

Experiential Learning Kit for School Children

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What is experiential learning?

Experiential learning relates solely to the meaning making process of the individual from direct experience. It is an inherent process that occurs naturally.

Why experiential learning?

Formal education inspite of all its advantages has rather become a platform for dissemination of ideas. Children find subjects like mathematics and science rather abstract because of the *absence of an immediate consequence* in their lives. In order to help the learning process become more interesting and effective, it becomes very important to make it experiential.

Aim

The essential idea is to extend the knowledge to usable experience thereby deriving the principle from the experience..

Approach

To create a paradigmatic model that is an autonomous entity but at the same time a trusty mediator between the original solution and the solvers intellectual activity.

Perceived Challenges

- Child Psychology
- Time constraint to understand and map the existing system/model
- Resistance from teachers
- Integration of the solution in the existing system

Encouraging Factors

- Growing awareness among parents regarding the necessity of an alternative method of education

Initial Studies

Visits

- Kohinoor Circus
- Homi Bhabha Centre for Science Education
- Nehru Science museum

Discussions

- Dr K Subramanian, Homi Bhabha Centre for Science education
- Priya Srinivasan, The Pomegranate Workshop
- Dr Vivek Monteiro, Navnirmiti
- Maths Teachers, Kendriya Vidyalaya IIT.

Literature

- Mathematics Textbooks from 1st to 10th standard
- Research Papers

Visits to Kohinoor circus, HBCSE, Nehru Science Museum

- Children are not interested in reading instructions and are more interested in actions and excitement
- Children are fearless to experiment and to discuss about their experiences
- Children are easily distracted and creating a atmosphere through music and lighting helps in maintaining their focus on the subject
- Children constantly discuss amongst themselves and bring to the attention of their friends about their '*discoveries*'.

Informal meetings and discussions

- “ Parents have little time to ‘participate’ in the child’s education”
- “ Schools must be the key place for learning as there are fewer distractions”
- “ Children tend to forget the earlier lessons in classrooms”
- “ Children in classrooms have the fear of committing mistakes”
- “ They tend to rote learn the concepts rather than understand it”
- “ There is little time to cover the entire syllabus”

Literature Survey

Different topics from Mathematics textbooks of the NCERT syllabus was studied from classes 1-10 in order to select an area to work on...

A transition in the syllabus was observed from class 5 onwards and it becomes less experiential. Ironically, it is in these classes that children start learning geometry.

Formula is introduced for the first time in class 5 (*lxb*) and it becomes critical to address this as children resort to rote learning.

Research papers were studied on related topics to select a topic to work on.

Selection of Topic

Different topics on geometry was analyzed and informal discussions were conducted with the mathematics teachers to understand the topics which children find difficult to understand. Informal interviews and discussions were conducted with older children to understand the problems faced by them in different areas of geometry.

Based on these analysis and discussions, *Area*, was chosen as a topic that needed to be worked on.

Area is the first time children encounter transition of dimensions. And it becomes very important to understand the concept of different units.

User Study

A group of eighty children belonging to urban middle class families with an average age group of 11 years were interviewed and quizzed to understand their concept of area.



A series of three quizzes were made in a manner that would help to understand their perception of the concept of area and the difficulties that they face while encountering 'Area' problems.

Fun with Area...the quizzes

Fun with Area – 1

Does this have an area?

What can you do with an area?

Fun with Area – 2

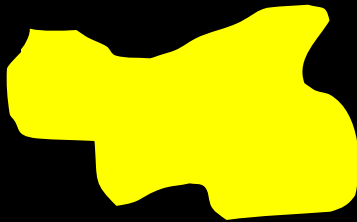
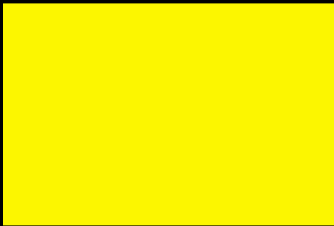
Questions from the text book

Fun with Area – 3

Questions based on research papers to validate and conform their findings.

Fun with Area...Quiz 1

Does this have an area



- Leaf
- Box
- Mobile phone
- House
- Pen
- Computer
- Ball
- Hand
- Feet
- Newspaper
- TV
- Water
- Sun

Fun with Area...Quiz 1

Can you...

Sit in an area
Run in an area
Sleep in an area
Play in an area
Go into an area
Jump onto an area

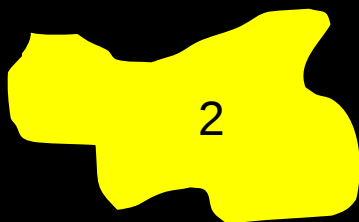
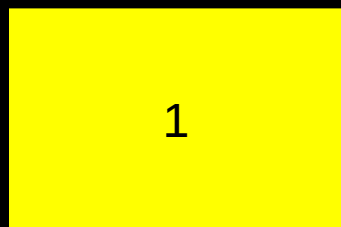
Eat an area
Drink in an area
Move an area
Paint an area
Pull an area
Push an area
Squeeze an area
Suck an area
Touch an area
Pinch an area
Mix an area
Sit in an area

Add an area
Subtract an area
Multiply an area
Divide an area
Arrange an area
Fill an area
Increase an area
Decrease an area

Can area be long
Can area be small
Can area be tall
Can area be short
Can area be round

Results

Does this have an area



Yes

No

Don't Know

100

0

0

20

80

0

Figures in percentages

Results

Does this have an area

	Yes	No	Don't Know
Leaf	50	50	0
Box	100	0	0
Mobile Phone	100	0	0
House	100	0	0
Pen	10	80	10
Computer	100	0	0
Ball	20	70	10

Figures in percentages

Results

Does this have an area

	Yes	No	Don't Know
Hand	10	<u>80</u>	10
Feet	10	<u>80</u>	10
Newspaper	<u>100</u>	0	0
TV*	100	0	0
Water	20	80	0
Sun	10	80	10

* Only LCD TV

Figures in percentages

Results

Can you...

