Making Education Fun

(a workshop on Gamification of Education)

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Abstract

This project is a collaboration of Rajya Shiksha Kendra (Madhya Pradesh) and IDC. The aim of this project was to make education fun for kids. We started with studying and understanding the academic syllabus of primary schools followed by a discussion on the problem areas. Two primary areas maths and language were identified as the one requiring maximum attention. This report covers the gamification of the chapter of Simple Interest(SI) as in commercial mathematics concerning children of class five onwards. The calculation of SI boils down to the act of substitution on values in a given formula of PRT/100 but the proper explanation of the elements in the formula is often overlooked by the teacher as well as the students. The game explains the concept of a bank, borrowing, paying interest as well as taking care of ones savings. This game breaks down both the concept and the calculation into smaller fun steps such that the child learns in the eagerness of playing the game.

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Contents

Introduction

The project started with understanding existing games. It then lead to the understanding of the factors which contribute to the making of a game. It is not necessary that every game will have all the factors but a game will definitely have most of the listed factors which would contribute in its making. A duration of 4 hours was allotted to make a simple outdoor educational game based on a text book topic.

A meeting with the members of the Rashtriya Shiksha Kendra enabled us decide the topics we needed to convert into a game or a learning based activity. The first phase (1st 15 days) of the project consisted of making a physical game on the allotted topic, while the second phase (next 15 days) of the project was to ideate and layout the basic structure for converting the game into a digital medium.

Background

Education in primary schools is a major problem in India. Over the years government has come up with various incentives like minimal fees, free books, uniforms, midday meals etc. to motivate kids to come to school. Yet there hasn't been a significant improvement in the number of children willing to go to school even for primary education. In most of the places even if children end up in schools there is an acute shortage of teachers and resources. The number of teachers to the number of classes being taught at times is as bad as 1:5.

The Madhya Pradesh Government in its resolve to address this problem came up with an innovative solution to make schools a fun place to which kids would want to return everyday. They were looking for a solution which would not only address the shortage of teachers but also promote peer learning. One solution to this problem was to convert the lessons from the regular text books into games or activities. This would not only break the monotone of rote learning but will inculcate a habit of peer learning. Any activity introduced as a game to children is more readily accepted than a regular lesson or a chapter to be learnt.

Chapter 1: Understanding the game world
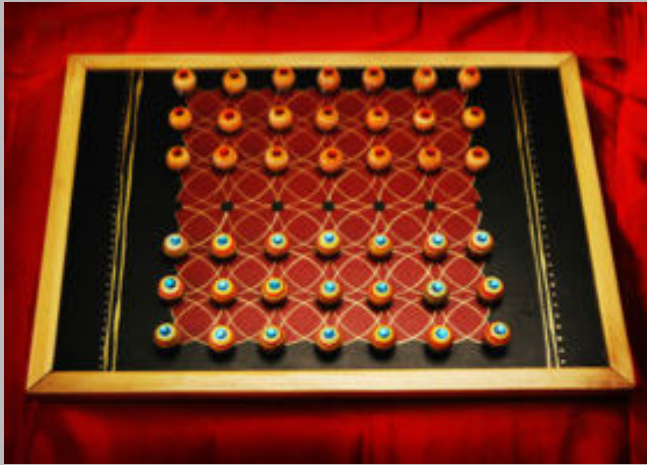
The game of Chakra View

A game world is most of the time a created environment. It does not follow the rules of the real world. This is what makes each game unique and enjoyable. The best judge of the degree of enjoyment possessed by a game are the players of the game. Hence this was our very first exercise to understand an existing game and then to improve it based on our experience as players.

1.1 Improving the game of Chakra View

Chakra View is a two player game. Its a game in line with the game of chess, unlike chess there are only two types of tokens in it the pawns and the mantris. Both of them are allowed certain moves. But the fun part is that they move in arcs rather than straight lines. That being a short and basic introduction to the gameplay of the game. What we were required to do was to play the game several times and improve it. This improvement could be in any and every direction, visually, conceptually, strategically etc. Hence we came up with the following improvements:

1.   The game has two roles one is to defend your tokens and other to injure/kill other peoples token. However the biggest loophole in the existing game is that if both the players just keep defending their tokens and don't attack on the other players token, it leads to a deadened where players are left with no moves. This is because there is only one central free line in the board, and once it gets occupied while no tokens from the board has been removed the board gets full. The proposed solution to this issue was making the layout of the board bigger by one circle.

