Project 1

Gamification of Education

8th May-8th June 2015

at

IDC, IIT Bombay

Name: Boski Jain
Roll Number: 146250006
Specialisation: Visual Communication
Batch: 2014-2016

Declaration

I hereby declare that this project work entitled "GAMIFICATION OF EDUCATION" submitted to IDC, IIT Bombay, is a record of an original work. This work was done as a part of a workshop "GAMIFICATION OF EDUCATION" guided by Prof. Uday Athavankar, Professor, IDC, IIT Bombay.

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any data/fact/source 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 which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Certificate of Participation

Workshop on
GAMIFICATION OF EDUCATION

This is to certify that

Ms. Boski Jain

has participated in the workshop on
Gamification of Education
conducted by *Industrial Design Centre, IIT Bombay*
from *8th May 2015 to 8th June 2015*

Prof. B. K. Chakravarthy
Workshop Co-ordinator
IDC, IIT Bombay

Prof. U. A. Athavankar
Workshop Faculty
IDC, IIT Bombay

Approval Sheet

This report entitled “GAMIFICATION OF EDUCATION” by Boski Jain (146250006) is as partial fulfillment of the requirements for the award of the degree of “Master of Design” in Visual Communication.

Date :

Place :

Examiners:

Acknowledgments

I would like to express my deepest appreciation to all those who provided me the possibility to complete this project. The Rajya Shiksha Kendra, Madhya Pradesh and IDC, IIT Bombay for conducting this workshop.

A special gratitude I give to our guide Prof. Uday Athavankar who invested his full effort in guiding the team in achieving the goal. His stimulating suggestions and encouragement helped me to coordinate my project.

Furthermore I would also like to acknowledge with much appreciation the crucial role of the staff involved in the project who gave the permission to use all required equipment.

A special thanks goes to my team mates, whose combined efforts turned this project into reality.

Name: Boski Jain

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Introduction & Overview

A project by IDC, IIT B along with RSK (Rajya Shiksha Kendra) for government schools of Madhya Pradesh involving the creation of supplementary material that is game based and interactive in order to enhance the quality of learning in primary schools across the state. (Class 1 -5, particularly in subjects like Mathematics and language- English and Hindi)

The workshop was conducted at IDC, IIT Bombay and included students from National Institute of Design, National Institute of Fashion Technology, Design Dept. IIT Guwahati and IDC, IIT Bombay.

Quality of Education

According to a report, the quality of learning as measured by reading, writing and arithmetic has either shown no improvement or actually worsened in the last few years.

5th Standard Reading and Arithmetic 2013

Poor: 0-30 (out of 100)

Class 5 students who can read a text of class 2 level

61.3%
2005

47%
2013

Class 8 level students who can do division

69.8%
2005

46%
2013

Class 3 level students who can read class 1 texts

40.4%
2011

40.2%
2013

Class 3 level students who can do simple subtraction

30%
2011

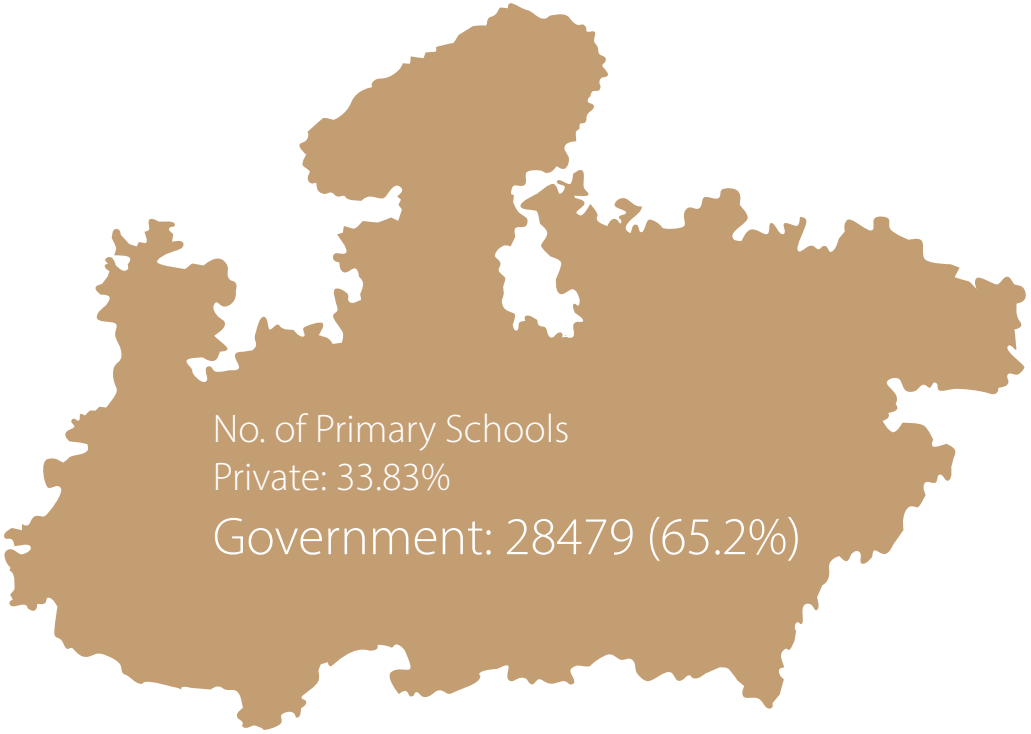
26.1%
2013

Source: http://www.livemint.com/rf/Image-621x414/LiveMint/Period1/2014/01/16/Photos/School%20Kids1--621x414.jpg
30.6.2015

Enrollment in Private Schools

Similar report paints a grim picture of the quality of education in government schools, even as it notes that there has been a steady increase in private school enrollment from 18.7% in 2006 to 29% in 2013. In some states such as Manipur and Kerala, nearly 70% of the students are in private schools. Even in states such as Uttar Pradesh, the proportion is close to 50%.

In states where enrollment in government schools is high, a higher portion of students were found to depend on private tuitions to supplement what they learnt in school. For example, in Bihar and Odisha, where only 8.4% and 7.3% of students are in private schools, respectively, 52.2% and 51.2% of students were taking private tuitions.



Source:http://www.livemint.com/Politics/db5Bfb8qSTFhO70WEafBpJ/Indias-education-quality-has-failed-to-improve-finds-ASER.html
30.6.2015

Source: **Statistics of School Education 2011-12**
http://mhrd.gov.in/sites/upload_files/mhrd/files/statistics/SSE1112.pdf
30.6.2015

Student-teacher ratio

Student - teacher ratio: Right to education act (RTI) mandates an optimal student teacher ratio of 30:1 for all Indian Schools.

In Madhya Pradesh,

No. of schools: 28,479
No. of teachers: 1,91,705
No. of students: > 1 crore

Student- teacher ratio in schools:
primary schools: 38.26
middle school: 35.79

Single teacher schools:
primary schools: 14510
middle school: 3431

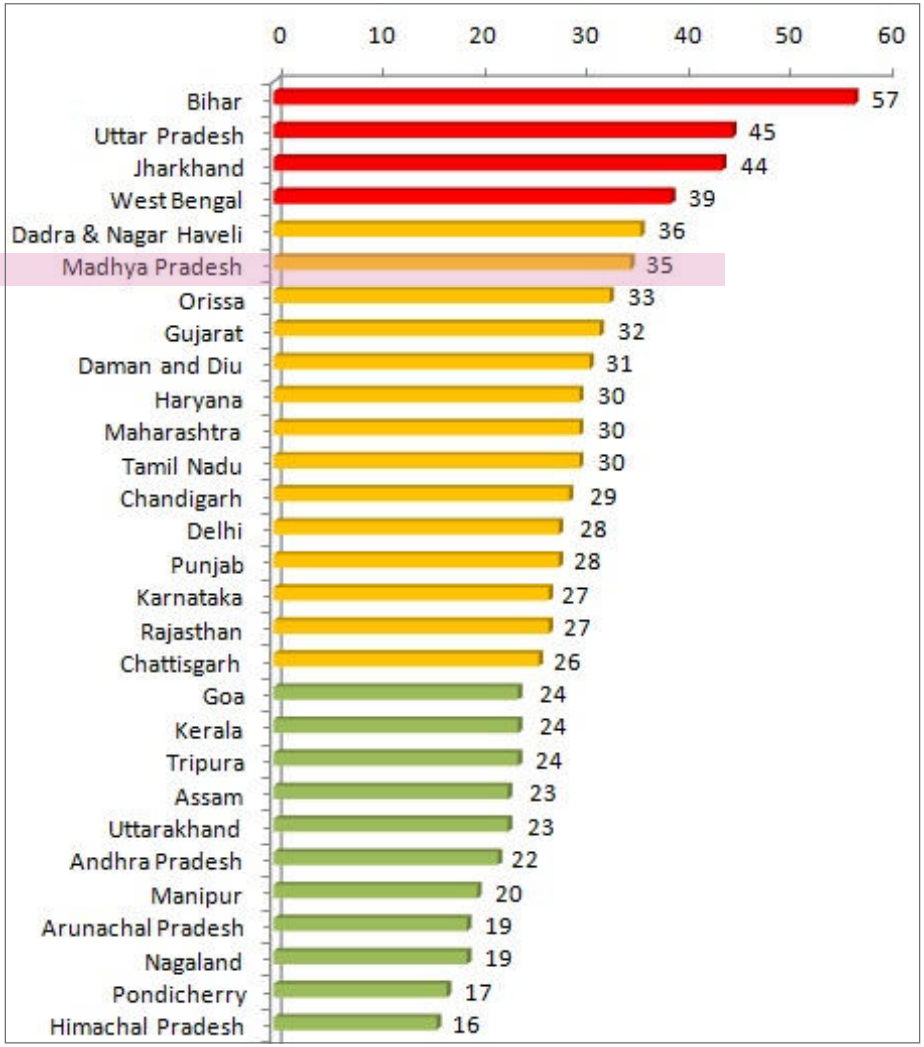


Image Source: http://schoolcountry.com/blog/post/2011/08/12/Student-teacher-ratio-for-primary-schools-in-India-How-does-your-school-perform.aspx
1.7.2015

Source: **Statistics of School Education 2011-12**
http://mhrd.gov.in/sites/upload_files/mhrd/files/statistics/SSE1112.pdf
1.7.2015

Sarva Shiksha Abhiyan, MP
http://www.ssa.mp.gov.in/educationalprofile.htm
1.7.2015

The need

Because of such a scenario in the state, different bodies (government and non-government) have been working continuously to generate more supplement material for the curriculum. Taking one such effort forward, the RSK team approached IDC to develop games and activities to that will aid the current education system.