	Yes	No	I don't know		Yes	No	I don't know
Sit in an area	30	<u>70</u>	0	Add an area	80	20	0
Run in an area	80	20	0	Subtract an area	80	20	0
Sleep in an area	60	40	0	Divide an area	80	20	0
Play in an area	<u>100</u>	0	0	Multiply an area	50	50	0
Eat an area	50	50	0	Arrange an area	90	0	10
Drink an area	40	60	0	Fill an area	70	20	10
Go into an area	90	10	0	Increase an area	30	70	0
Jump onto an area	80	20	0	Decrease an area	30	70	0

Figures in percentages

Results

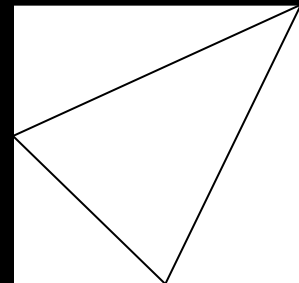
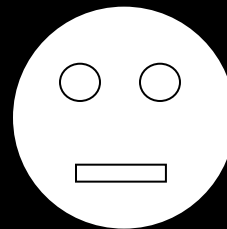
Can you...

	Yes	No	I don't know		Yes	No	I don't know
Move an area	50	40	10	Pinch an area	20	80	0
Paint an area	<u>100</u>	0	0	Mix an area	20	80	0
Pull an area	0	90	10	Can area be long	100	0	0
Push an area	30	60	10	Can area be small	100	0	0
Squeeze an area	0	90	10	Can area be tall	40	60	0
Suck an area	0	90	10	Can area be short	60	40	0
Touch an area	<u>100</u>	0	0	Can area be round	60	40	0

Figures in percentages

Fun with Area...Quiz 2

1. Raj wants to cover the floor of a room 3m wide and 4 m long by squared tiles. If each square tile is of side 0.5m, then find the number of tiles required to cover the floor of the room.
2. Five square flower beds each of sides 1m long are dug on a piece of land 5m long and 4m wide. What is the area of the remaining part of the land?
3. A wire is in the shape of a rectangle. Its length is 40cm and breadth is 22cm. If the same wire is re-bent in the shape of a square, what will be the measure of each side? Also find which shape encloses more area.
4. From a circular sheet of radius 14cm, two circles of radius 3.5 cm each and a rectangle of length 3cm and breadth 1cm are removed. Find the area of remaining sheet.
5. Find the area of the shaded portion (*Triangle in the middle*)



Results

Results

Question	Correct		Incorrect	
	G1	G2	G1	G2
1	27	55	73	45
2	<u>71</u>	<u>84</u>	29	16
3	39	51	61	49
4	-	23	-	<u>77</u>
5	-	52	-	49

Two groups were given this test. Group 1(38) had an average age of 11.3 years and Group 2(43), an average age of 11.7 years.

Figures in percentages

Fun with Area...Quiz 3

1. Which among the following has the largest area? (*Dimensions were not given and a white sheet was used*)



4 x 4 cm



8 x 2 cm



16 x 1 cm

2. How many of these tiles would be required to cover the given area?



a



b



c



Fun with Area...Quiz 3

3. What will happen to the area of square if its sides are doubled

- 1.Area will remain the same
- 2.Area will be doubled
- 3.Area will become four times the original area
- 4.Area will increase

4. Which among the following has the largest area?



Results

	Correct	Incorrect	Don't know
1	18	79	3
2a	81	16	3
2b	71	26	3
2c	55	42	3
3	71	29	0
4	5	95	0

Figures in percentages

Surprising User Statements !

- TV does not have an area but LCD TV's have an area
- Irregular shapes do not have area because they don't have a '*good*' shape
- Leaf has an area because it approximately looks like a triangle.
- Irregular shapes do not have area because it is not in the text book
- Mobile phones/computers/TV have area because they are approximately like cubes.
- Water does not have an area because it is transparent
- Water does not have an area because we cannot find the dimension
- Water cannot have an area because of ripples

Observations

- Children do not realize that area is a surface phenomenon.
- Children believe that only regular geometric shapes like rectangle, square and triangle have area.
- Children believe that irregular shapes do not have area
- Children believe that only three dimensional objects resembling cuboids have area.
- Children believe that organic shapes do not have area.

Observations

- Children are unable to visualize the problems and convert them into figures when encountering word problems.
- Children have little visual sense of lengths.
- Majority of children have difficulty in visualizing word problems.
- A good number of children multiply the sides of a triangle or a quadrilateral to find its area which indicates the lack of understanding of the derivation of area of a rectangle/square.
- A good number of children have a very vague idea about units or its significance.

Observations

- A good number of children find it difficult to relate area numerically. (*Whether to divide or multiply*)
- Children tend to get confused between area and perimeter in the absence of any direct hints/clues either verbal or visual.

Difficulties faced by children to understand the concept of Area

1. Children use perceptual justifications, focus only on the dominant dimension of the shape, or compare the areas of shapes by their perimeters. (Douady & Perrin, 1986)

Task : Which among the following has the largest area ?



4 x 4 cm



8 x 2 cm



16 x 1 cm

All the three figures are of the same area, but only 18% of the children interviewed could realize that. Most of them thought that the 8x2 rectangle was the biggest.

That the children use perceptual justification to compare area becomes clearer in following tasks.

Difficulties faced by children to understand the concept of Area

2. They often have difficulty in conceiving the inverse relationships between the size of a unit and the number of units required to cover the same area. (Carpenter and Lewis, 1976)

Task : How many of these tiles would be required to cover the given area?



a



b



c

80% answered the first one correctly, 71% answered the second correctly and only 51% answered the third correctly.

