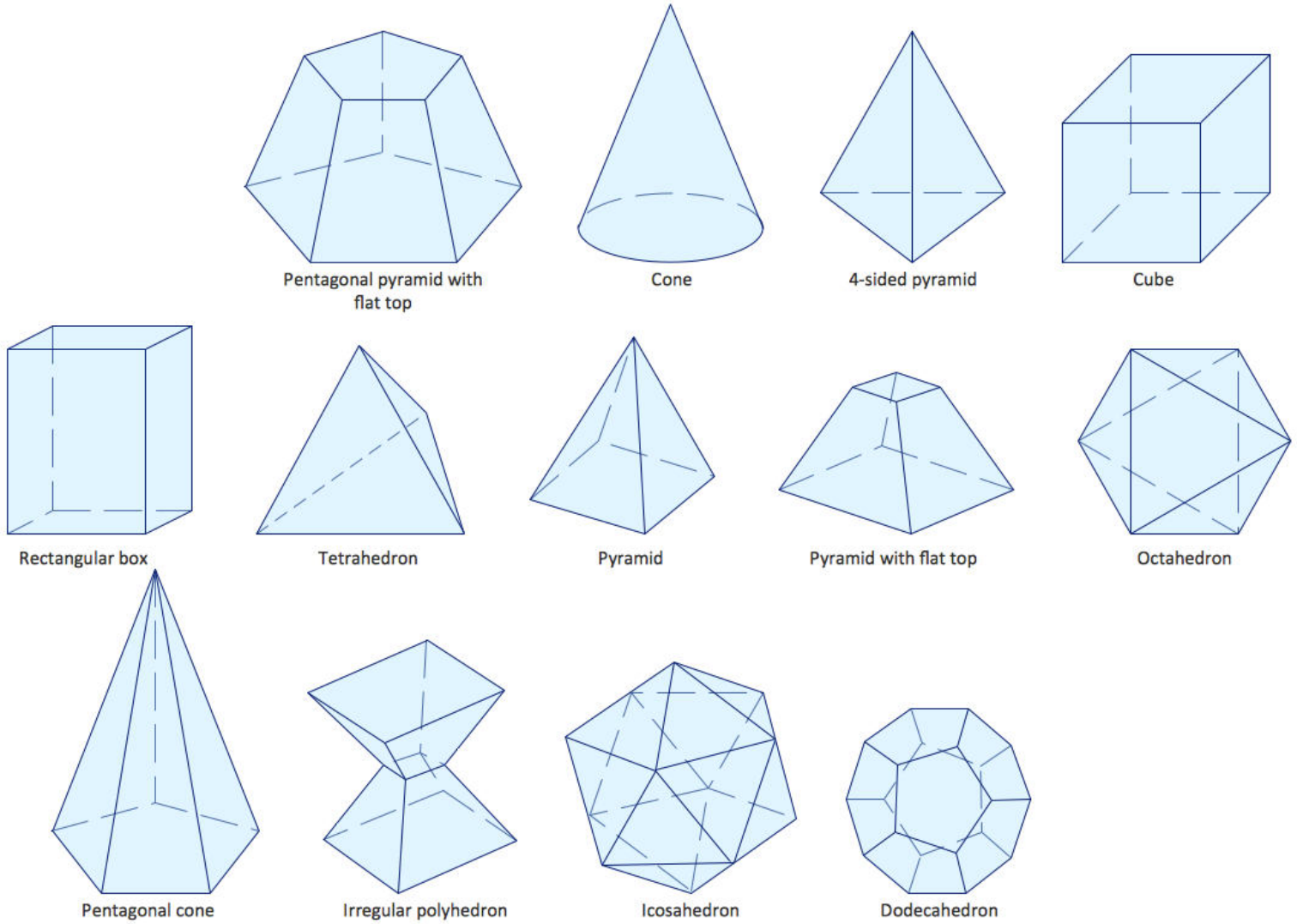


Net of Cube, folding

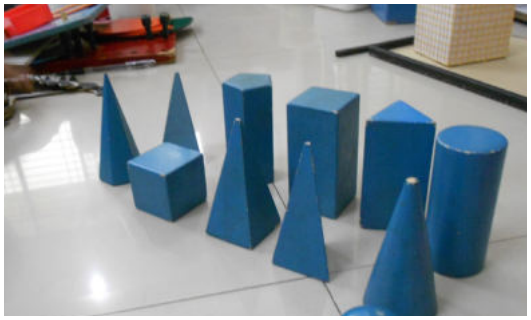
Net of Cube, folding



Net of Cube, fully made



Possible shapes which can be made with the nets concept



Existing products/objects/aids for teaching/learning.