Since years, educators, teachers, social workers, government officials have been working on these problems. Now they were eager to include designers to see what more inputs could be brought in.

Image sources (6.7.2015):
http://i.dailymail.co.uk/i/pix/2011/12/02/article-2068930-0F04DEA500000578-424_634x396.jpg

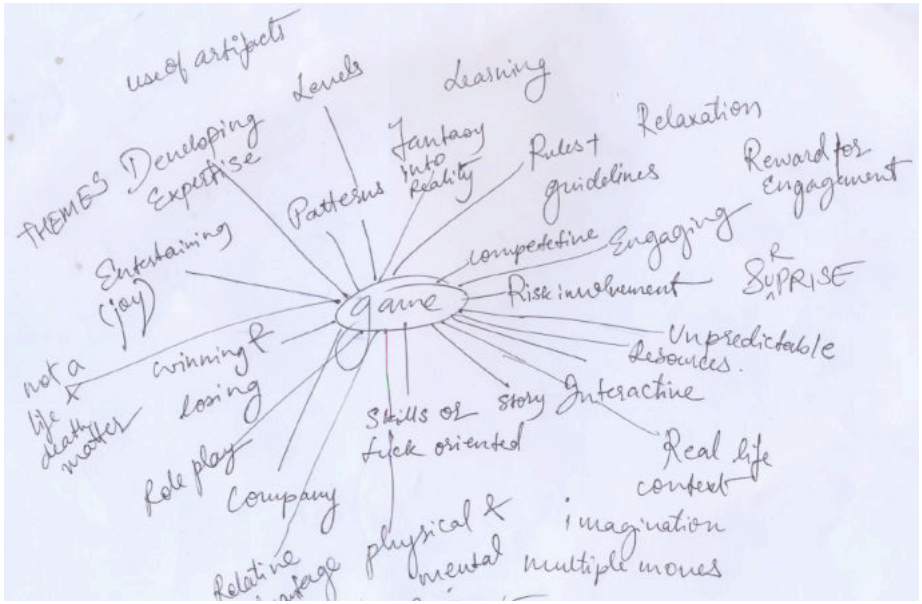
http://www.instablogs.com/wp-content/uploads/2012/07/ruralschool_ws4O4_22863.jpg

http://www.livemint.com/rf/Image-621x414/LiveMint/Period1/2013/02/26/Photos/Sharp%20Imagemint--621x414.jpg

Game

A competitive activity involving skill, chance, or endurance on the part of two or more persons who play according to a set of rules, usually for their own amusement or for that of spectators.

Further discussions were done to refine the definition of a game which appeared to be subjective. A common pool of words was created which included everybody's ideas about games. This brainstorming session later helped us in cross checking the qualities of the product with requirements and characteristics of a good game.



Definition Source: http://dictionary.reference.com/browse/game

Gamification

Is the concept of applying game-design thinking to non-game applications to make them more fun and engaging. Game playing elements can be point scoring, competition, rules of play, story, unpredictability, surprise etc.

Why apply it here

- To create aids for teachers.
- To help create more interests or students.
- If engaging activities are created, they can be passed from one generation to another.
- These activities can act as supplements for theory or text books.

Project objective

Exploring online and offline game design solutions for 'Gamification of Education'

Creation of supplementary material that is game based and interactive in order to enhance the quality of learning in primary schools across the state of Madhya Pradesh, and can be later implemented in other areas.

Image Source: http://schoolcountry.com/blog/post/2011/08/12/Student-teacher-ratio-for-primary-schools-in-India-How-does-your-school-perform.aspx
1.7.2015

Study of Curriculum

Learning Areas

The syllabus of class 1 to 5 (Mathematics and Languages- English and Hindi) was divided into broad categories. Then each category was studied by groups who made presentations about what is taught in each class. How topics within the category are introduced and how much curriculum in all does each category cover. These categories are as follows:

- Number system
- Operations
- Measurements
- Geometry
- Fraction/ Decimal system
- Commercial Mathematics
- English- basics
- Hindi- basics

The Group

Shubit Sagar- NID (Exhibition and Space design)
Saloni Dandavate- NID (Animation Design)
Boski Jain- IDC (Visual Design)

Area to be studied:
Geometry

Once the groups were made, a thorough study of the syllabus was done. This was done referring the books published by the Educational Portal of Madhya Pradesh (www.educationportal.mp.gov.in/Default.aspx).

Based on this study and presentation, the RSK team, who have been working with both the teachers and the students, identified certain problem areas. These were then taken as key reference points for the development of the games.

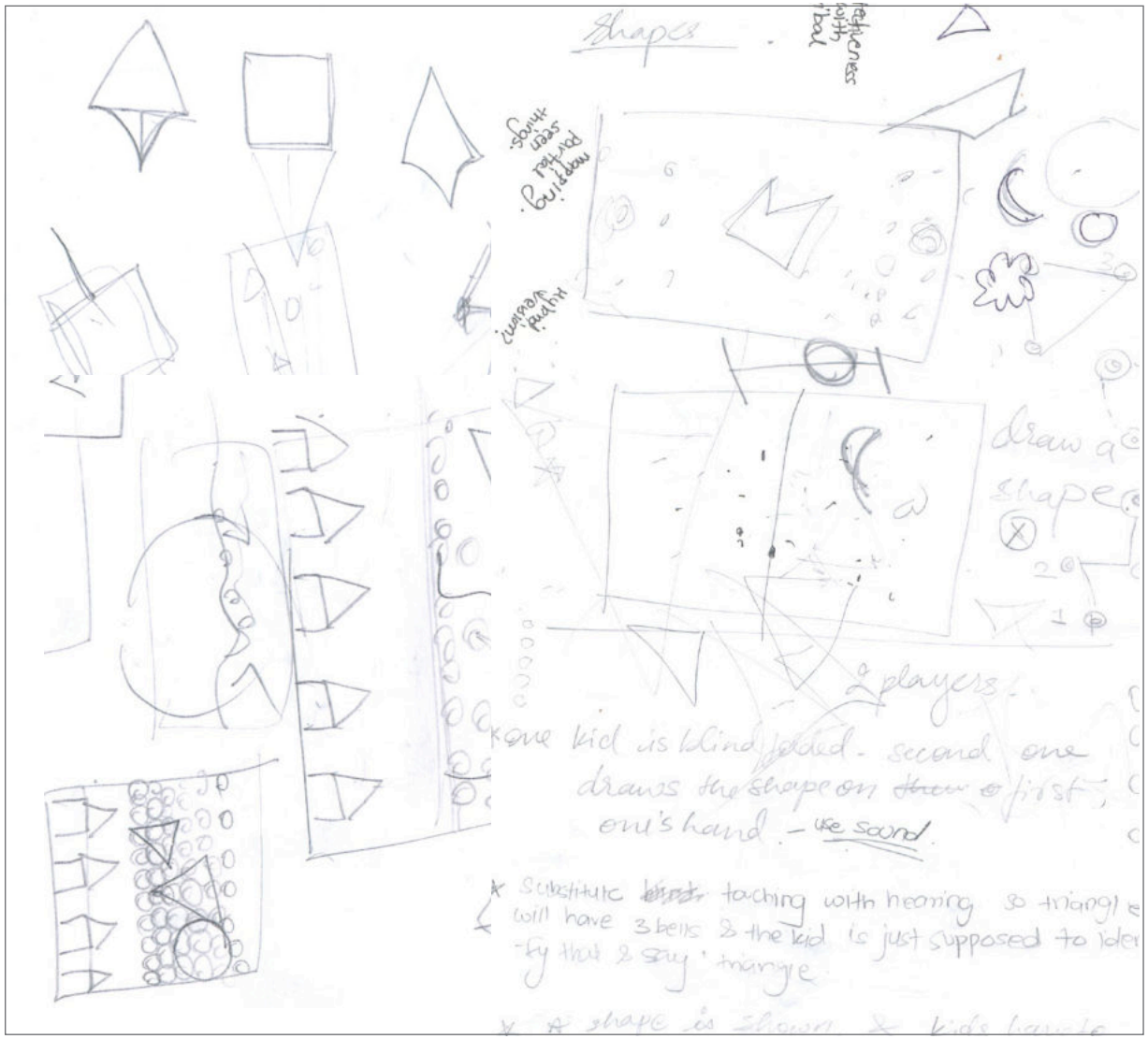
Geometry: Curriculum, Problem areas

	Class 1	Class 2	Class 3	Class 4	Class 5
Shapes	Triangle, circle, square	3D: Sphere, cube, cylinder, cone	Closed and open shapes	-	types of triangle- sides and angles, sum of angles is 180
Surfaces	-	Curved and Plane, Counting the no. of surfaces	-	-	-
Lines	-	Horizontal, Vertical, Slant	Straight, curved	-	Lines, line- segment and rays, parallel and perpendicular
Vertices and sides	-	-	No. of vertices: square, triangle, circle	-	-
Construction of circle	-	-	-	Using thread, radius, diameter, circumference, chords	Circle with a given radius
Angle	-	-	-	Types without measurement	Vertices, arms, measurements, classification
Symmetry	-	-	-	Identifying symmetrical and asymmetrical objects	Axis of symmetry
Perimeter	-	-	-	Concept of circumference	Formula for square and rectangle
Area	-	-	Understanding 1/2, 1/4 and 3/4	-	Concept of area