Difficulties faced by children to understand the concept of Area

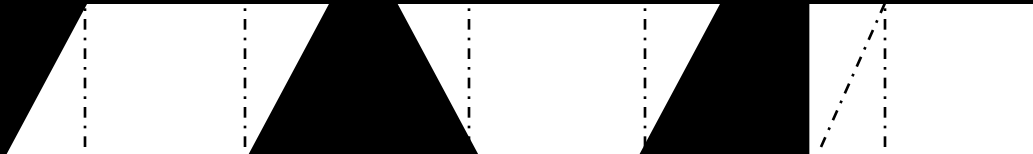
3. Children have problems in finding a strategy to measure irregular shapes. (Douady & Perrin, 1986)

This has been a recurring observation throughout the study. Most children believed that irregular shapes did not have area. A few children tried to use the graph method to calculate the area.

Difficulties faced by children to understand the concept of Area

4. Children are unable to conserve units from their parts (Hirstein et al., 1978)

Task : Which among the following has the largest area ?



Only 5% of the children interviewed realized that that all have the same area. Most of them thought that figure in the middle has the largest area. Some of them justified this perceptually yet some others compared the perimeters. This strengthens the earlier observations too.

Difficulties faced by children to understand the concept of Area

5. Children are unable to connect standard area units with standard length units or could not appreciate the size of a rectangular area with known dimensions. (Kordaki & Potari, 1997)

This became quite visible when the children could not understand the concept of units or when they could not draw figures close to the dimensions, for instance children drew squares in problems involving rectangles and vice versa even though they wrote the dimensions next to the sides of the figure.

Difficulties faced by children to understand the concept of Area

6. Children believe that the ratio between areas is same as the ratio between the corresponding dimensions. (Kordaki & Potari, 1997)

Task: What will happen to the area of the square if the sides are doubled?

About 71% could answer correctly that the area would become four times the original area.

How does an average child spend its day...

Children are exposed to multitude of sensory stimulations all day long. The change in their behavioral patterns are fairly visible and it becomes very important to understand how the spend each day. What do they play, what do they read, what do they watch on TV...

School	8
Play	1
TV	2
Other classes	1.5
Study/Tuition	1.5
Getting ready, commute, relaxation etc.	2
Sleep	8

In Hrs..

What do they play...

Boys: Football, Cricket, Basket ball
Kabaddi, Relay race
Hide and seek

Carrom, Chess, Monopoly

Counterstrike, Roadrash, NFS, GTA, Pokemon

Mobile Phone games

Girls: Badminton, Dodgeball, Handball

Kho – Kho, Relay race

Gallery, Catch and Catch, *Lagori*, Hide andseek, ,
1234, Lock and key, *Khamba* – *Khamba*.

Carrom , snakes and ladders, Monopoly

Mobile Phone games

What do they watch...

Pokemon, Doraemon, Kiteretsu, Dragonball Z, Inuyasha, M.A.D, Mickey mouse, Looney Tunes, Batman.

Most girls also liked watching popular soaps where as boys preferred watching sports. It is surprising that the stereotyping of preferences happens at such an early age.

What do they read...

Batman, Spiderman, Tintin, Amar Chitra Katha, Tinkle.
Harry Potter, Eragon, Narnia.

It is ironic and surprising that movies and animations of popular books have encouraged children to read books

What do the teachers say...

- Children tend to forget the topics that they learn in previous classes.
- The number of students in each class (*approx. 40*) is more than what they can handle
- The syllabus constantly changes making it difficult for teachers to update themselves
- There is a redundancy in syllabus.
- Children have very small attention spans.
- Children are exposed to mind numbing stimulus that there is no space left for independent thought.
- Children resort to rote learning as it is much faster and easier for them to memorize just before the exams rather than to understand the concepts.
- The time that a teacher gets to cover the syllabus is very little.
- Craft/Work/Art education is not a part of main curriculum.

What do the teachers say...

- Children no longer are attentive in classes as they know that they can learn these things in their tuition centers.
- Parents need to involve actively in a child's education, which seems missing.
- Children are highly influenced by TV/Internet and they are under a very high peer pressure.
- Different children come from different family backgrounds and their learning curve largely depends on the family.

What do the parents say...

- Children have very little time. They do so many things in so little time.
- Some teachers in school are good but many are not.
- Price is not a major factor when parents buy toys for children unless it is exorbitantly expensive.
- Most of the parents interacted did not actively take part in child's academic or extra-curricular activities. They attributed it to the lack of time.
- Parents tend to confront children when addressing issues.
- Some parents who involve directly in their child's education read the topic first themselves.

What do the parents say...

- Most parents believe that a tuition centre can be depended for their academic development of the child and that it is more effective than the child studying at home.
- Parents do not approve of the programs that the children watch on TV are often unable to do anything about it.
- Most parents realize that their children are under intense pressure to perform, but have accepted that and are afraid that the child may lose to other children.

Workshop Environment



Workshop Environment

Theatre workshop by Mr. Divya Bhatia, Pomegranate workshop

1. Children prefer to work/play in groups
2. Four to five is a good size for a group
3. Children tend to perform better when a specific task is given rather than open ended tasks.
4. Children do not mind gentle persuasion and positive criticisms
5. There is always one dominant member in each group who directs the play/work of the group.
6. Children freely express themselves once they realize that they are not being admonished or judged.
7. Figures of authority in a workshop environment are often ignored.

Discussions and Interviews with Tradesman

Informal discussions and interviews with

- Masons
- Tailors
- Carpenters

Tradesmen – What is their concept of area

Masons

- Masons work mostly with rectangles and squares. They have an ability to break a given rectangle/ square into smaller pieces to fit in the tiles.
- When dealing with marbles, they have to optimize the size of the marble pieces according to the size of the floor and the size of available marble while trying to minimize wastage.
- They tend to think in a **Grid pattern** i.e overlaying a grid over the given floor and dividing it into squares/rectangles.

Tradesmen – What is their concept of area

Tailors

- Tailors have a very distinctive pattern of thinking since the basic shapes they deal with are much more complex than a carpenter or a tailor. They deal with irregular shapes (*Templates for different dresses*)
- Tailors tend to think in a **Jigsaw puzzle pattern** as they have to fit the different templates in a given rectangular area while minimizing wastage and also have to join various different parts to produce a complex object.