2.   The game of Chakra View is a strategy based game hence requires some thinking, to involve children of lower age groups its preferable to make the layout of the board more interactive by adding grooves to the board and wheels to the coins.

3.   By adding grooves and wheels we can introduce a sliding action since the tokens move in arcs in the existing gameplay, this action will add fun to the game.

4.   The complexity of the game might require the player to refer the rules or gameplay several times hence a facility of audio instructions might be useful

5.   As an incentive to the players we decided to introduce power or rewards on particular moves.

6.   The game board could be made visually more attractive and colourful.

1.2 What makes game a game?

To understand what makes game a game is one of the most important question that needs to be answered when we step into the field of game design. Hence this was one of the first questions that we had to answer in our program. A list of keywords contributing to answer the above question was thus complied.
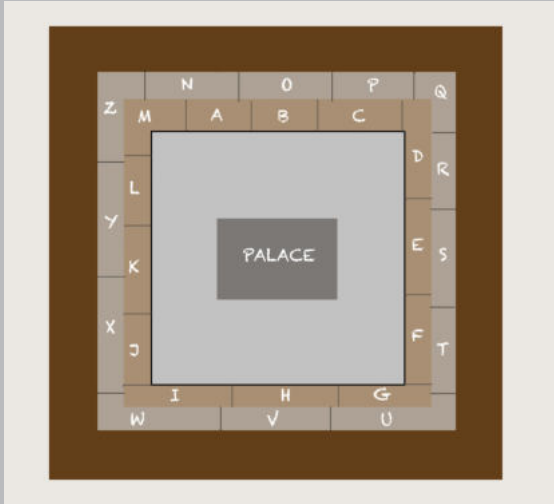
Spell Karo play area

Rules + Guidelines	Competitive	Resources	Unpredictable
Risk	Entertaining/ Enjoyable	Relative Advantage	Levels
Patterns	Fantasy Word	Relaxation	Real Life Context
Accomplishments/Winning & Losing	Story	Learning	Game Mechanics
Skills Involved	Role play	Imagination	Surprises
Luck Oriented	Use of Artefacts	Rewards/ Power	Themes
Interactive	Physical or Mental	Target Audience	

1.3 Designing an outdoor game

Having understood the key factors contributing to the formation of a game, we were given a task to design an outdoor game. The game had to be an educational game teaching anything from language, maths to social or political science.

Our team decided to select the topic of English language. The focus of the game was to help kids learn spellings interactively. As spellings are often a problem area for a number of kids and mugging up spellings can often become very boring.

Spell Karo!

Spell Karo is a multiplayer game, played on a square or rectangular layout.

The rules of the game
1.   Players can stand randomly anywhere on the alphabet area but on one leg.
2.   One player gets to stand in the palace. This player stands on both his legs. Lets call him the King (Queen in case of a girl)
3.   The king then calls out a word. Example 'Elephant'
4.   He also has to spell out the word.
5.   Other players will have to hop and reach the last alphabet of the word. In this case 'T'
6.   The player who reaches the last alphabet first gets a point and exchanges place with the current king to become the king.
7.   If a player falls down in the process of hopping he has to go to the outer penalty area and keep circling

the alphabet area unless he or she gets back to the alphabet area.

8. The game can continue for as long as the players want to play.

9. The player who reaches the palace the maximum number of times wins the game.

Feedback for the game:

1. The game has good interaction between players.

2. All the players in the game are busy hence no one gets bored.

3. The game has a good balance of physical and mental activity.

4. The game does not have a definite end time.

Chapter 2: Discovery of Byazigar

2.1 Understand the problem and Topic assignment

The aim of the project was to gamify lessons from the syllabus of primary schools of Madhya Pradesh. The games or game based activities should pertain to the subjects of English, Hindi and Mathematics.