Explorations

while giving first thoughts to the games, we wanted to know whether or not, the children are aware of the basic terms that they are supposed to know. To know what was the current level of the children, we made them play some basic games like Chinese Whisper. We told them to sit in a circle and said one word into the ear of one person which was carried forward. After giving them some simple words, so that they understand the game, we gave the names of basic shapes.

This was done see their familiarity with the words. But since these game was tried with kids attending English- medium schools, Hindi terms were new for them.



Physical Games (indoor and outdoor activities)

Game 1

Educational objective:

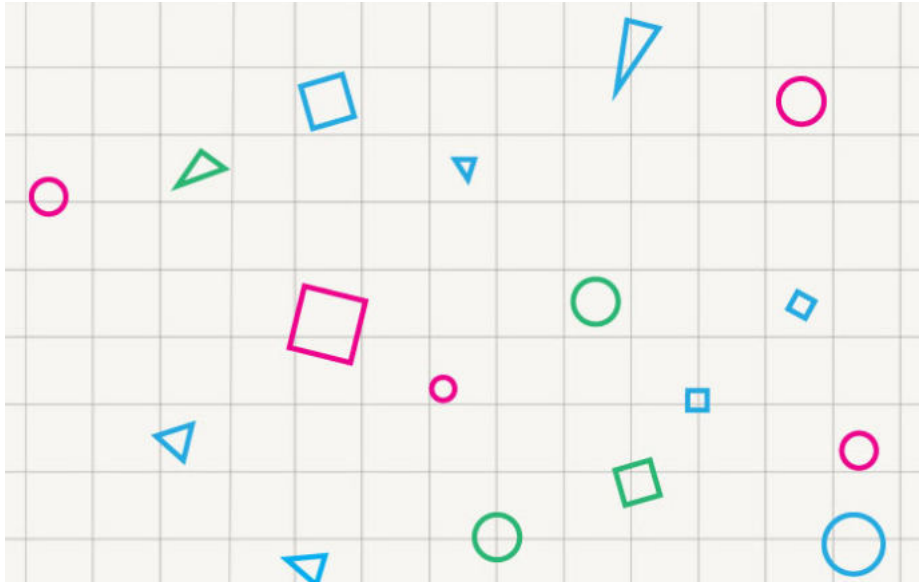
Introducing shape. Application of gained knowledge of shapes

Age group:

4-6 years of age

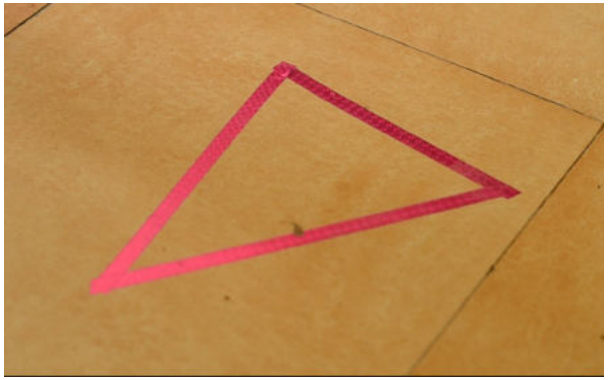
Mode of Play:

Can be played outdoor and indoor



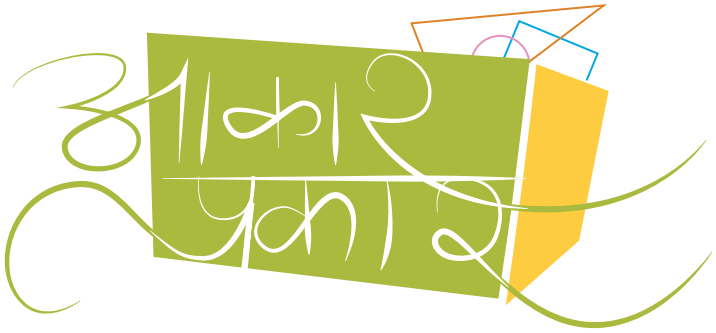
Description:

- Basic shapes are drawn randomly around the floor.
- Line by line a rhyme is recited that the kids repeat as they run around in circles (on the floor where these shapes are drawn).
- At the end of the rhyme, the conductor announces the name of a shape.
- The kids have to identify the announced shape from the drawings on the floor and stand on them.
- Once a kid reaches and stands on the shape he has to shout out the name of the shape.
- One who is left out or stands on the wrong shape looses.
- One who reaches the shape last looses.
- The one who survives the longest wins.



The kids have to identify the announced shape from the drawings on the floor and stand on them as soon as a shape is announced.

Game 2- Akaar Prakaar



Educational objective:

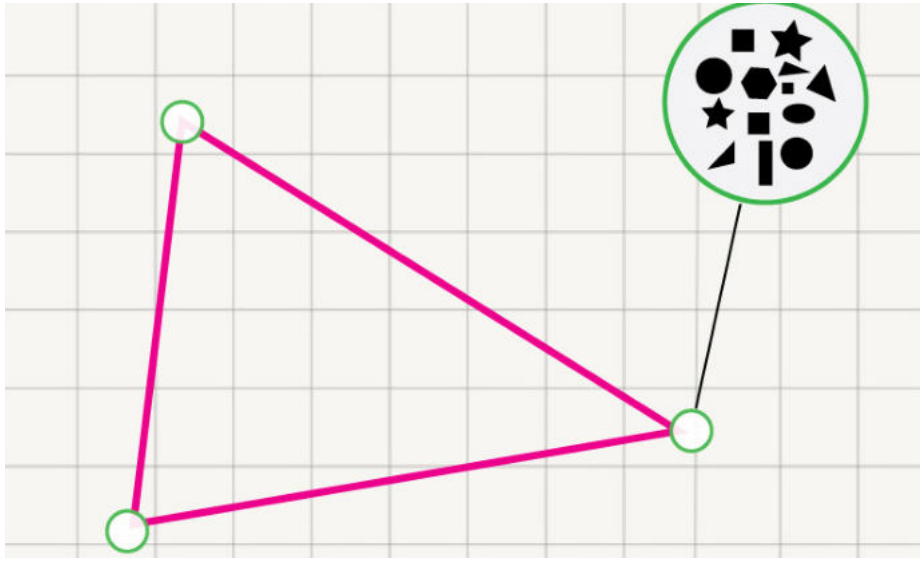
Understanding the concept of the shape (number of corners and sides). Recognizing the shape and naming it.

Age group:

4-8 years of age

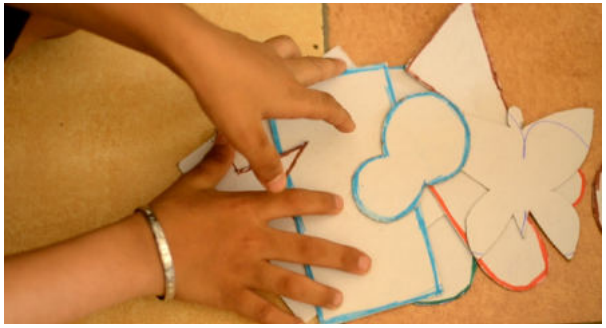
Mode of Play:

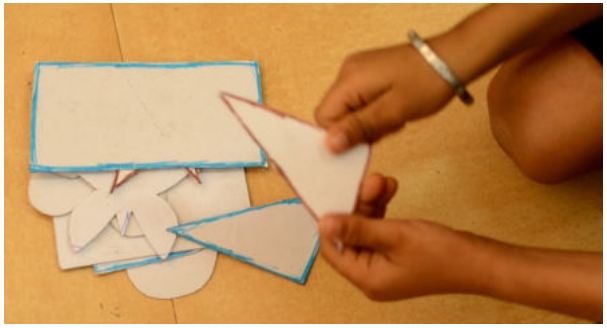
Indoor activity



Description:

- 2 teams with minimum 2 people in each.
- There is a set of 2D and 3D shapes kept in between the 2 teams.
- These shapes include basic as well as random shapes.
- One team plays at a time.
- The team that plays has one person blind folded while the other stands outside helping the player.
- The blind folded player has to pick out the given shape from the pile of shape cutouts.
- The opposite team players are allowed to distract by prompting the wrong answers while the partner prompts the correct one.
- The team to collect the maximum number of correct shapes in the minimum amount of time in one round, wins.