Tradesmen – What is their concept of area

Carpenters

- Carpenters think in terms of length and breadth and their idea of area is predominantly rectangles. Even if they are asked to imagine a circle or an organic shape they instinctively tend to enclose it in a rectangular space.
- Carpenters are adept in conservation of area. They have the ability to visualize and breakdown a larger piece of an area usually a rectangle into smaller pieces of squares/rectangles and occasionally other shapes and are good at optimizing that
- Carpenters employ both grid pattern and the jigsaw puzzle pattern of thinking.

Product Brief

To design a tacit intuitive model using a suitable exemplar that will convey the concept of area and its manipulation without distorting, misleading or blocking the correct interpretation of the concept.

Essential objectives of the design will be to convey the following...

1. All surfaces have area and that area 'covers' or defines a space within a boundary.
2. Concept of units and unit iteration.
3. Manipulation and conservation of area.
4. Irregular shapes/ 3D/ organic shapes have area.
5. To introduce both the methods of understanding area – Grid Pattern and Jigsaw Puzzle pattern

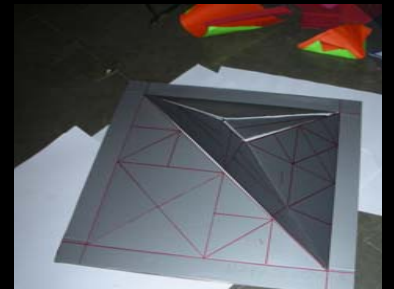
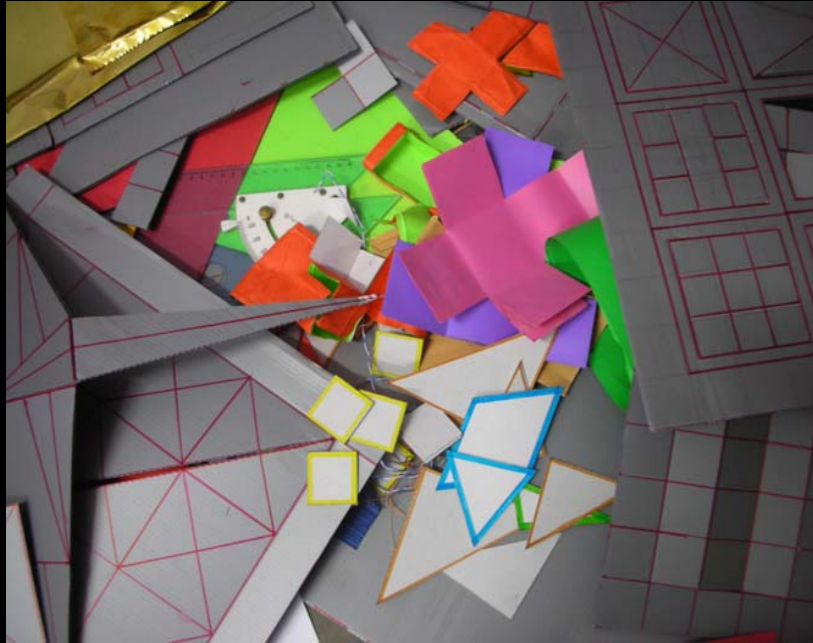
Approach

To create a paradigmatic model that is an autonomous entity but at the same time a trusty mediator between the original solution and the solvers intellectual activity.

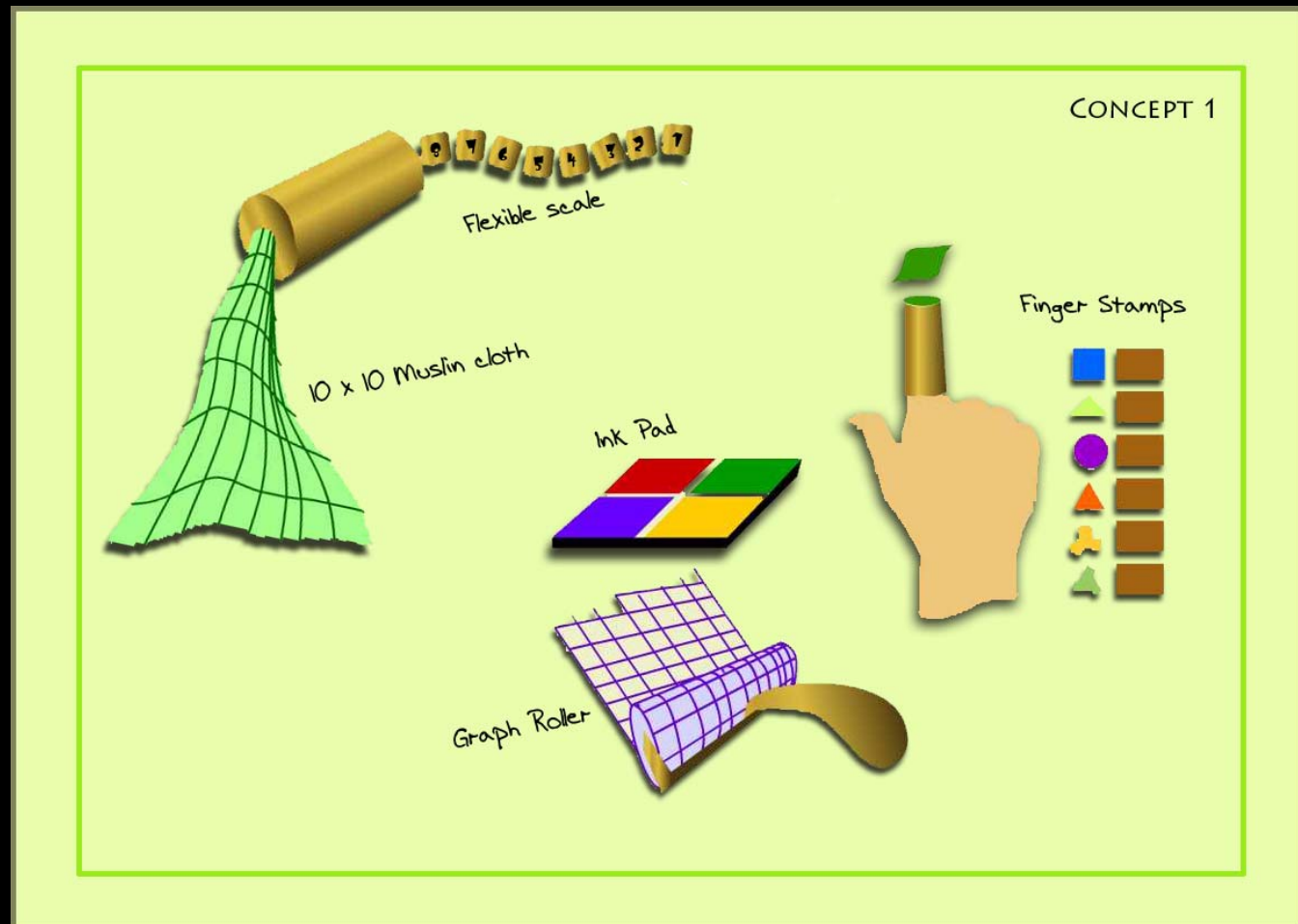
To help understand how lots of surfaces can be arranged in various ways to create a new shape or form and vice versa with the help of suitable props based on the grid method and jigsaw method.

