MA/2019

"VIRTUAL
AND
REAL"

YIFAN LI

VIRTUAL AND REAL

A TABLET GAME DESIGN FOR IMPROVING KIDS' MATH SKILL

Course

DEGREE PROJECT FOR MASTER OF FINE ARTS IN DESIGN

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ABSTRACT

According to the statistics from Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS), a continuously declining trend is showed in Swedish kids' mathematical performance during recent years. In comparison with other OECD countries, the mathematical literacy of 15-year-old students in Sweden is almost below average. So more and more people start to doubt about Swedish math education system.

Nowadays, tablets appear commonly as teaching tools in schools and we accept digital tools better and better in teaching and learning.

Scientific EdTech, a startup in the field of educational gaming industry, aims to create a brand new tablet game to improve the first to third graders' basic mathematical abilities. I joined their team as a 2D and concept artist. So I mainly paid attention to game design, including background, visual apprearance, game logic, and interaction logic.

The experiment the team did about traditional teaching and tablet teaching showed the potential of gamification in education. And the result of the survey about children's preference of the game art style reflected the change of their aesthetics. Through analyzing the existing educational games, we realized the current games cannot be a reliable way of teaching math. So there is an opportunity to make an ideal mathematical game.

The outcome of the project would be an educational tablet game, which aims to create an appealing virtual world to stimulate children's enthusiasm for learning math and improve their mathematical performance in reality. The project tries to influence the digitization in the right direction together with the teachers and innovate in backward teaching methods and give both teachers and students a better experience.

International 15-year-old children's mathematical performance (PISA, 2015)

BACKGROUND

SWEDEN LOSES TOP MARKS FOR EDUCATION

The quality of Swedish education has been keenly debated over the past decade, following declining results among Swedish students in international comparisons.
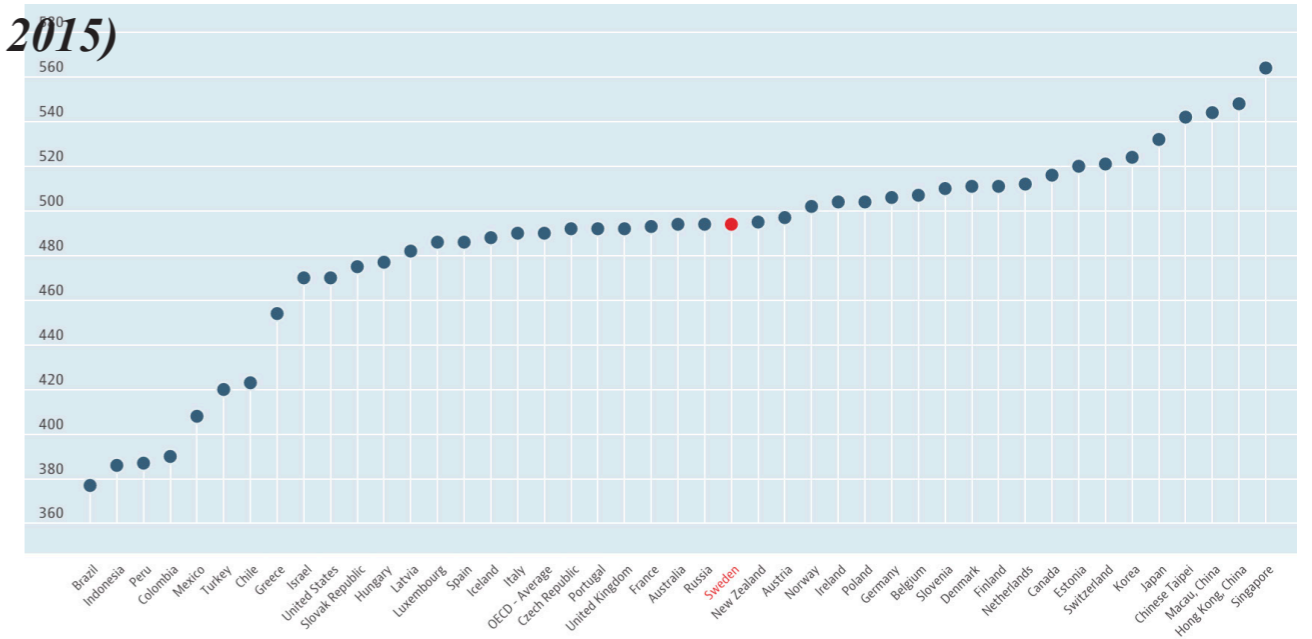
International studies such as Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) have indicated a deteriorating performance among Swedish children in recent years.