A discussion session with the members of the Rashtriya Shiksha Kendra helped us understand the issues and difficulties faced by them. Some of the issues faced by them are as follows:

1.   High dropout rates/ Inadequate attendance in the primary schools
2.   Inadequate teachers in the schools, sometimes the condition is so poor that one teacher has to handle five classes alone.
3.   Children fear the concept of going to school. Its looked upon as a place of enforcement and rigour.
4.   The rate of peer learning is very low.

After we attained a basic understanding of the issues faced in the primary schools we were distributed topics to gamify. We were assigned the topic of commercial maths pertaining to standard fourth and fifth covering topics of Unitary Method, Average, Percentage, Profit and Loss and Simple Interest.

RSK Team member explaining the syllabus

	Unitary method	Profit and Loss	Percentage	Average	Simple Interest
Class 4	understanding the concept of unitary method,	Add amounts upto a sum of 100			
	given the cost of multiple object find cost of one	convert rupees to paise and vise versa			
	given the cost of one find cost of multiple	explain the concepts of cost price, selling price, profit and loss			
		solve everyday problems			
Class 5	above all + Given the cost of a set of objects to find the cost of another set of objects	above all+ problems of increased difficulty	meaning of percentage and to determine percentages	the concept of average	concept of Simple Interest
		calculation of profit and loss using percentage	convert decimal to percentage	determine average and to express it with the respective units	explain the concept of principal, interest, rate, time, amount
			convert percentage to decimal	solve problems related to average	calculate interest, amount and principal using formulas
			determine the percentage of a given amount		calculate simple interest problems using formulas

Image from initial brainstorming

Playtesting (left) Making paper prototypes(right)

2.2 Initial Brainstorming and Play-testing

Commercial Mathematics is a huge topic and each chapter under this topic is extremely important. But to gamify all the topics given the short duration of the project was not possible.Hence we were required to select a chapter which would solve multiple problems. The initial brainstorming consisted trying to design various kinds of games like:
• Card based
• Outdoor
• Indoor
• Mental Calculation
• Written Calculation
We make paper prototypes of our games and tested them with the kids.

2.3 Evaluations from the Play-test:

1. Any form of mental and physical activity go well as long as the mental activity is very minimal or easy. When things like calculation is incorporated in a game involving moving or running around then it not only becomes difficult to concentrate it also reduced the learning quotient of the game.
2. If a game is educational it needs a stronger fun element to hide the learning it inculcates.
3. Skill based games have a higher chance of repeat play
4. When the game deals with complex calculation its best to break it down into steps.

2.4 Why Gamify Simple Interest?

After the initial evaluation of the topics we found that the chapter of Simple Interest(SI) is not only difficult to understand concept wise it also covers other aspects of commercial maths. Some of the reasons why Simple Interest was chosen as a topic for gamification are as follows:

• The concept of SI is probably the first educational introduction of the kids to banking, along with that it also introduces the value of savings.
• SI is the best example to understand the working of a bank.
• It is an introduction to the concept of principal amount, rate , time and interest
• Understanding the profit a bank makes by taking interest on the lent amount
• Why people borrow money from the bank. The value and need of buying property.
• Understanding the concept of paying interest
• Understanding of the concept of choosing a beneficial interest rate
• Breaking the fear and monotone of complexity calculation
• The topic covers multiple aspects like use of multiple operations, concept of percentage as well as profit and loss by deciding the correct investment plans.
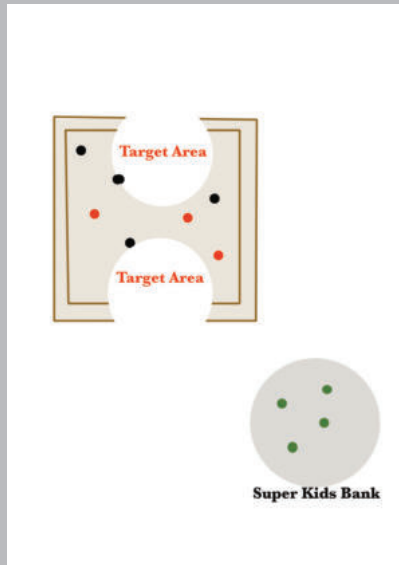
One of the initial layouts of the game with separate area for the principal coins

The initial board, the tokens and the layout

2.5 Initial Game Concepts

Once the topic was decided we started thinking of the possible game-plays. Some of the initial game concepts were:

1. To convert each element like principal, time and rate into a separate token.
2. To strike one token with the other to represent multiplication.
3. To add a skill element by introducing a particular hit sequence after scattering all the tokens randomly on a board or smooth surface.
4. Introducing a scenario of bank agents trying to determine the best interest combinations for the bank
5. Idea of a common pool to chose principal amount and then hit the other coins from a target area

2.6 Initial Designs

Some of the initial ideas for the physical design of the game were as follows:

1. A board or smooth surface to strike the tokens.
2. Using different shapes to represent elements of principal amount, rate and time
3. All tokens of the same colour
4. Values of principal, time and rate written on the tokens

2.7 Difficulties and Failures

Once the initial gameplay and the game design was play tested a lot of things became clear. We got a clear understanding as to what was actually working and what was not working. Some of the difficulties and failures faced are as below:

• The idea of acting as the agents of the bank does not apply to a common man scenario so it is difficult to relate to.
• Idea of a common pool to chose principal amount and then hit the other coins becomes too luck based and limits the number of choices.
• All tokens were of the same colour hence difficult to distinguish
• Only values were written on the tokens so children's started calling them by the shapes hence the purpose was defeated
• The fun element was missing, the game was flat and same paced.

Playing coins modified

Discussion with the paper boat animation company

2.8 Changes and Improvements

- After analysing the difficulties the following changes were made in the design of the game:
- The shape of the coins were changed to round
- The different elements were colour coded
- The coins were made more detailed

2.9 Feedback Phase

Once the initial gameplay and game design was in place there were various presentations, brain storming and feedback sessions from different game companies which helped us improve the game and resolve some of the issues faced initially.

2.10 Final Game Concept

The final game saw a lot of improvement and changes. Some new features were incorporated in the same. Also the language of the final game was changed to hindi such that it is suitable for the children of hindi medium rural schools. The hardware of the game was kept very minimal and easy to produce. The final concept of the game was as below:

1.   To enable kids understand the concept of principal amount, rate of borrowing and the time for which a sum is borrowed.
2.   Each Player is given an initial savings amount
3.   The coins of principal amount now have a property image on them.
4.   Special coins of interest exemption (byaj maaf), interest reduction (byaj kam) and interest increment (byaj jyada) were introduced.
5.   A calculation sheet for making the calculation easy.
6.   The players being a smart citizen have to try to get the least amount of interest combinations and save maximum amount from their savings.
7.   Also a small luck element was introduced by choosing some principal coins in the beginning of the game.
8.   The whole game was now converted into hindi to suite the convenience of the kids.

Final Physical Games
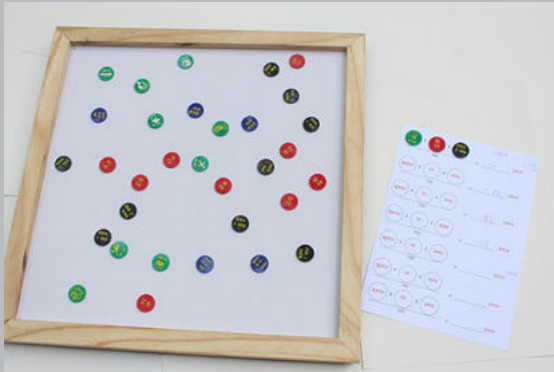
2.11 Rules of the game

Game Name: Byazigar

Number of players:
Two player or two team game.

The game has the following elements:
• A board of dimension 20 inch by 20 inch
• Ten tokens with principal values written on it: green in colour
• Ten tokens with rate values written on it: red in colour
• Ten tokens with time values written on it: black in colour
• Two interest exempt tokens and two interest reduction token and one interest increment token: blue in colour
• A formula sheet where the student arranges their coin and calculate the interest.
• A notepad and pen to keep track of points

In a two player game:

• In the beginning of the game every player will have an amount of Rs 1000 in their savings account.
• All the principal tokens with values and images of the assets on them are kept upside down randomly.
• Each player chooses five tokens each, then sum up the values on the coins and make note of their initial assets. At the end of the game a caparison of the total value of assets earned is made with the amount chosen in the beginning. If the player has

a higher amount he gets an increment of Rs 200 in his/her savings account.
• All the four kinds of tokens are then spread randomly on the board. The interest reduction and increment tokens are placed upside down on the board.
• A player has to achieve the minimum interest by hitting a combination of the principal, rate and time tokens.
• A player has to start with a Principal token using which he/she can hit either the rate token or the time token, The second coin should then be used to hit the third coin. For example a player uses two fingers to strike the principal coin which then hits the time token, a second strike has to be made by the player to then hit the rate token using the time token.
• A combination once achieved belongs to the player and the interest calculated has to be deducted from the savings.