Game 3: Jodo Modo

Educational objective:

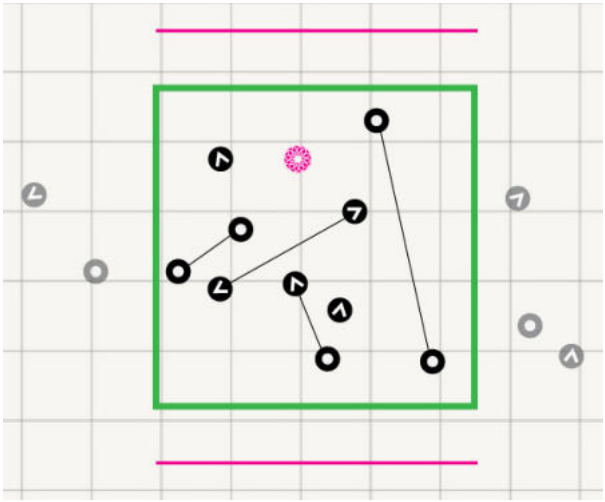
Introducing point, line, segment and ray. Understanding their properties. Application of the gained knowledge

Age group:

8 years and above

Mode of Play:

Can be played outdoor or indoor



Jodo modo is an outdoor game for kids ten years and above. It intends to teach the concepts of lines, line segments and rays through physical activity.

It consists of chips designated as points, arrows and one king.

The game can be played between three or more players. The play area consists of a large square with two lines called the throwing crease drawn along one pair of opposite sides at a considerable distance.

The game begins with a player throwing all the chips inside the square from behind the throwing crease. The game play involves this player trying to connect as many chips as possible. But not all chips can be connected. Those that fall outside the square are not a part of the game. Any two chips designated as dots can be connected with a straight line, to make a segment. Similarly, two chips designated with an arrow can be connected with a curved line or a straight line only if the arrows are aligned opposite to each other. Lastly, A dot and an arrow can be connected only if the dot aligns to the direction of the arrow to make a ray.

This game is played between the player inside the box versus those on the outside. Once the player inside begins connecting the chips, those on the outside begin targeting the king chip while the player on the next turn monitors the game of the one inside. The King chip can be hit with a ball, one throw at a time, thrown from behind the throwing crease.

The turn finishes if:

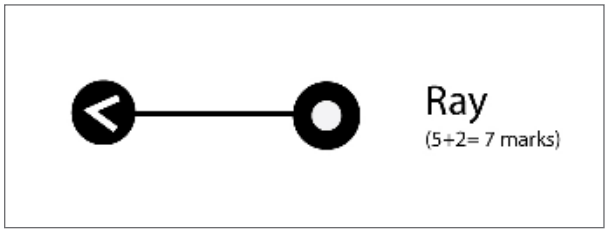
The king chip is hit by the players outside

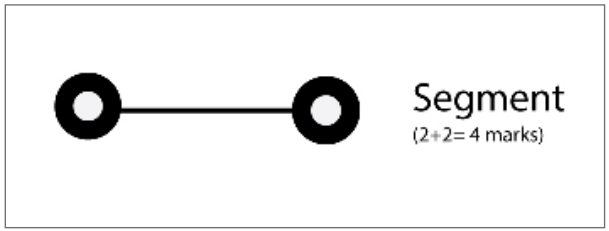
OR

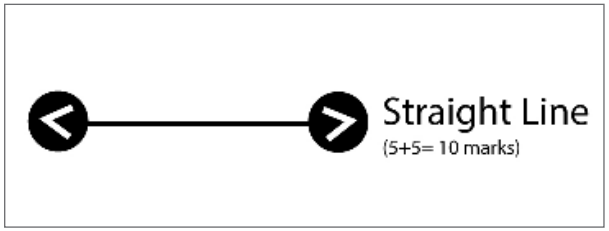
The player inside finishes connecting all the possible chips.

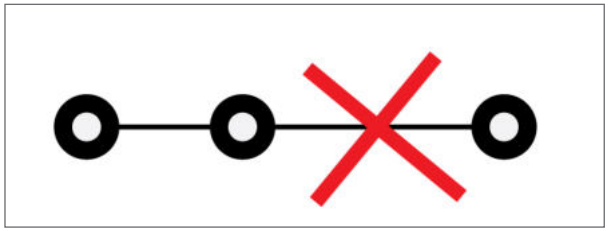
If the player inside the square is able to identify the longest line segment and connect it then his score of that turn, doubles.

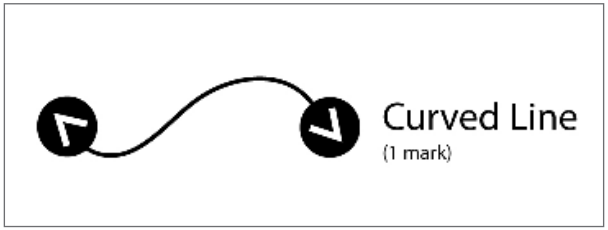
The game continues in rounds till one of the players reaches a score of 100 points.

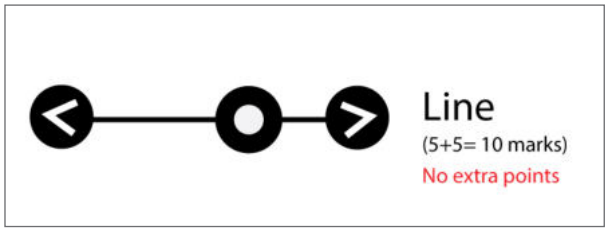












Hardware

While the game was being tested, carom chips were used with hand painted arrows and dots. But since these are circular, they would spread over a large area once thrown on the ground. Hence the newer chips were square. Again work was done on the King chip to give it a 3D shape so that is moves easily when hit with a ball.

In all, the hardware was kept simple. Easy to develop by both manufactures ans teachers (or students) themselves.

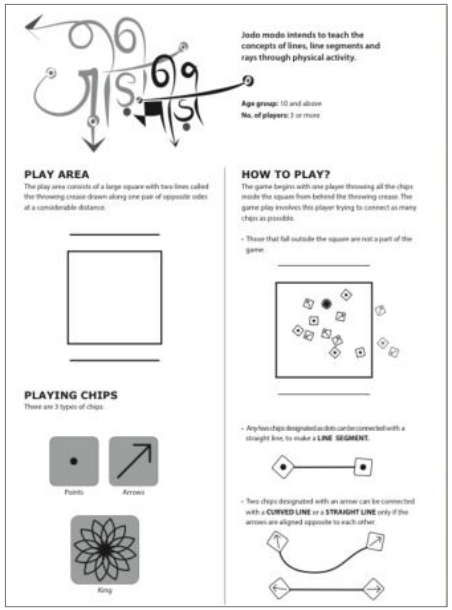
Packaging

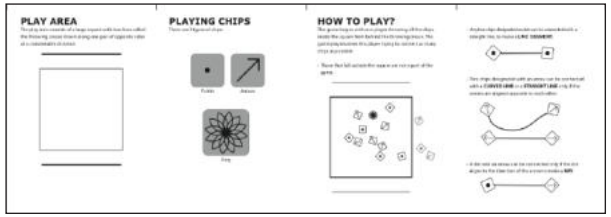
Since the hardware did not include a lot of elements, a simple packaging would be enough to hold everything together. The contents would include the playing chips, chalks, a ball and instructional manual.

A small bag, made of thick fabric and draw-strings to secure it, was thought appropriate for the job. The cloth packaging looks elegant and would also last longer than cardboard box.

Instructions

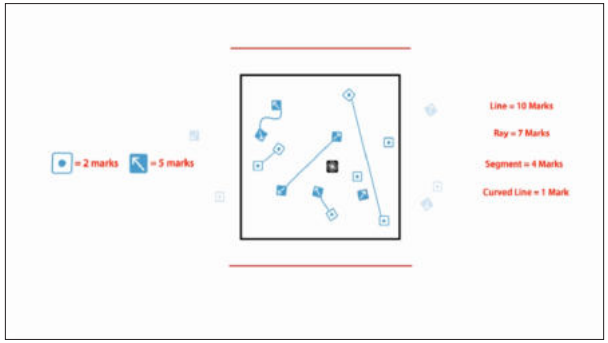
Two formats for the instructional manual were designed: A5 size, which would fit in the cloth bag. And a black and white A4 size format, which could be printed or be photocopied easily.



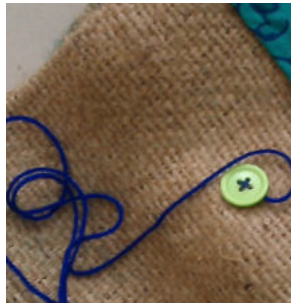


Video

For the benefit of the instructors and the students themselves, an instructional video was made so that the game is understood by them with ease. This was a two minute video which would talk about the educational purposes of the game, rules and winning conditions with an example. The video was shot in IDC itself with the help of the children who were helping out with the testing of the games.



Final Prototype



Observations

- Why did the games work?
  Running
  Singing
  Prompting
- Blind folding
- Older kids can teach younger kids
- Always requires an instructor
- Tracing the shape on the floor in Game 2 was not completed.
- The game also lacked the power to strategize and affect the opponents game.
- Confusion related to the direction of the arrows and how to use them
- The unpredictability of the direction of arrows often lead to many being left out.