PISA scores in Sweden have declined over the past decade from around average to significantly below average. No other country taking part in PISA has seen a steeper fall.

As a strong welfare state, Sweden prizes the development of the individual and the pursuit of equality. Schools seek to build good citizens, with life skills and an intrinsic desire to learn. Testing is of limited importance, and goals are based around a long view of success: the adult who becomes, not the grades a child achieves.

The traditional test, as an effective tool to examine how well students have grasped the knowledge they learnt, might stand at the opposite of the value of Swedish education. Studying for tests may deprive children's creativity and passion of learning. But it should not be the direction that the test will go. A new form of the test, even a new learning method, is necessary for improving Swedish kids' math competence and stimulating individual's learning enthusiasm.

International 15-year-old boys' mathematical performance (PISA, 2015)
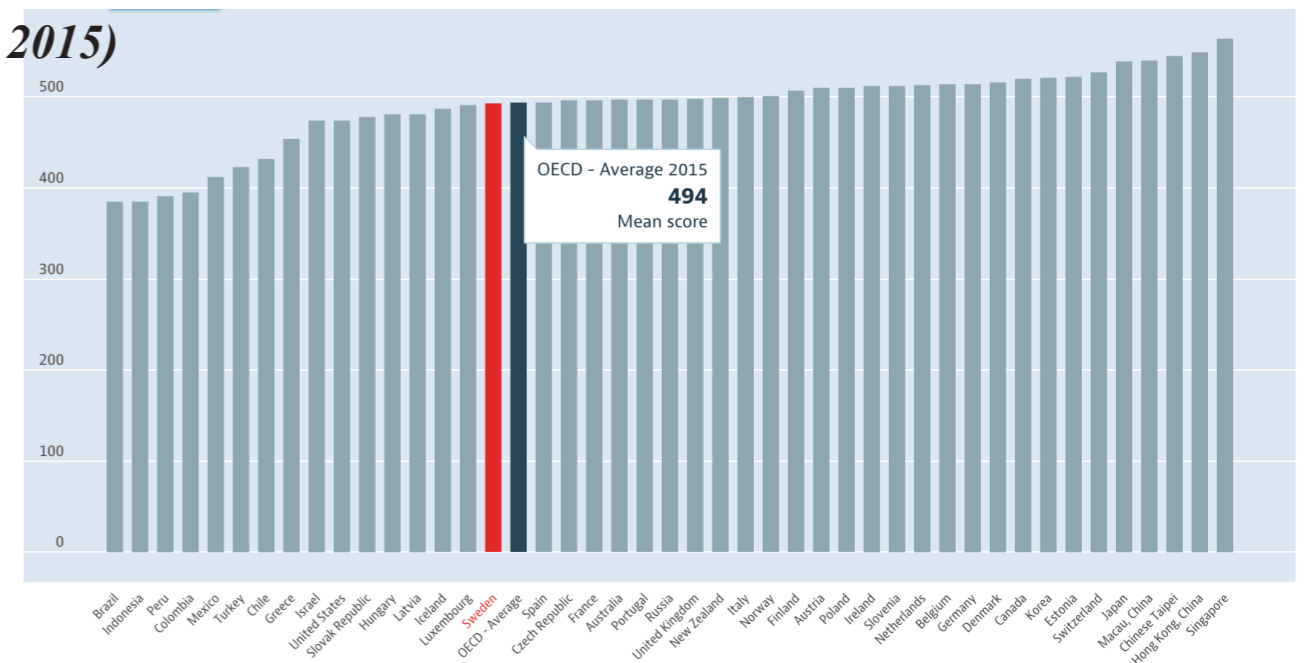
"Gains for high-income OECD countries could gain 1.5 times their current GDP if every 15-year-old acquires at least basic numeracy and literacy skills by 2030.

For upper-middle income nations the gains were estimated to be about 7 times their GDP (OECD, 2016)."

THE IMPORTANCE OF EARLY MATH SKILLS

Math competencies such as arithmetic and number knowledge have been proven essential to promote success in life.

A meta analysis by Duncan et al. (2007) on six longitudinal data sets across three countries found that math competencies among 5-6 year old are the strongest predictor for later school achievement.

A British study by Parsons and Bynner (2006) concluded, after examining approximately 17000 persons followed from birth to 30 years of age, that low math skills was more strongly associated with negative outcomes on employment, physical and mental health.