The essential idea is to **extend the knowledge to usable experience thereby deriving the principle from the experience.**

Explorations

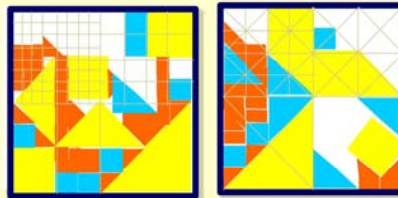
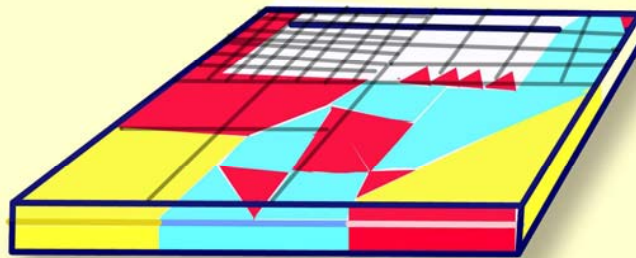


Initial Concept



Initial Concept

CONCEPT 2

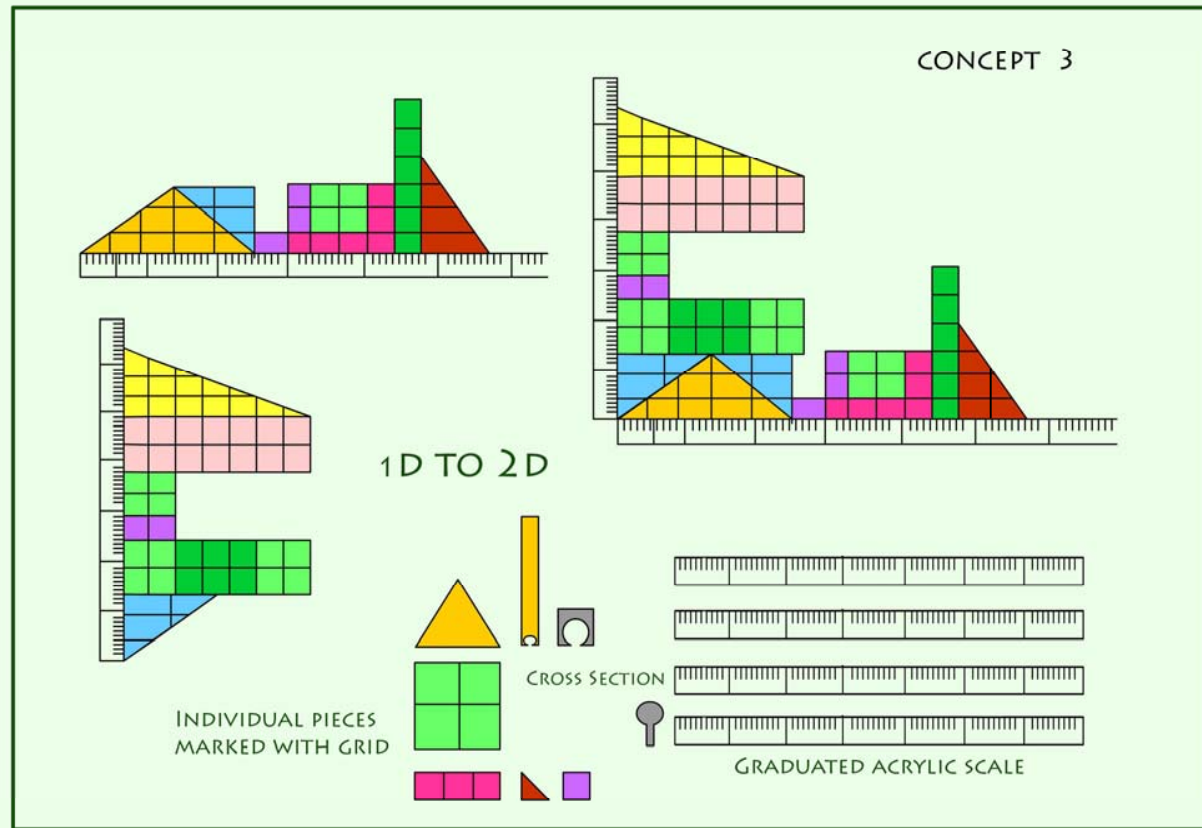


DIFFERENT POSSIBLE PATTERNS

ACRYLIC TILES OF DIFFERENT SHAPES AND DIFFERENT COLOURS ARE ENCLOSED IN A ACRYLIC BOX WHICH HAS A GRID PATTERN ETCHED ON ITS SURFACE.