Penalties:

• A player cannot hit two similar tokens with each other, like hitting the rate token with rate, time with time and so on is a penalty and the player has to play a fine on Rs 50 more than the highest interest value on the board.
• Any missed chance has a penalty of Rs 100 more than the highest interest value on the board.
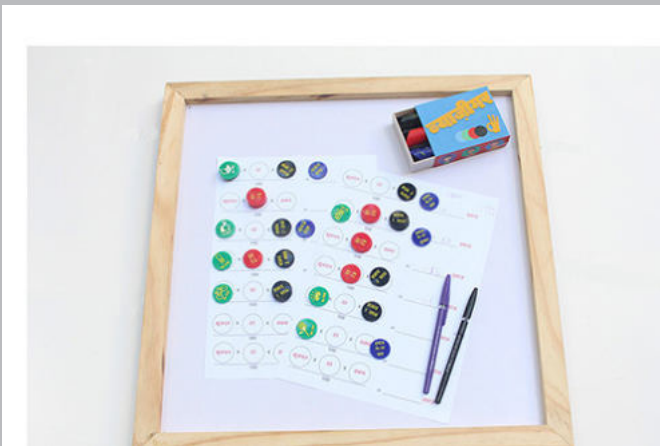
How to determine the penalty amount?

The amount to be payed as penalty is determined by adding Rs 20 to the highest interest amount on the board. For example if the highest principal amount on the board is Rs 1000, the highest rate percent is 5% and the biggest time value is 2 years then the amount of simple interest to be payed is 1000 x 5 x 2/ 100 = Rs 100 . Hence the penalty amount to be payed is Rs 100 + Rs 20 = Rs 120.

Bonus:

•   If a player hits the interest exemption token after hitting the highest combination they get a total exemption on the interest amount.
•   If a player hits the interest reduction token after hitting a combination, the said amount gets reduced from the interest to be paid.

Byazigar:

•   After deducing the interests thus made by hitting the minimum interest combinations the remaining savings amount is calculated.
•   The player who makes profit after comparing his/her initial and final assets gets to add Rs 200 to their savings.
•   A player who pays the minimum interest in total and saves a bigger portion from their savings wins.

Chapter 3: Digitizing Byazigar

Opeining screen of the game

Once the development of the physical game was complete we moved on to the second phase of the project which is the conversion of the game to an online platform. The digitisation of the game was beneficial in terms of saving manufacturing cost, wear and tear, multiple usages etc. Since the hardware would be minimal even cost for the space and structure gets saved. Also as mentioned in the beginning of the report the project aimed at making multiple games on different topics hence it was necessary to have a common platform to host the projects and save time.

The digital version of the game was modified in various ways to use its advantages and to overcome the limitations.

3.1 Game Concept:

1.   The basic concept of the game remains same with its physical game. To summarise:
2.   The purpose of the game is to introduce and explain the concept of bank, borrowing and paying interest on the borrowed sum.
3.   To motivate kids to do complex calculation through game.
4.   The game deals with the subject of commercial mathematics
5.   The game is designed for 5th standard kids and above.
The game needs prior explanation to the concept of calculating Simple Interest.

3.2 Core Mechanics:

The core mechanics of the game consisted of :
•   Calculation: Hitting a combination of coins to make minimum interest amount.
•   Precision: Control the force of hitting the coins to avoid penalty hits.
•   Decision Making: Choosing a combination with least interest and biggest principal value increases players chance of winning
•   Attentiveness: The player can also attempt to get exemption of interest through special coins like interest reduction and interest exemption coins.