Although the early math skill takes a such vital role in personal growth, it still does not gain enough attention in Sweden comparing to the secondary or higher-level math skill. The school day in Swedish primary school is very short, which is usually 3 hours each day and 3 days each week. And students do minimal homework. So people will think children do not get challenged enough.

The project will focus on the early stage of math learning and try to help children to learn better together with schools and parents.
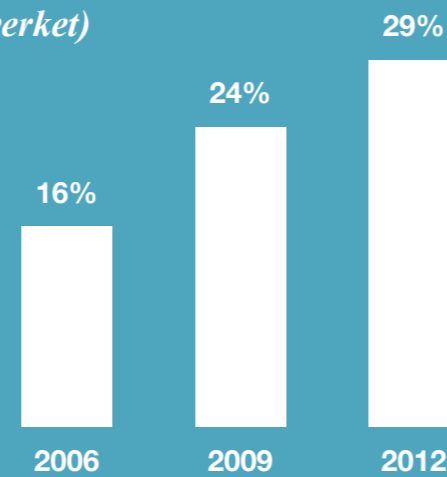
PROBLEMS IN SWEDISH MATH CLASS
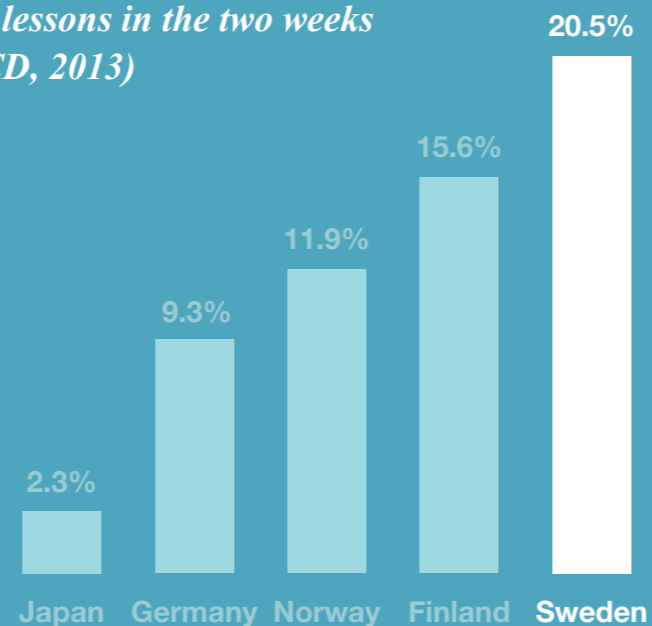
RESEARCH METHODS

Field observation

Statistics from reliable resources

Swedish students who are disturbed by their peers in most of their lessons (Data from Skolverket)

Truancy: students who missed one or more lessons in the two weeks (OECD, 2013)

RESULTS

Students lose their attention easily during the teaching process.

Numbers are abstract for kids. So math lacks of ability to attract kids congenitally. For the teacher, it is hard to get every kid's attention throughout the class. After all, no one wants to be a screaming teacher.

Teacher cannot keep tracking on each student's learning pace.

There are around 20 students in a class and they have different levels of learning ability. So it is difficult to give everyone suitable guidance according to their different learning process.

Lack of proper management.

The class discipline is not good enough.

Ineffective training after teaching knowledge.

Learning math needs a lot of training to strengthen memory. Swedish primary students usually stay in school 3 hours per day and 3-4 days per week. The study time is not enough.

Students lose motivations for improving math competence.

We do not want students to learn math for good marks. However, there is little achievement they could gain while learning.

ANALYSIS

The traditional teaching methods do not fit today's mission very well. It does not build a good connection among students, teachers, and parents. Students need extra motivations and achievements to unlock their passion for improving mathematical performance.

GOAL:

Create an interesting and effective method to give better experience to students, teachers, even parents and help students to find their potential for learning math.

TARGET GROUP:

7-9-year-old children in Sweden (grade 1-3)
Try to help them in the early stage.

COLLABORATION WITH SCIENTIFIC EDTECH

Scientific EdTech is a startup in Lund, who is developing the optimal digital learning tool for teaching basic math to 7-9-year-old children across the world. Martin Hassler Hallstedt, one of the founders, did some psychological research about child math education in his Ph.D. thesis, which became the starting point of this project.

The company built a close relationship with primary schools in Sweden and pedagogical experts in the US. They try to establish an authoritative and multinational team and provide a dependable approach to help children.