Scope

Game 1: Quick Pick

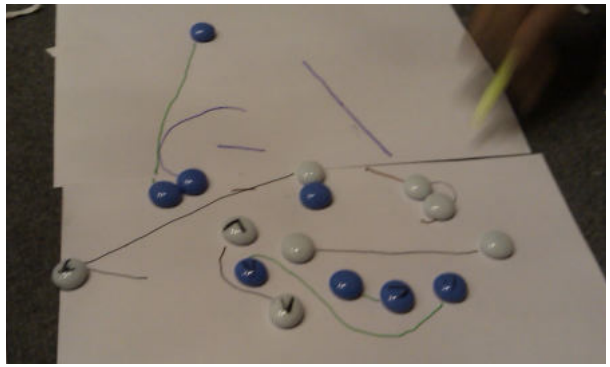
- Introduce images of 3D shapes (cube, sphere, cuboide and cone)
- Introduce images of everyday objects
- Incase of no instructor, children can alternatively take responsibility.
- Learning angles

Game 2: Akaar Prakaar

- Introduce actual 3D forms while the player is blind folded.
- Introduce shapes from everyday objects
- Kids can also sit blind folded with a pile of shapes and guess them
- Learning angles

Game 3: Jodo Modo

- More levels can be created that angles, closed shapes.
- Similar rules but played as a board game by two players.
- An explanatory video to teach shapes and concepts can overcome the problem of absence of a teacher.



Digital Game

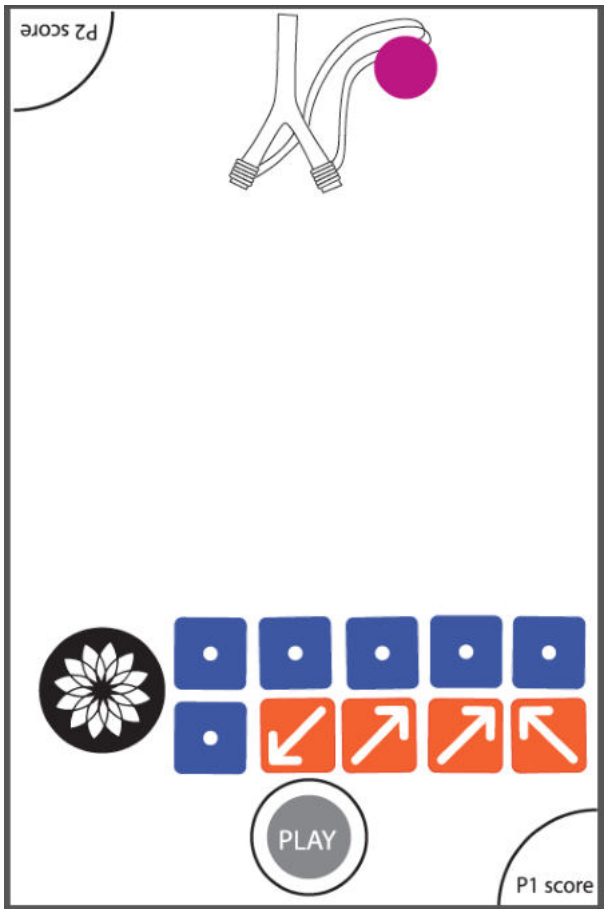
- For Aakash tablets (800x480 px, android)
- 2 or more players

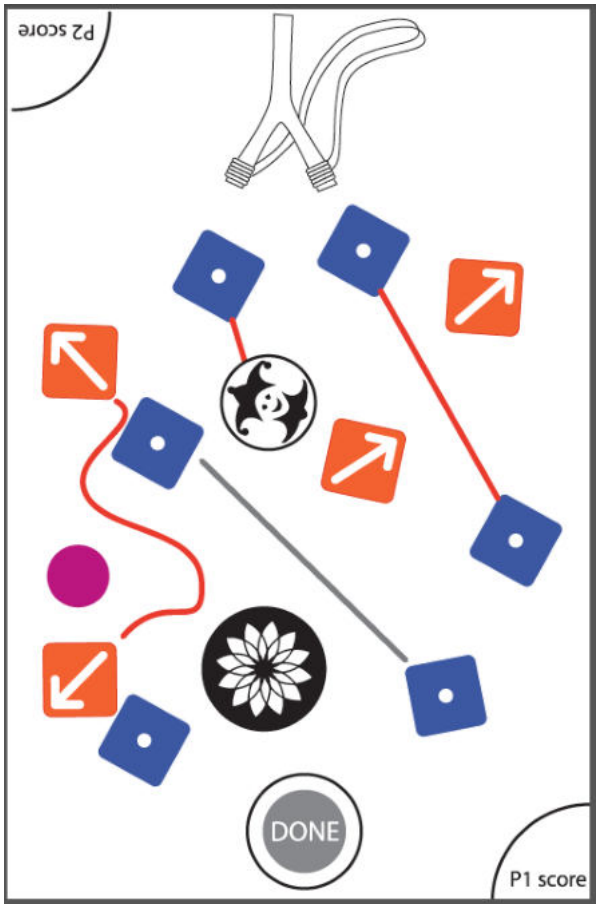
First Attempt

We were asked to convert one of the physical games developed in the last few days into a digital game. As the first two games were more or less activities, we picked the third game, JODO MODO, to be converted into digital format. Hence a 2-player game with rules similar to the physical game was proposed.

One player scatters the chips and starts connecting however possible, while the other player tries to hit the King chip with the catapult. There would also be some chips with special powers that keep appearing and disappearing, using the advantages of digital media and adding to the fun.

But the developers were not satisfied with this game. We were asked to rework on the game mechanics. Think of a different, more engaging theme for digital platform.

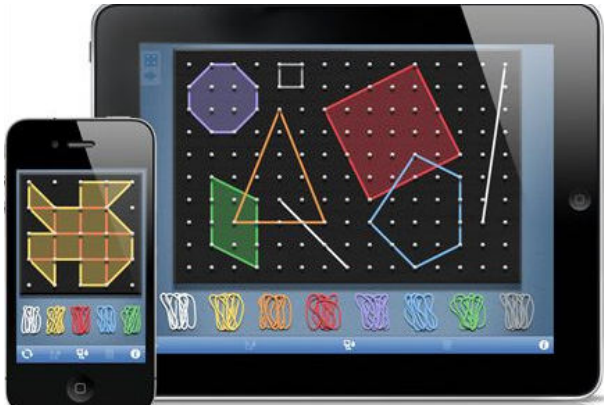




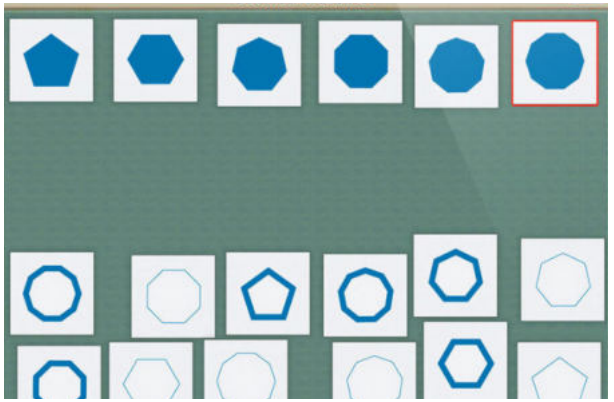
Similar Apps

Since there was a clear need of redesigning and re-thinking the digital game, a number of similar applications were studied. Many applications that introduced basic shapes were found. Some teaching trigonometry and and 3D geometry were also found. But there were no applications attempting to pin-pointedly teach the concepts of lines, line segment and rays.

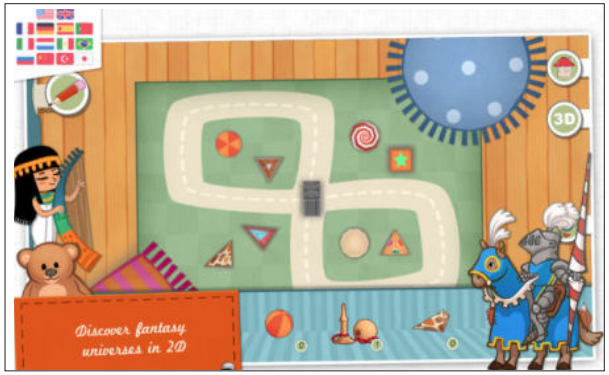
This void in availability encouraged the project further and no. of entirely new concepts and themes were thought of.