3.3 Play Mechanics:

The basic difference in the play mechanics of the physical and the digital version of the game was due to the interface on which the game was played. In addition to this certain new features were introduced in the game based on the advantages of the digital platform. Besides the overall play mechanics of the game was as follows:

1. The skill and precision required to gain the desired interest varies from player to player and can be practiced
2. The calculation is time based hence the fastest players can get bonus money.
3. The players can plan their moves depending on the coins in the queue
4. A higher principal on the table can be claimed with an exemption hence its also motivating
5. A missed chance has penalties hence the players need to be precise and attentive.

3.4 Progressive Mechanics:

• As the game progresses the following are the activities performed by the players:
• The goal of the players is to save as much as possible from a given amount of savings
• The players strive to strike the minimum interest combination possible.
• The presence of interest exemption tokens and interest reduction tokens acts as incentives in the game. The digital platform also facilitates the hiding of the surprise appearance of these coins.
• The players have a sense of competitiveness to achieve property of higher value as the total earned property will be compared with that earned in the beginning of the game.
• The Physical game has a limitation of size and hence the number of coins and the duration of games is fixed. However this can be overcome in the digital version since more coins can be released on the board in instalments.

• Also some of the special coins on the board can be saved for hitting coins of higher profit in the queue

3.5 Gameplay Experience:

• This section is based on the first hand experience and feedback gathered from the physical game and an estimation of the user experience of the digital game.
• Engaging: The game has plenty of elements to keep the players engaged and thinking. Like the six different kinds of coins, the hit sequence, the different types of calculations etc.
• Sense of achievement: The player makes a decision in every turn he plays and depending on the success of his/her decision there is a feeling of satisfaction or disappointment.
• Intellectually rich: The game deals with the subject of mathematics which is most of the time intellectually challenging
• Frustrating: Any missed turn, or wrong hit comes with a heavy penalty amount which is deducted from the players savings. This induces a healthy frustration in the players.
• Challenging: To be able to achieve the best combination is often challenging as even the other players aim for the same.
• Entertaining: This game is based on a topic which is not only educational for kids but also an interesting topic for the grown ups as it deals with everyday scenario. Hence the game is very entertaining.

The menu Screen

Avatars

3.6 Theme

The theme for the online version of the game was designed to be indian in terms of the look of the characters and the language of the interface. The colours chosen were very bright to attract kids.
A short backstory for the game was made as a setup for the game which would play before the game begins.

The video gives a fake scenario of a Bank named Bhuleshwar messing up its records and the agents of the bank trying to cheat the customers by extracting the maximum interest possible through interest combinations. The challenge is that if you are a smart customer you will find a way to pay least interest and defeat the purpose of those agents of cheating you.
The menu screen is where the player will select the course in which he would like to proceed with the game.

A screen of avatars is there for the players to select the screen image that they would like to have for themselves.
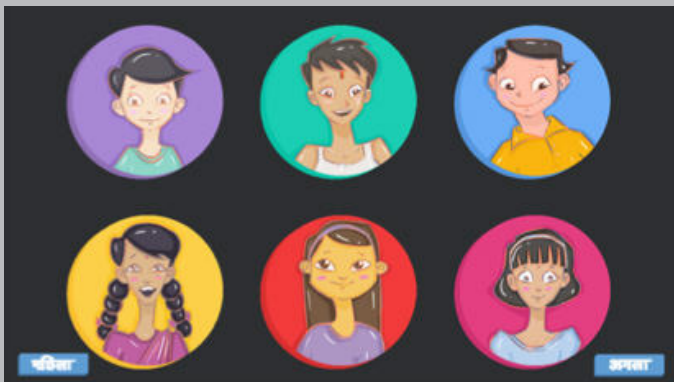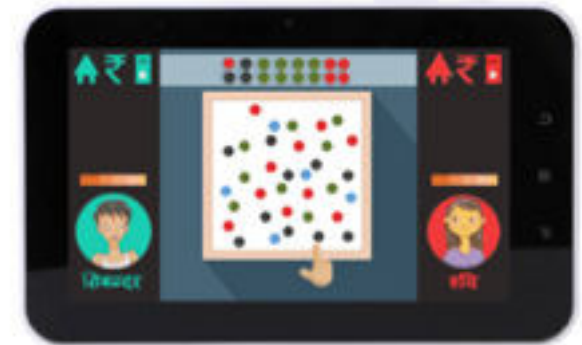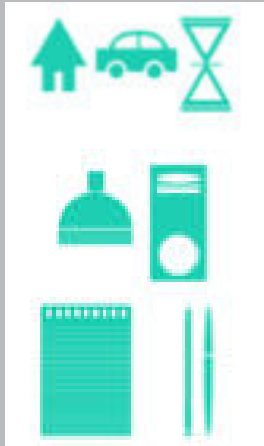
The pre final screen where the player enters their name which appears during the game