They believe that children deserve better learning experiences and teachers deserve better teaching tools as well. They want to replace backward teaching methods and help children find the fun in learning.

MATH TEACHING APPROACH

PAST

Board teaching & paper training

The traditional whiteboard(blackboard) teaching combined with paper training was deemed to be sufficient for math learning in the past.

Students were gathered together in the classroom and imparted knowledge by the teacher. In most instances, the students will follow the teacher and do what he/she asks. In the meantime, a mass of paper training will be arranged to the students to help them deepen the memorization of the knowledge.

Evaluation

The core of this learning method is repetitive work. The repetition is effective to make the brain to remember the knowledge point. However, it also bores 7-9-year-old kids easily. It will never be a good signal to feel boring in learning.

On the other hand, through board teaching and paper training, the students gain knowledge passively. How well the students will learn is limited by the teacher's knowledge since the teacher is the only exporter of knowledge in this process.

Now, more and more people realize the need for smart teaching methods to free children's desire for learning.

CURRENT

Gamification

In current fundamental mathematical education, the group game and the educational toy are involved in the class as auxiliary means. They are regarded as an activator to trigger children's interests in learning abstract math. In the textbook of primary schools, the math tasks appear in the form of gaming. Gamification provides the students with a relaxing atmosphere,

Interactive learning

With the development of interactive technology, the learning process becomes more and more efficient. For example, some interactive whiteboards start to come into use recently. Then the students can study math in a more initiative and figurative way.

In modern education, the teacher's role changes into a helper from a commander. The teachers tend to conceptualize effective teaching as interactions with individual children, building on students' ideas and emanating mathematics from everyday situations.

Online classroom

Education starts to get rid of the limitation of space and time. Students could learn everything based on their own willness. However, the content of the course stays regular. The effect of this method relies on students' subjective initiative.