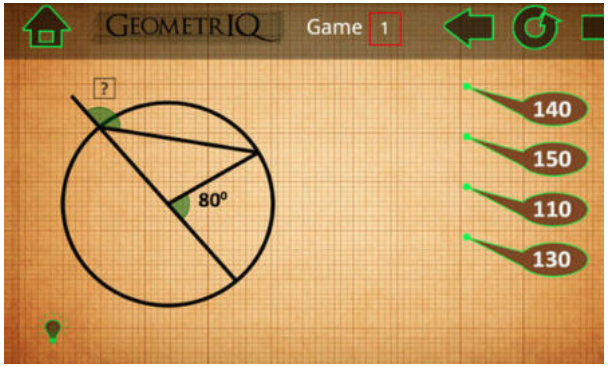
Geoboard



Geometric cabinet



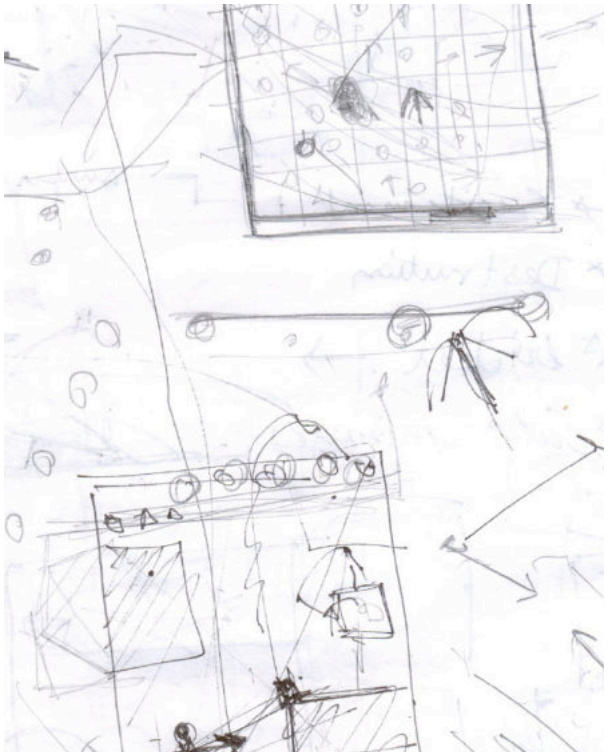
Geometric universe

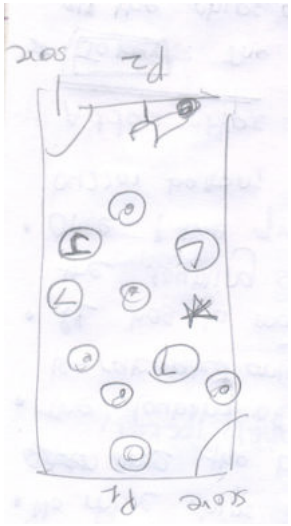


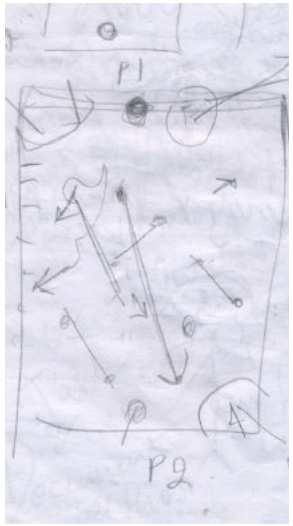
GeometryQ

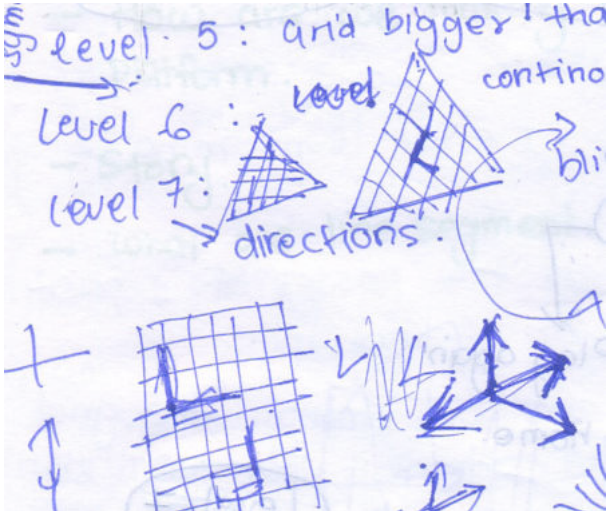
More Inputs

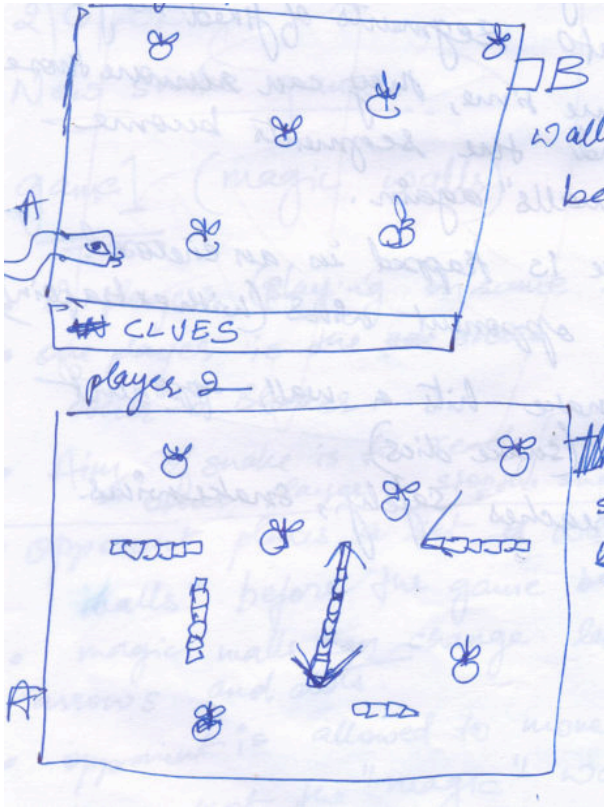
- Creating a maze with lines, line segments.
- Using some element like ‘snakes’ game: movement on a grid, getting trapped etc.
- Put a story around the task (theme).
- Should give equal opportunities for strategies to all players.
- Should keep them involved.
- Should be fun.





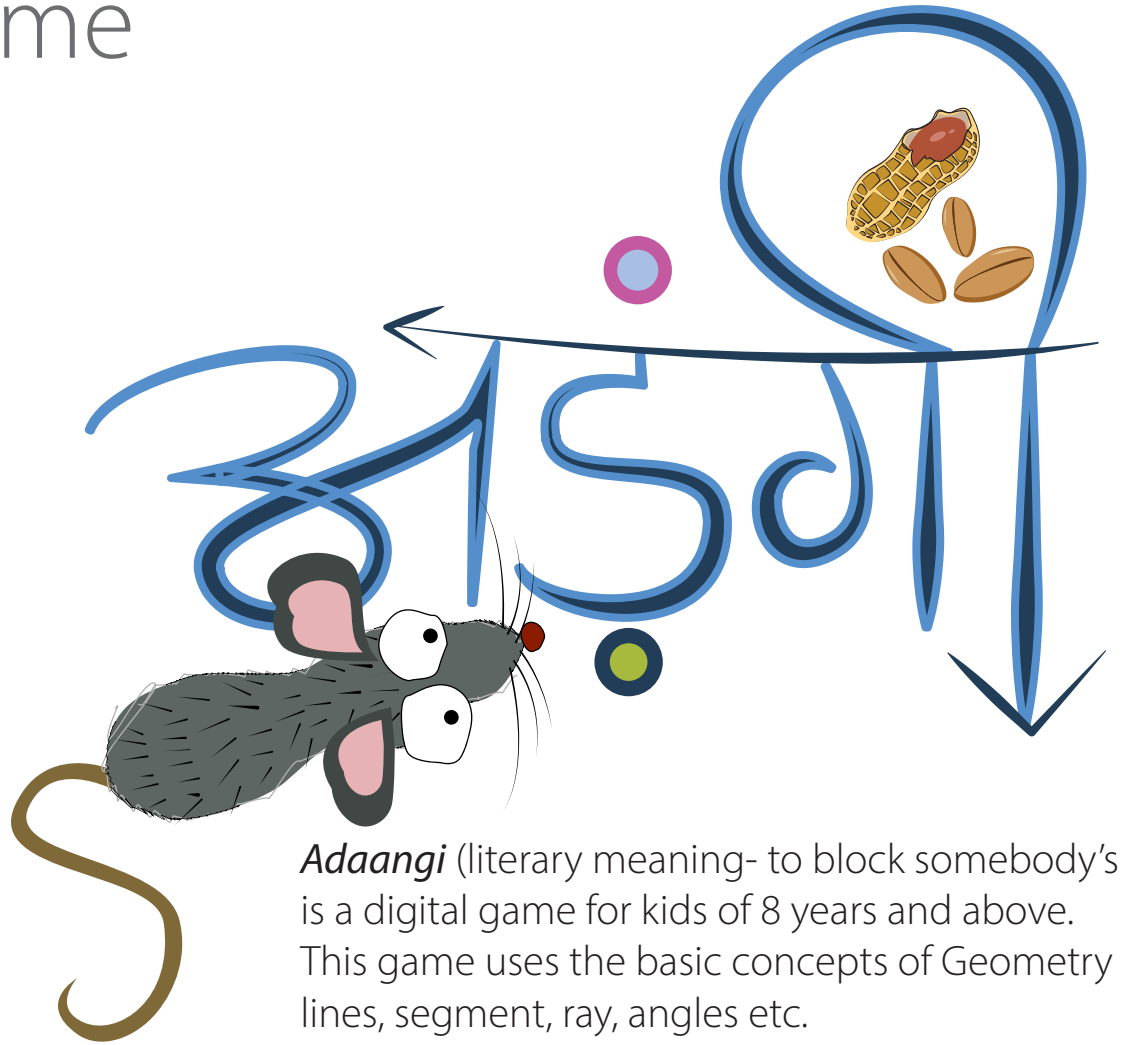






- Variation in base grids: like square grid to tech right angles and triangular grids to teach acute and obtuse angles.
- Inspiration from Battle-ship. Which incorporates the constraint of making a game for multiple players very efficiently.