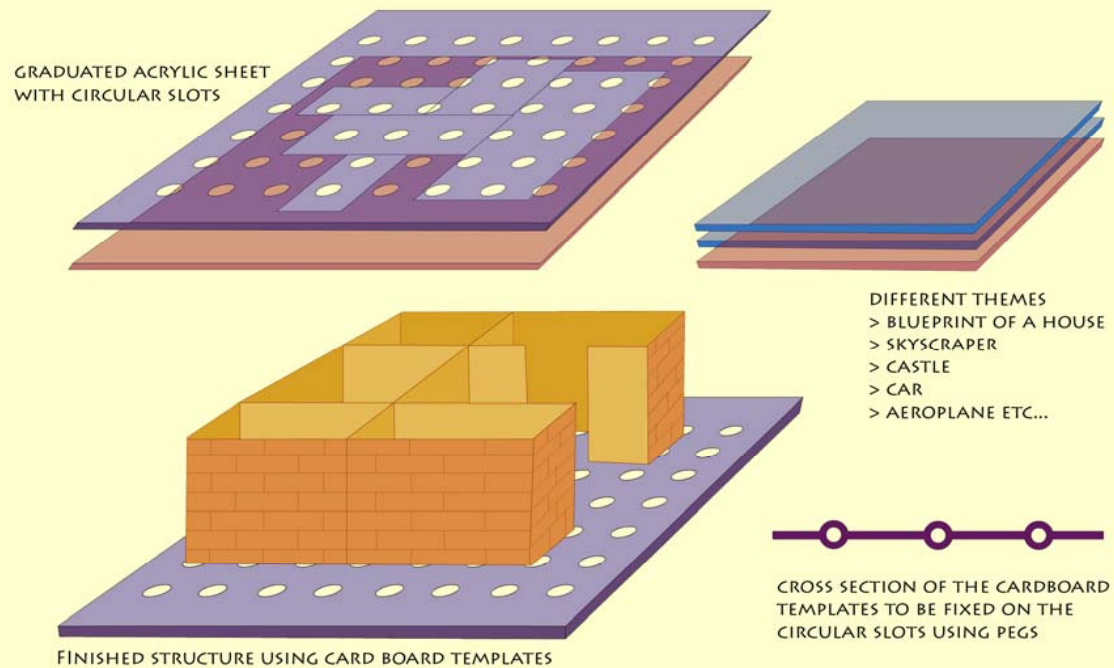
SHAKING THE BOX ALIGNS THE VARIOUS PIECES IN DIFFERENT PATTERNS WHICH HAVE THE SAME AREA.