NETS

Advantages of the proposed product for this purpose, that it is very compact, can be made with very low cost, less time, can be used to teach a wide variety of objects in the syllabus. Different activities and learnings in different levels.

Since it is very low cost, each child can have one set.
They could carry it with them to school and back to home, use while in class and at home.

The material proposed is polypropylene which gives the advantage of live hinge to the edges and can open up and close without breakage.

Advantages of existing products for this purpose is that it is very simple.

Dis-Advantages of existing products,
Takes lot of shelf space to store(bulky).
Doesn't lead to further exploration.
Not multi-purpose in nature.
Doesn't have any point of interest/
element of surprise to use further.

One major disadvantage of the concept is that **it cannot be used to make sphere or other shapes with 3D curves.**

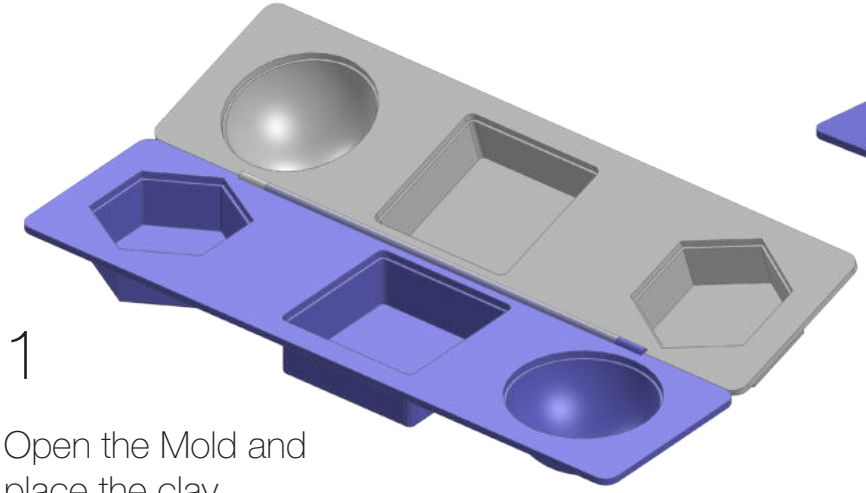
Concept 4

Play doh – mold concept

What is the product?
The product will be the molds of 3D geometric shapes like cube, sphere, prism etc. and play-doh (kind of clay children use to play with)
The molds will be used to mold the clay into respective forms

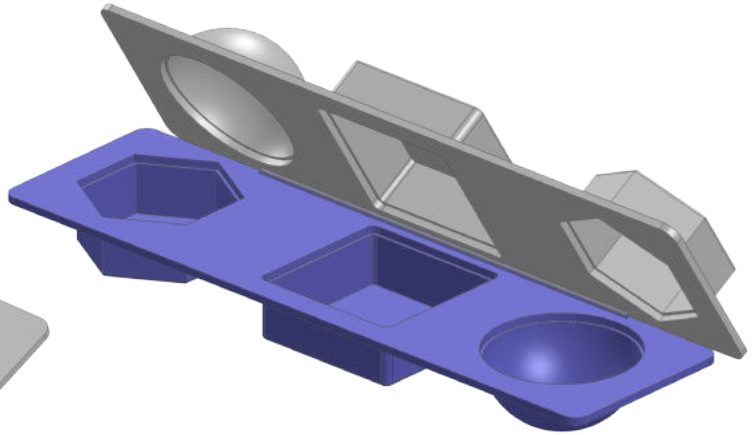
Who will teach/show how to use?
Help in the initial stage is required. Later the activity can engage themselves in creating according to them.

What all content can be taught?
Identification of 3-D shapes: Cubes, Cuboid, cylinder, sphere, cone, Prism (triangular), pyramid (triangular and square) Identification and locating in the surroundings
• Elements of 3-D figures. (Faces, Edges and vertices)