Final game



Adaangi (literary meaning- to block somebody's way) is a digital game for kids of 8 years and above. This game uses the basic concepts of Geometry like lines, segment, ray, angles etc.

Game Play

Two or more mice compete against each other to find food. They can block each other by using the concepts taught at each level of lines, segment, ray, angles etc.

The player is a part of the game as a mouse trying to compete for his food. He has to direct and guide the mouse. He can drag arrows to extend lines and rays thus creating obstructions for the opponent.

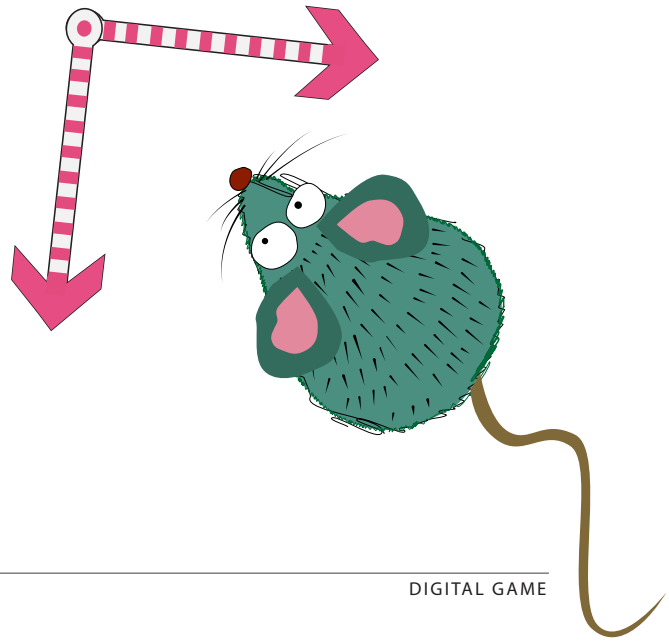
The game is played turn by turn during which the player can either move his mouse or extend any one of the used lines, rays etc. to block his opponent from reaching the food before he does.

Rules

1. Game can be played by 2 or more people.
2. Game involves 2 rats in competition with each other to reach the food.
3. The first one to reach the food wins.
4. Rats have different entries to the game area.
5. Each rat is given a certain set of segments, rays and lines which he can use to block out other rats.
6. Before the game begins, the players are supposed to layout the maze/trap for the other participants.
7. Once the placing is done, the game begins.
8. Game is played in turns. At a time, the player can either block the opponent or move its mouse to the next block.
9. One cannot move the mouse or block continuously for more than twice.
10. Players cannot obstruct the food from more than 3 sides with his lines, rays etc.
11. Players cannot obstruct the entry point from more than 1 side.
12. A player cannot use the opponent's lines or rays or segments.
13. A player cannot place all the segments and rays and arrows continuously interconnected to block the opponent.
14. Player cannot cross any lines, rays and segments even if they belong to him.
15. After a certain point in the game, the computer introduces finite number of lines, rays and segments. E.g. 1 line for each player so that they can use it to their advantage.
16. The rat cannot move in diagonal manner. Only forward, backward, sideways.
17. Powers:

    Escape hole: the rat can penetrate through a wall using these.

    I point to block: players can use point to stop a line or ray from growing.



Levels

Level 1: Straight lines and Curved lines

Level 2: Straight and curved Line, Segment and Ray

Level 3: Parallel and parpendicular lines

Level 4: Right angle.

Level 5: Acute and obtuse angle on a triangular grid

Level 6: Symmetry (provide few lines, once they are placed, more lines are generated by the computer in a symmetrical manner)

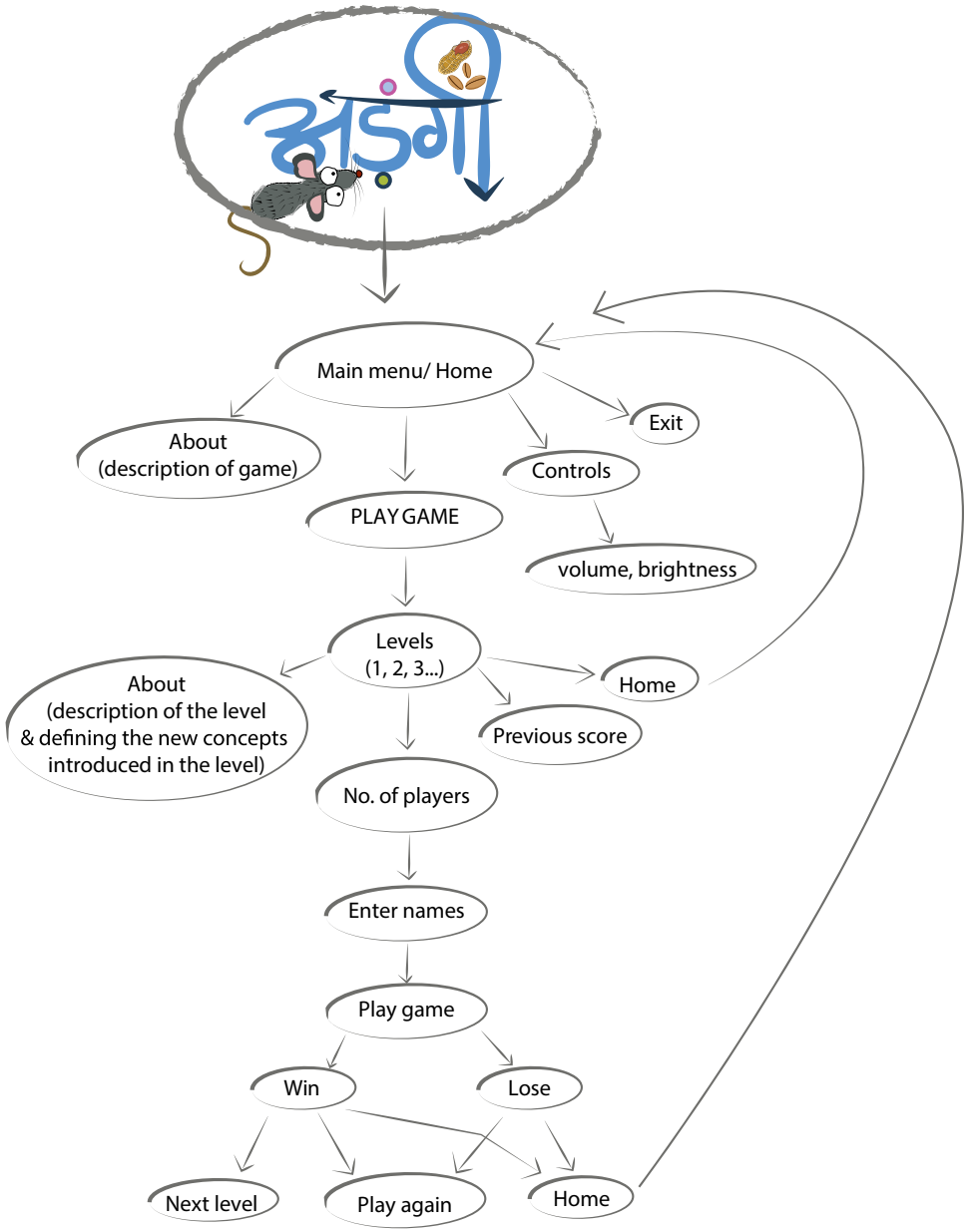
Level 7: Same as level 6, but the play area becomes bigger than the screen.

Level 8: Continuous moving mice. Limited time.

Level 9: Directions. Played on two screens. Players cant see each other's screens.

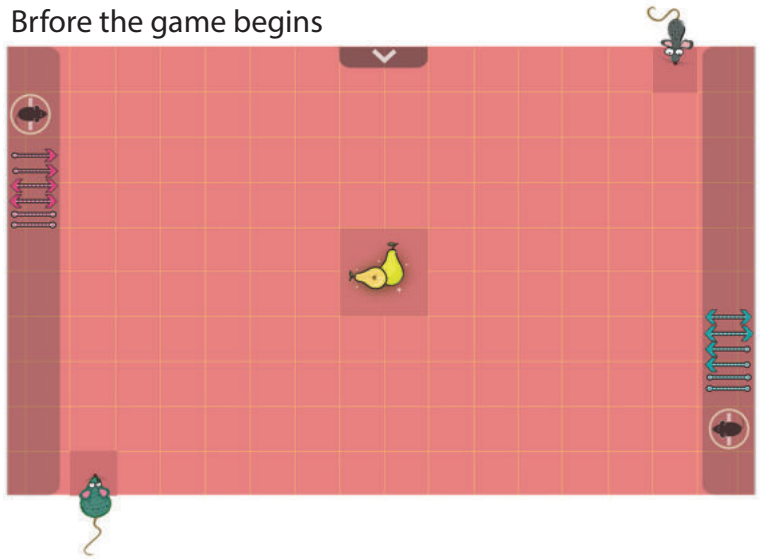
Learning

Levels	Topic	Curriculum
1	Straight lines, curved lines	3st standard
2	Lines, line-segments, rays	5th standard
3	Parallel lines, parpendicular lines	5th standard
4	Right angles	4th standard
5	Acute angles, obtuse angles on triangular grid	4th, 5th standard
6	Symmetry	4th, 5th standard
7		
8		
9	Directions	4th, 5th standard