Initial Concept

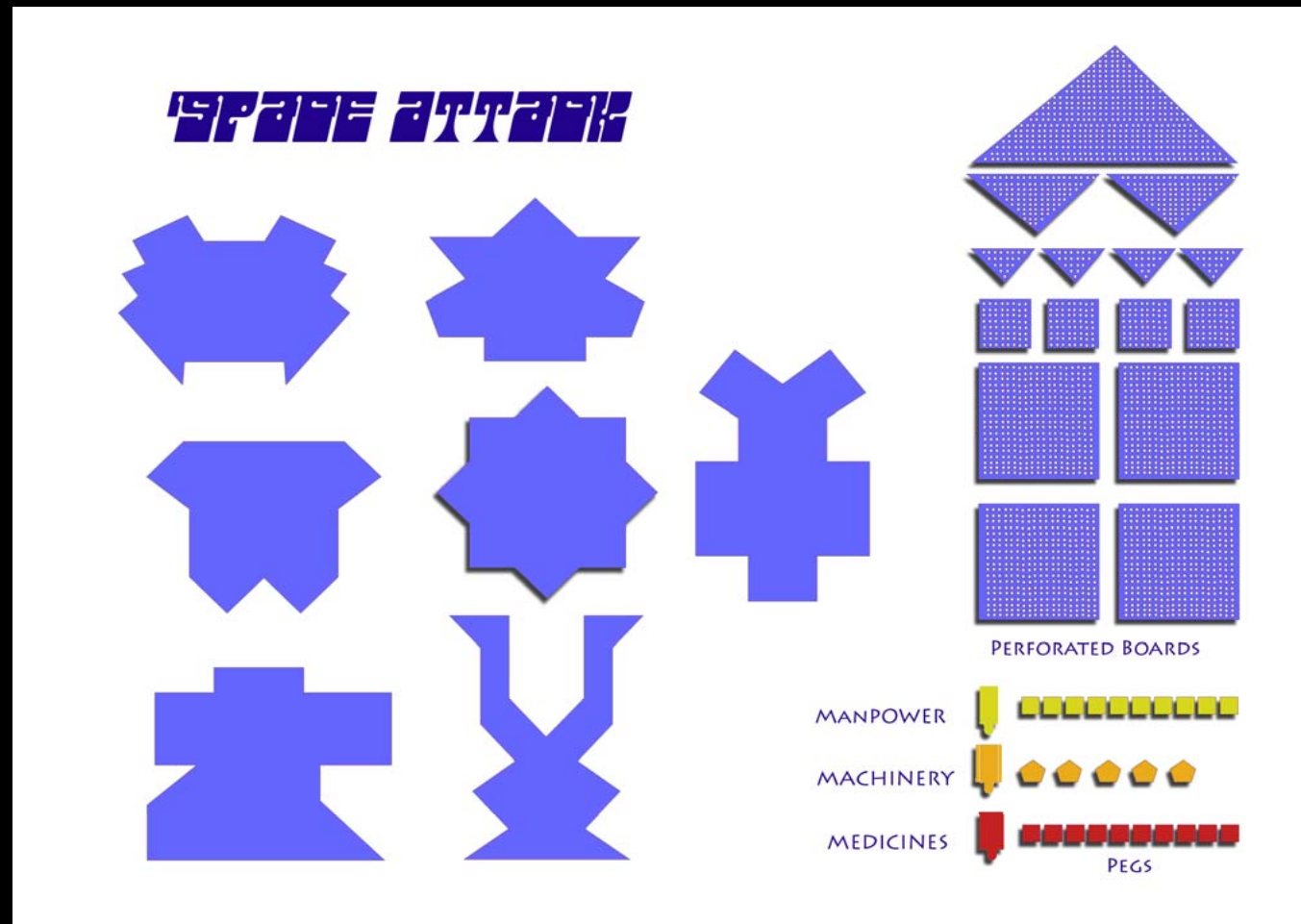


Initial Concept

CONCEPT 4



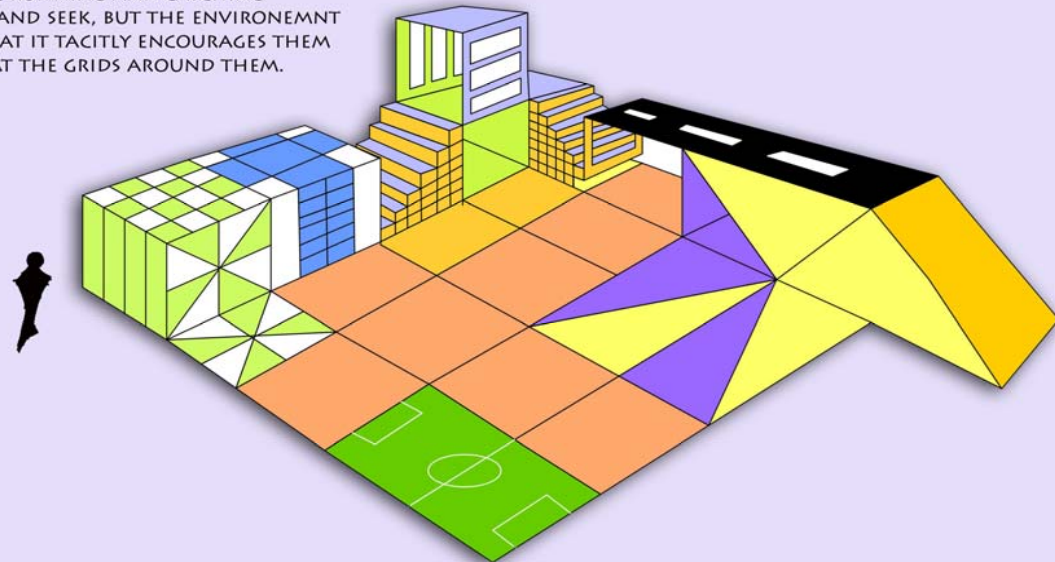
Initial Concept



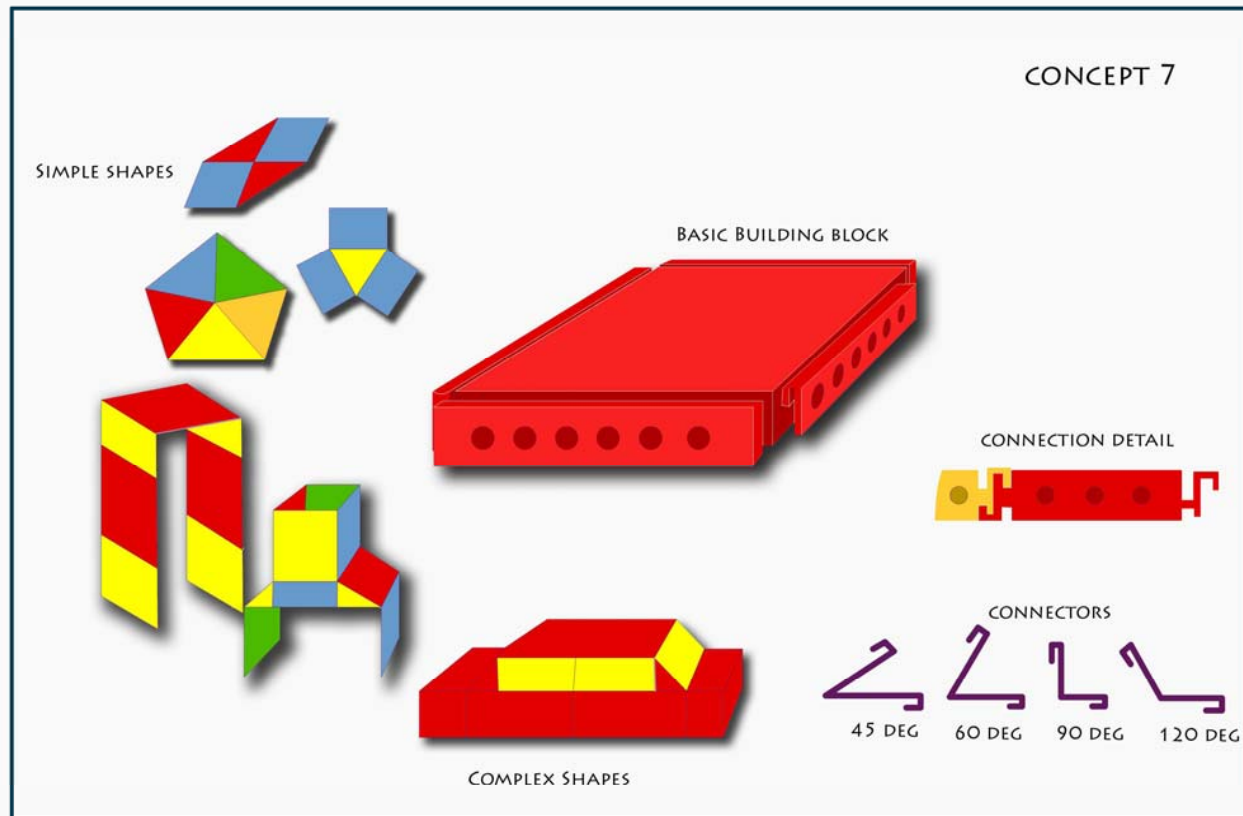
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CONCEPT 6

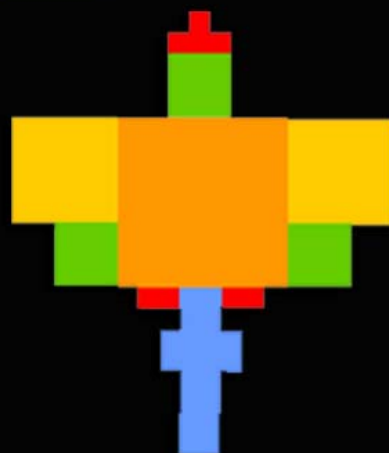
A PLAY SPACE FOR CHILDREN WHERE THEY CAN PLAY THEIR TRADITIONAL GAMES LIKE RUNNING AND CATCHING AND HIDE AND SEEK, BUT THE ENVIRONMENT IS SUCH THAT IT TACITLY ENCOURAGES THEM TO LOOK AT THE GRIDS AROUND THEM.