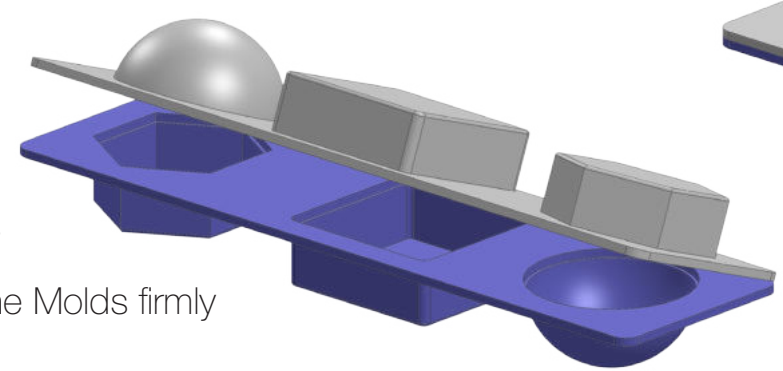
1

Open the Mold and
place the clay



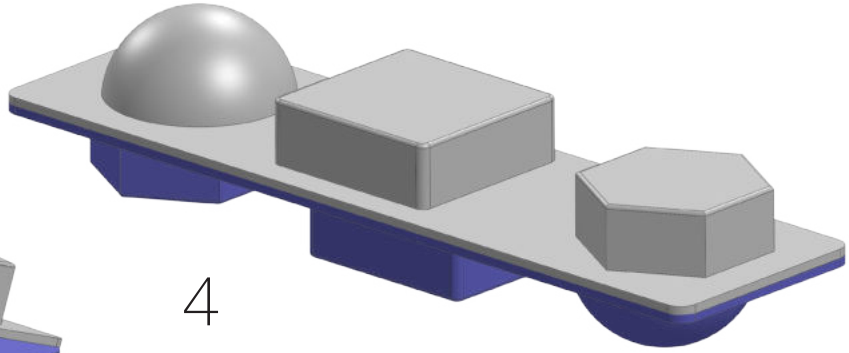
2

Make sure all the clay
is in the slot area.



3

Close the Molds firmly



4

Press completely and open the
mold and get the specific shape

The joy of spending time with play-doh, creating what the child wants. This particular idea is used this concept.
http://www.fridgecheck.com/images/blogpost/images/3.JPG

Existing products/objects/aids for teaching/learning.

Advantages of existing products for this purpose is that it is very simple.

Dis-Advantages of existing products,
Takes lot of shelf space to store(bulky).
Doesn't lead to further exploration.
Not multi-purpose in nature.
Doesn't have any point of interest/ element of surprise to use further.

Play-Doh & Mold concept

Good thing is that they could touch and feel both positive and negative of 3D solids. For example : When they touch and understand how a sphere feels like, they can also understand how the depth it is. How the volume also feels like.

The disadvantages of this concept is, that when they touch the edges to know what it is there are chances that it might get deformed. Also while molding if not put the clay properly there will be uneven surfaces/gaps which might create confusion among the blind children.

Concept Evaluation

	Concept 1 Geo-base	Concept 2 Modular	Concept 3 NETS	Concept 4 Mold and clay
Most resembles the theoretical Model	9	8	9	8
Easy to use	9	9	9	9
Easy to understand	9	8	9	9
Cost effective (Manufacturability, Easy to make, fast to make, Material and technology)	8	6	9	7
Compact (easy to carry, Easy to store.)	8	7	9	7
Long lasting	8	8	8	8
Other possibilities	playful activities	playful activities	playful activities	playful activities
Syllabus covered	Most 2D shapes	3D solids	Most 3D solids and surfaces	Most 3D solids and surfaces
Appropriateness to the context	9	8	9	8
Total	60	54	62	56

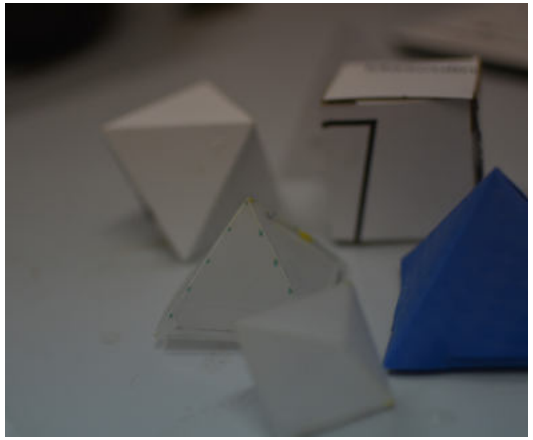
Concept 1 + Concept 3 + Workbook Are combined to form the final concept - A kit which will include all the 3 aspects

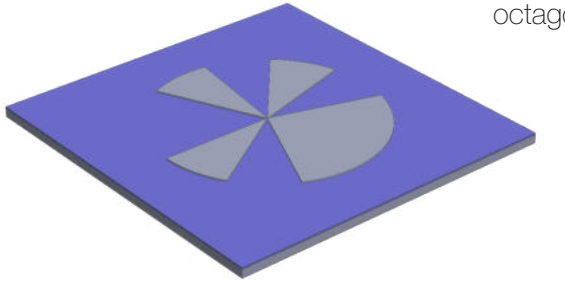
Final concept

Geo-base

What is the product?