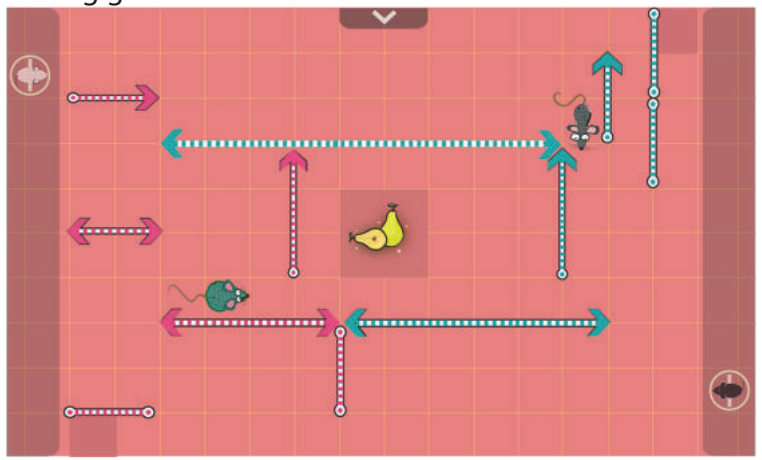


Screens

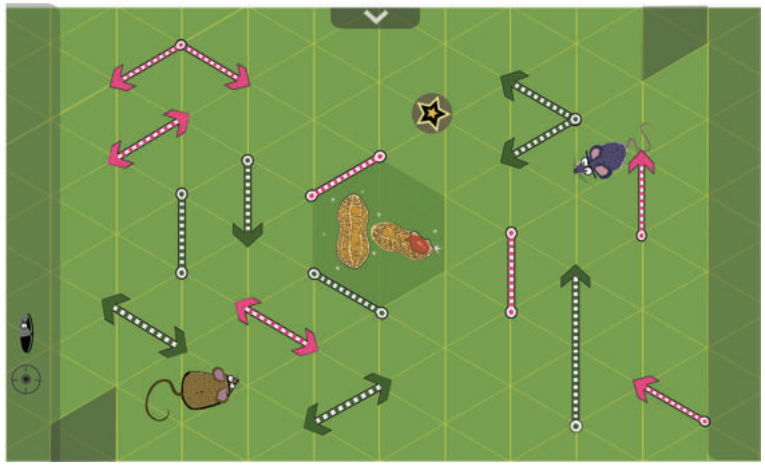
Brfore the game begins



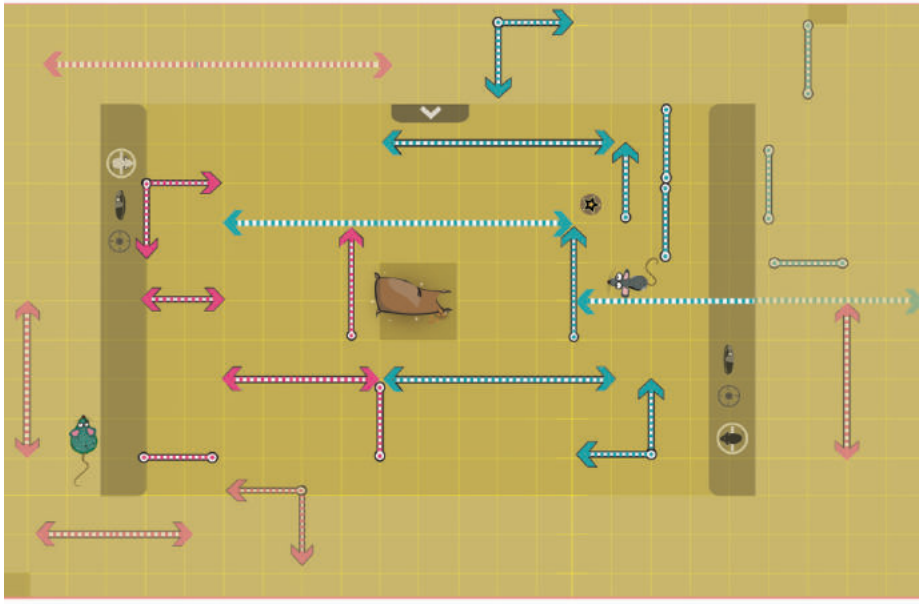
During game



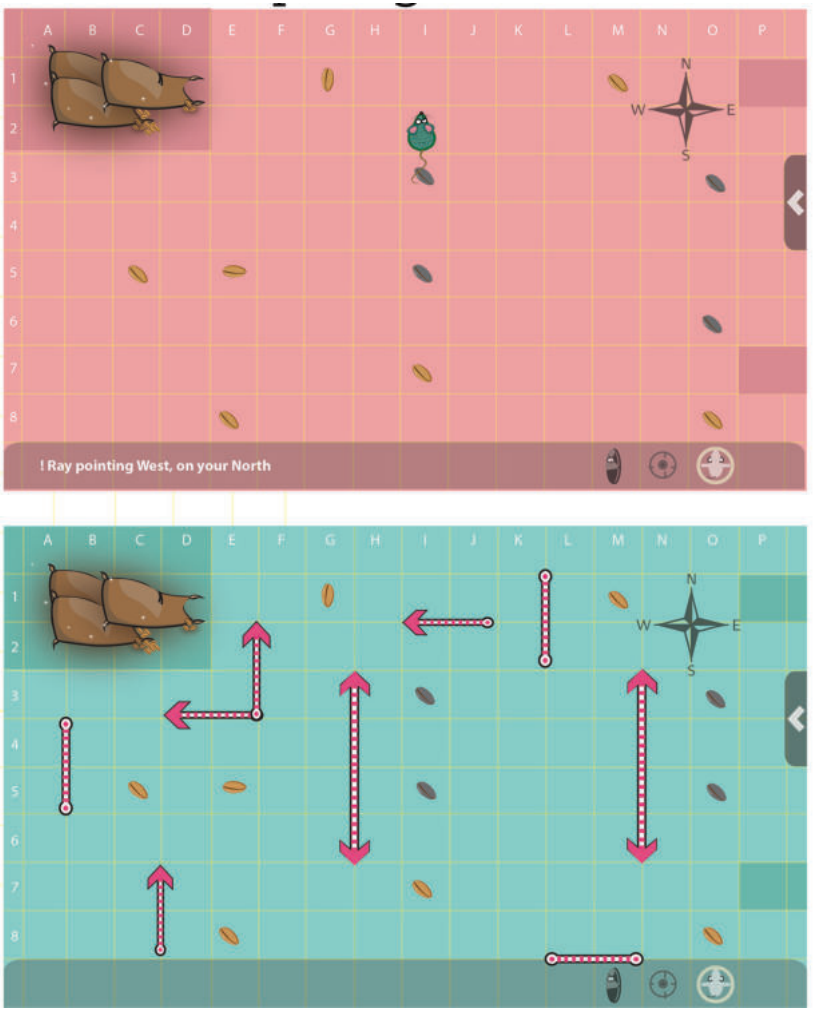
Triangular grid



Play area bigger than the screen



Game played with 2 screens. Both players cant see each other's screens



Experience

- Fun and personal
- Ten minutes of glory for the winner.
- Application of the learnt concepts
- Race to reach the food first invokes competitiveness which is exciting.
- The feeling of being able to strategically control the opponent's game makes one feel powerful.
- Various helplines and powers bring excitement to the game.

Testing

Even though testing of a digital game with non-digital medium seemed unfair, it was done nonetheless. Before we presented it to the developers, 2 kids were asked to play it on paper.

They used plastic chips as representatives of their mice and different coloured pens to depict their own sets of lines, kine segment and rays and played the game. Although the experience cant be compared to a digital game, it helped in fine tuning the rules as more possibilities and loop holes could now be recognised. It also helped in knowing what the children wanted from the game, how, according to them, the game could be made better.

- Rules for blocking food and entrance while placing the obstructions
- Replacing one's obstruction with the opponents
- Power to stop extension, escape holes.
- Want to place new obstructions after the game has begun.
- Changing directions of the obstructions.
- Confusion regarding one's obstructions with the opponent's and wanting to the power to extend those.

Conclusion

Education is one the biggest concerns of this progressive country. As pointed earlier, despite of the attempts being made by government and private bodies, a large number of population remains deprived of good quality of education. Hence attempts like these should prove useful for such a situation.

In all, the entire workshop was a great learning experience. There was a diverse group involved and each member brought something new to the learning. Work did not just happen within groups but interaction with each other helped in inter-relating solutions. Taking this forward, attempts were made to come up with hybrid solutions: ones which could integrate a large potion of the curriculum using similar hardware or infrastructure. Making the solution more that what was expected by the RSK team.

Regular presentations and involvement of a organizations working in the same field was beneficial. It helped in understanding the kind of work that has already happened or is being happening in the field of education.

Efforts were taken to make the games that serve their purpose right for the target users, even though, no real interaction with the children in Madhya Pradesh was a little disappointing. This could have affected the project hugely.

- The project explored the various possibilities of addressing the setback in the current education scenario through gamification.
- Collaboratively working with the children to understand their psychology was done.
- Young minds can be evoked and made to explore the topics they have to study at school.
- This can also develop an interesting culture of learning in govt schools.
- The concepts were constantly refined based on the feedback.
- There is availability of such material. (activity based learning material)
- There are government and non-government agencies working on these.
- Accessibility to such material is difficult for the people these were designed for.