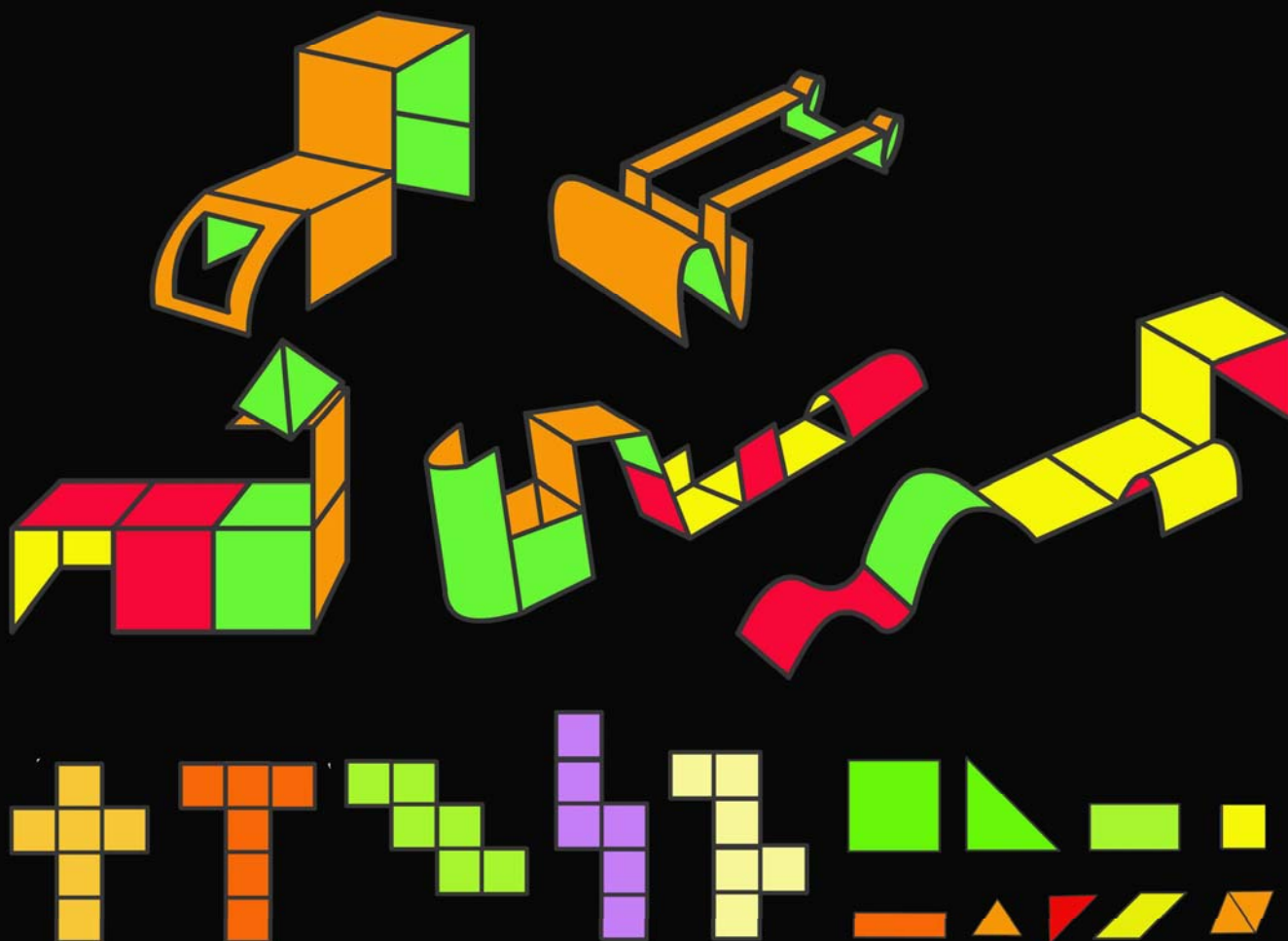


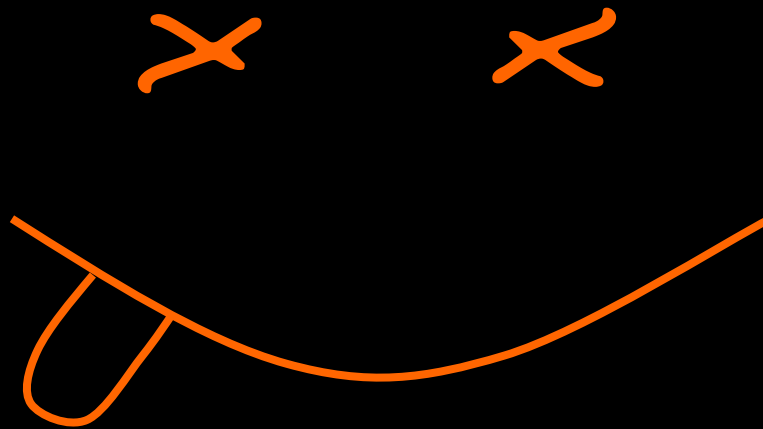
Initial Concept



Final Concept







That's all folks !!!