Evaluation

These methods have prominent advantages, however, the drawback still exists. Some educators stress the importance of a clear presentation of mathematics, routines, and homework as well as specific goals for every lesson. Current teaching methods such as game and interactive teaching have difficulties to measure the learning process of every student. So a part of these teaching methods is not able to be widely used in mathematical education but rather show interesting conceptualizations of effective teaching.
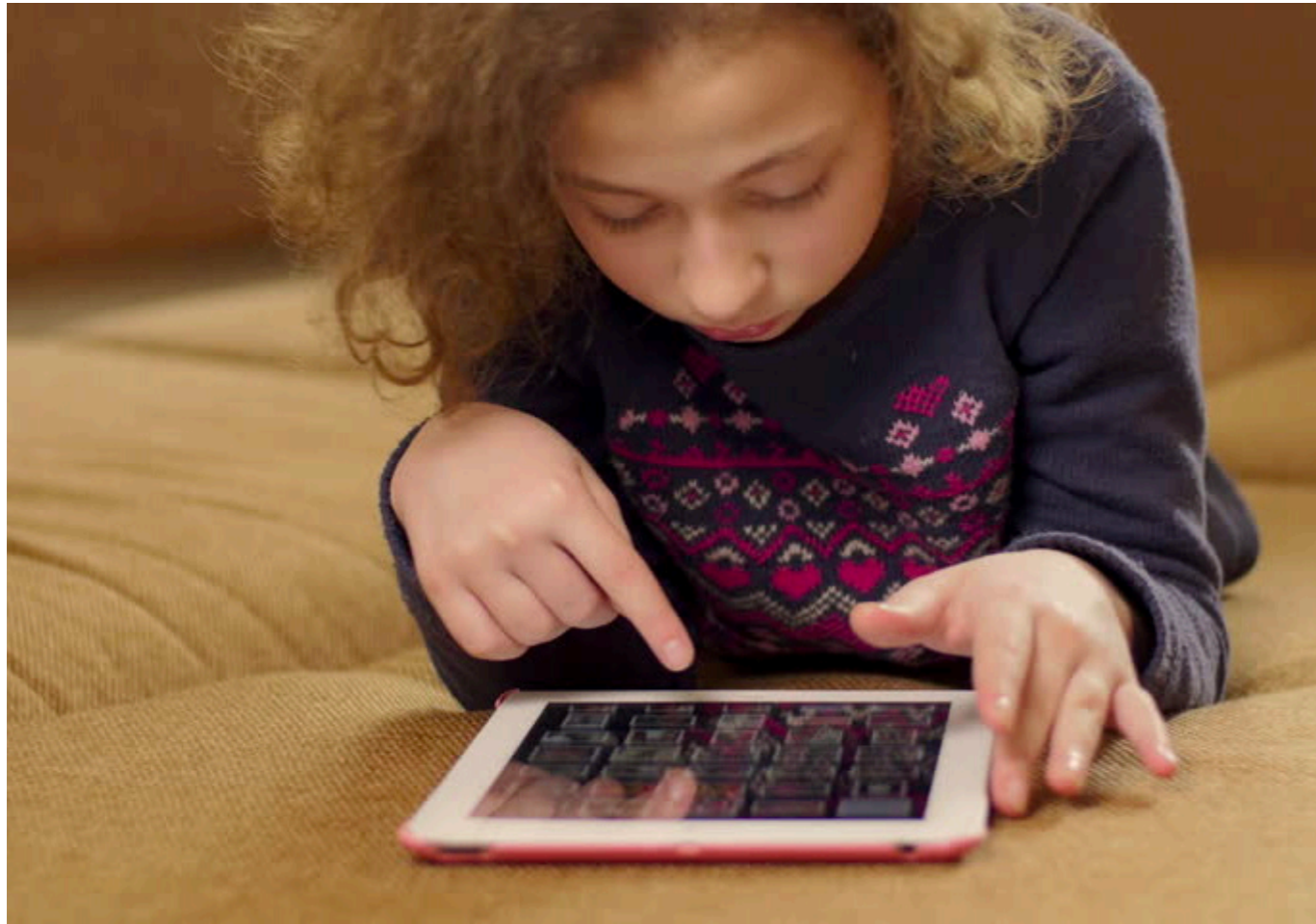
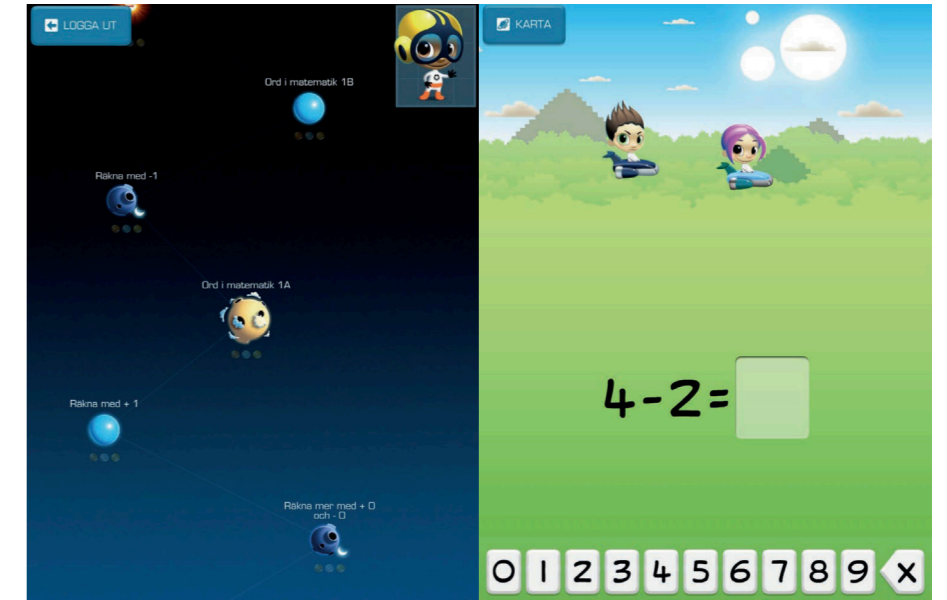# HOW WILL THE TABLET GAME FIT THE TASK?