So in the final concept the product of concept 1 and product of concept 3 will be given together as a Kit. So buying one such kit can cover a major portion of syllabus in geometry(which we have selected).Along with them will be developed, a workbook which will have both instructions in Braille and English/Hindi.





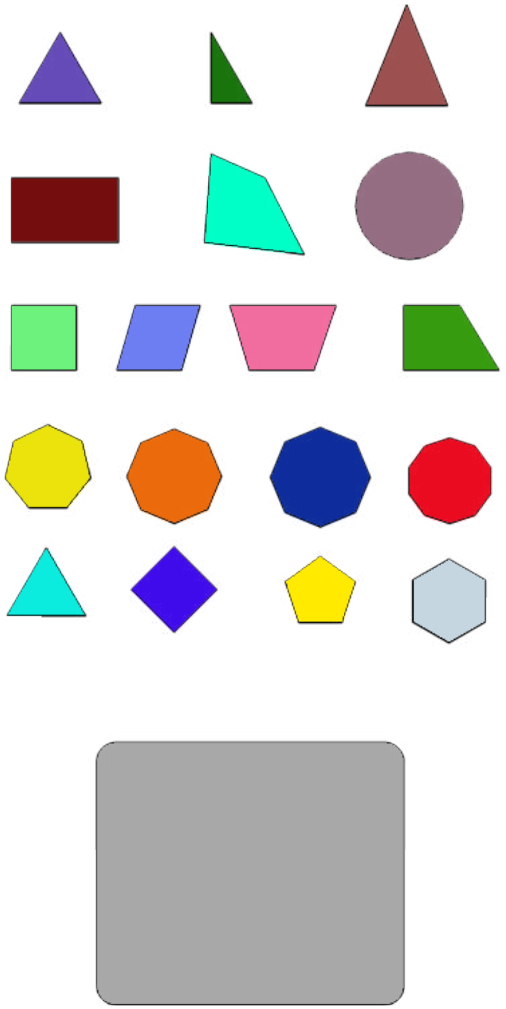
What all content can be taught?

Solids, surfaces, volumes, and other properties of most of basic geometric 3D shapes.
Open and closed figures.
Identification of 3-D shapes: Cubes, Cuboid, cylinder, sphere, cone, Prism (triangular), pyramid (triangular and square) Identification and locating in the surroundings

- Elements of 3-D figures. (Faces, Edges and vertices)
- Nets for cube, cuboid, cylinders, cones and tetrahedrons.

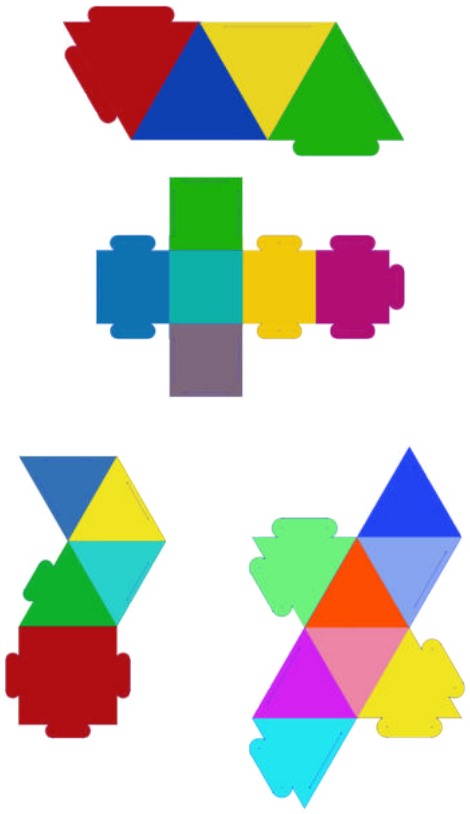
Classification & types of triangles (on the basis of sides, and of angles)

- Types of quadrilaterals – Trapezium, parallelogram, rectangle, square, rhombus.
- Simple polygons (introduction) (Up-to octagons regulars as well as non regular).



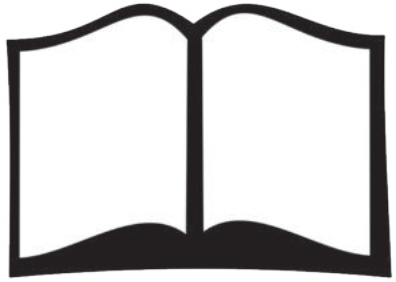
Mag Geo-Base & 2D shapes

Concept 1



NETs of 3D objects

Concept 3



A workbook
(which have instructions and the method of learning/teaching)

Concept evaluation & review

By Faculty & Children

The mock-up models and report was taken to The centre of NAB in Dombivli. The materials was shown and discussed with the faculty, parents & one of the student (visually impaired) and his mother.