Game screen for a 2 player game

Shown above are the game screens for a two player game as scene in the tablet.

Extra elements for the hybrid system

3.7 Technology:

The biggest advantage of the digital game besides the cost factor was that it could be played by multiple players at the same time and the biggest disadvantage being the fact that it reduces the social interaction which the physical game offers so strongly. Hence the technological analysis of the game was made on two grounds being independent and hybrid.

Independent

In the independent design of the whole game could be played in the tablet itself. Even if there was a requirement of an additional component it would be satisfied by another tablet. The most import additional feature required being the sheet/ space for calculation. Hence we came up with the following combinations:

1. A single tablet which could be used to play the game as well as to calculate scores. However changing screen multiple times and removing the tablet again and again from the play area might act as an unnecessary disturbance in the game.

2. Using two tablets. One central table for playing the game and a second tablet which would be used for calculation. The circulation of the second tablet among the players introduces a good social interaction but the synchronisation of the two tablets for the correct player to be calculating his/her score might become problematic.

3. Using three tablets where two players share a table for calculation in a four player game and the central tablet acts as the game board.This is a more optimum solution as there is considerable interaction between the players and not much confusion while calculating the scores.

4. Using five tablets. Where every player gets their own tablet to keep track of scores and a central tablet to play. Most feasible option as long as the arrangement of the game is concerned but most uneconomical and socially isolated one.

Hybrid:

The idea of the hybrid technology was incorporated to keep up the fun and interaction which the physical game provided. The idea was to have a central tablet for the game but various other physical elements pen and paper for calculation, a sand clock timer to keep track of calculation time, a buzzer or a bell to indicate time out and property tokens to give the kids a sense of ownership.

A two player sitting arrangement

A four player sitting arrangement

3.8 Configuration:

The configuration of the game basically refers to the arrangement of the players and the game. This was in combination with the various options possible technically.

In a two player sitting arrangement both the players will be sitting opposite to each other. They will not be allowed to change the position of the central playing tablet.

In a four player sitting arrangement the players will be seated in the four corners of the board. Along with them will be placed the other elements of the game like notepad and pen for calculation, buzzer or bell and property tokens.

Evaluation and feedback

On the final day of the project a presentation was made to an audience of eminent people from various game companies and educationalists. Game Company like Paper boat Animation , Edu is Fun, Learning Mate, Yellow Monkey were present for the presentation. To summarise the feedback points were as follows:

- The game got a good feedback in terms of the topic it attempted to gamify. The topic of simple interest is a complex yet essential topic that doesn't interest everyone, hence the idea to gamify it was very good.
- The game mechanics was appreciated especially for the digital version of the game.
- A very interesting proposal to shake the tablet was made in order to add more fun by disturbing the arrangement of the coins for the opposite players
- Another very interesting idea which came up during the discussion was of actually showing the coins merge into each other when the strike each other to show the action of multiplication. Like when the principal coin strikes the rate coin it forms a single coin named PR which when strikes with time becomes PRT.

Conclusion and Future Work

- The game still needs to be tested and evaluated with the kids of primary schools in Madhya Pradesh.
- Changes in the games may be required according to the response.
- The digital version of the game needs to be finalised in terms of design and look and feel.
- The digital version can be further explored in terms of game mechanics.
- A response or feedback from the teachers is needed as the game was initially developed with the concept of facilitating the problem of shortage of teachers.

References

http://www.educationportal.mp.gov.in/Public/TextBooks/View_TextBooks.aspx

https://www.facebook.com/KHELatIDC