RESEARCH METHODS
Comparison
Follow-up test

Chasing Planet
It is simple tablet game for the test, which is made by Henrik Rosvall, CTO of Scientific EdTech. In this game, the player needs to answer some math questions to gain more speed for surpassing the opponent.
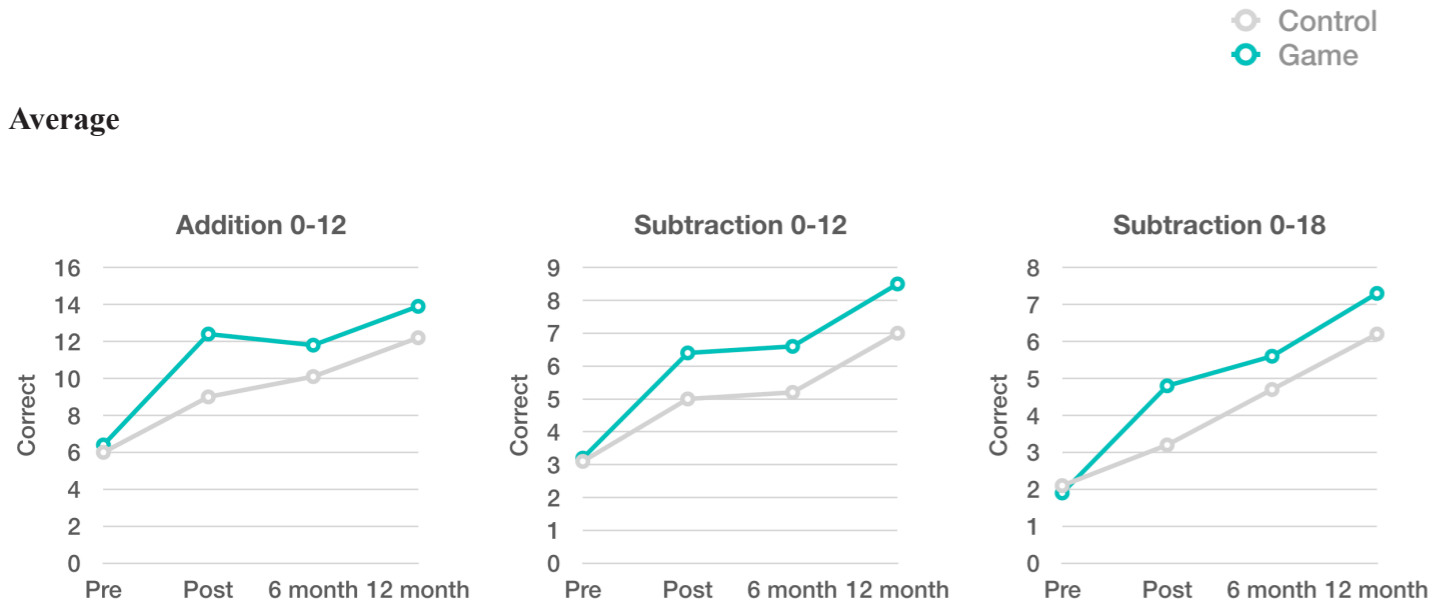
FINDING POTENTIAL

Today, tablets are increasingly being used as teaching materials in schools and we see digital tools as a natural part of the teaching. Furthermore, it diversifies the ways of teaching and learning.

Children lack motivation while learning math, but they never lose motivation while playing tablet game.

Combine tablet game with math teaching might be a good way to cover the shortage of backward teaching methods. And gamification has great potential in education.

RESEARCH

A test included 283 second-graders who were spread across 87 classes in 27 schools from Landskrona, Helsingborg, and Stockholm.