Main points discussed

The possibility of using **Nets in the environment of a classroom** is suggested as **not good possibility/ situation.** The assembly/making time to form a cube/any other shape from the nets should be much less. Increase in complexity/ increase in taking time to form the shape might create time lag or even students might get distracted during the class hours which are just sufficient enough to teach each subject.

Introducing such a geometry set during the class of 5-7 would be good since it will help the child to understand without the constraints/limitations of time.

The size of the board and its related pieces should not be too large. The **size should be optimized** so as the child doesn't have to move his/her hands much to understand the object/shape.

The smooth side of magnetic sheet in which white board marker can be used should be **white in color** in order to get a **good color contrast** to low vision students.

The flexible sheet is good for keeping in handbag, school bag etc but is not good while using bigger pieces/shapes of tiles. If the magnetic sheet is rigid enough it wont flex, hence the pieces will sit without falling off the sheet.

Concept 4 - in which clay-doh is used would be good idea for the small kids as it might be a good time engaging activity.

Refined concepts , what all are modified in the kit

The flexible magnetic base will be made rigid so as to avoid falling of large shapes and pieces.

The shapes and pieces will be made in a size which are comfortable to read with hands.

The color of surface will be white.

Use of texture and Braille language will be integrated with 2D shapes for enabling more information and might help in unders

Designing/structuring the Teaching Method,
(The way information is meant to be delivered)

Development of Teaching-Learning materials for
the blind children (to teach/learn basics of geometry) and
Designing the means and method of Teaching-learning,
for effective information delivery

Structuring and Designing the process

The information delivery methodology is structured after the primary and secondary research with the help of faculty, parents and visually impaired children. The feedback and review at each stage was taken and considered while designing the process.

This deals with the teaching of basic aspects of form education such as:

- Tactile recognition of shapes and words
- Developing fine motor skills
- Form, shape and space identification and verification
- Solving problems and equations
- Construction of shapes and forms

Relevance

- The tasks are to understand and learn the concepts through activity based learnings and bring in a different approach to teach/learning.
- The process and steps are designed to deliver maximum information with minimum effort to teach.
- The learning is which was based on books, now is designed to be experiential, to the children.

Objectives

To introduce the visually impaired students to the actual shapes and forms of Basic geometry

To equip the students with concepts of basic/geometry and understand its properties

To enable learning through experiential methods.

To enable and enhance the interaction between students, faculty, parents/elders.

Contents

(i) Basic geometrical ideas (2 -D):
Introduction to geometry. Its linkage with and reflection in everyday experience.
Quadrilateral — Sides, vertices, angles, diagonals, adjacent sides and opposite sides (only convex quadrilateral are to be discussed), interior and exterior of a quadrilateral.
• Circle — Centre, radius, diameter, arc, sector, chord, segment, semicircle, circumference, interior and exterior.

(ii) Understanding Elementary Shapes (2-D and 3-D):
• Classification of triangles (on the basis of sides, and of angles)
• Types of quadrilaterals – Trapezium, parallelogram, rectangle, square, rhombus.
• Simple polygons (introduction) (Upto octagons regulars as well as non regular).
• Identification of 3-D shapes: Cubes, Cuboid, cylinder, sphere, cone, Prism (triangular), pyramid (triangular and square) Identification and locating in the surroundings
• Elements of 3-D figures. (Faces, Edges and vertices)
• Nets for cube, cuboid, cylinders, cones and tetrahedrons.

(iii) Symmetry: (reflection)
• Observation and identification of 2-D symmetrical objects for reflection symmetry
• Operation of reflection (taking mirror images) of simple 2-D objects
• Recognising reflection symmetry (identifying axes)

Methodology

- Observation, identification, verification and articulation of basic shapes, forms and other elements of Geometry using (hands/fingers) tactile sensation for blind children.
- Discussions and activities with other children, teachers and parents.
- Solving problems and finding solutions
- Reading, writing and other activities based learnings.

(left) Sri.Rajendra Pawar, teacher at NAB Dombivli centre, reading and understanding about ideas and mock-ups

(Bottom left) Sri.Kundalik Bandgar, teacher at NAB Dombivli centre analyzing the concept and giving feedback

(Below) Teachers at chandrakant patkar Trust, NAB Centre in Dombivli

As on 16.07.2016

The kit is given to NAB Dombivli centre for user testing and awaiting for further feedback

If you have any feedback regarding the product or project, please contact The student or the Guide who handled the project

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With the help of friends & faculty

A project by **patric john**

Thank you