The participants were divided into 2 groups (Control&Game). The control group learned basic math as usual, primarily reading and a lesser extent motoric skill on tablet for 20 minutes each day. The game group practiced Chasing Planets for 20 minutes each day.
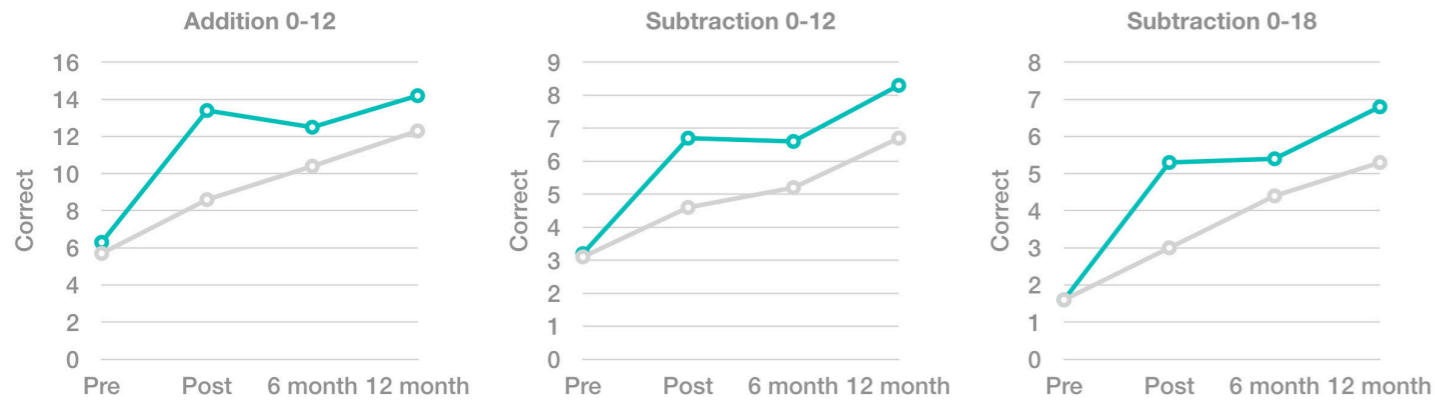
Then Martin Hassler Hallstedt, CEO of the company, conducted assessments for them to 12 months follow-up. I collected datas and rebuilt graphs with core figures.
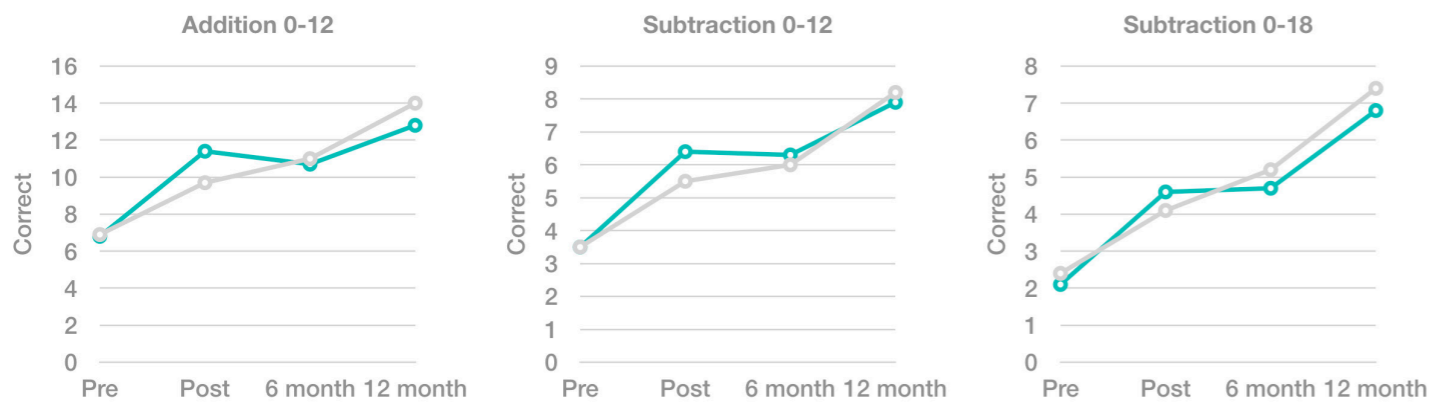
RESULT

Legend: ○ Control ● Game

Average

Addition 0-12
Subtraction 0-12
Subtraction 0-18

Students with lower IQ.

Addition 0-12
Subtraction 0-12
Subtraction 0-18

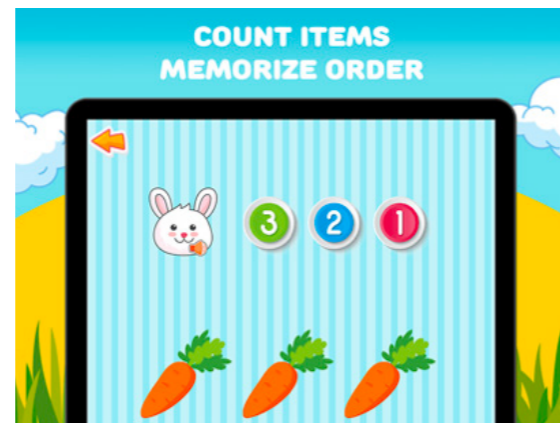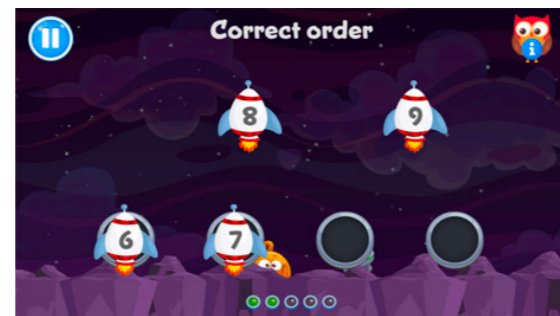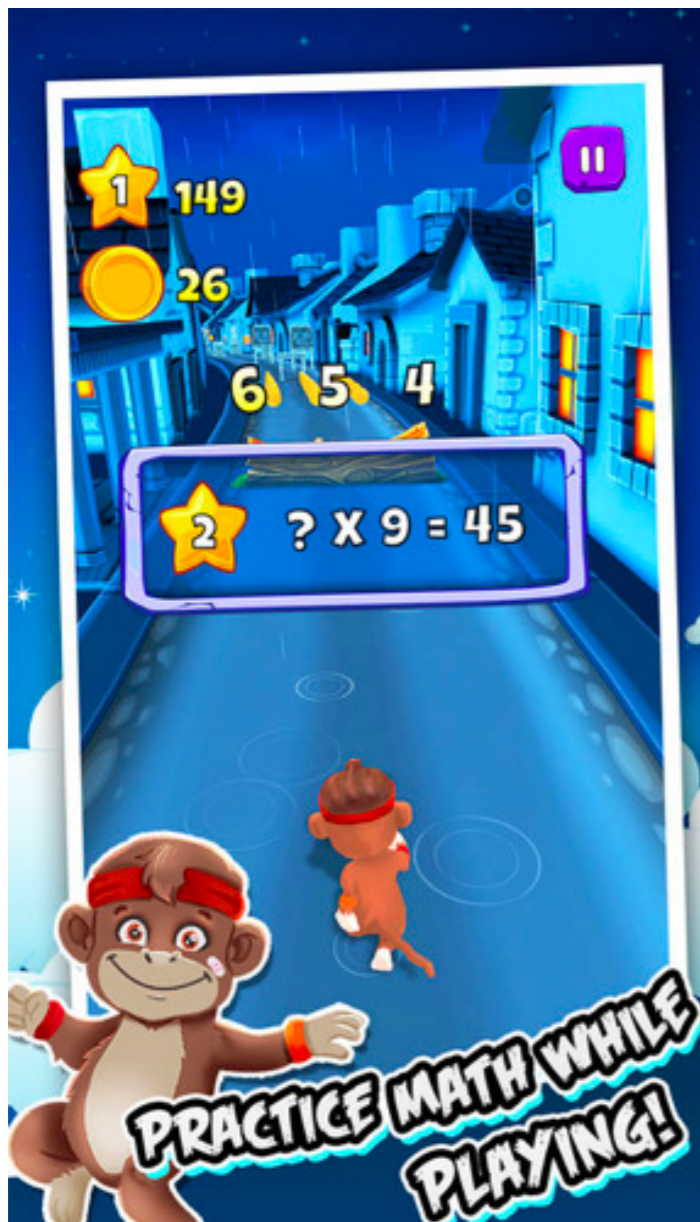## Students with higher IQ.

Addition 0-12
Subtraction 0-12
Subtraction 0-18

CONCLUSION

Tablet game did have a positive influence on basic math education.

Tablet game has a more significant help for children with Lower IQ.

COMPETITION AND OPPORTUNITY

There are lots of game products for children's math education in the market and cover the knowledge from every grade. However, there are still some opportunities for us.

Their art styles rarely cater to kids, which will be proven by my test later.

Experience of most games is quite linear. Usually players just go forward in one direction. They cannot explore freely, which betrays kids' instinct.

Poor connection with teachers and parents, students can get little guidance when they face difficulties.

No assessment to assess how well students master the knowledge.

WHY THE TABLET GAME COULD BE THE SOLUTION?

Nowadays, mathematics pedagogy is usually included in the school syllabus, which is set up by the local ministry of education and guides the teachers to impart knowledge. In current primary math education, math curriculum will be subdivided in several learning modules such as count, arithmetic, and geometry. To master different modules requires different abilities. The teacher will explain the basic principles first. And then repeated practices help learners understand how to utilize the principles in real cases. Finally, periodical tests will be arranged to evaluate the learners' level of mastery.

With the help of images, toys, and other tools, the teacher teaches the students to grasp the math principles. And the tablet, as one of the most convenient and efficient tools, starts popularizing. The core of math learning is persistent practices. In practices, the students will meet endless mathematical problems and endless problems need proper media. Normal solid support like paper, toys, and printed images will consume plenty of resources. However, the tablet, as a new platform, could avoid this issue. Furthermore, everything about the math curriculum in the tablet could be updated fast, which means more and better teaching methods can be quick-pitched later. The high efficiency and low cost are the reasons why the real world sometimes asks the virtual world for help.

Math learning is a dull process. A wise teacher always tries to delight the students in repeated work. And the game, as a common way, has always done a successful job in this aspect. In the game field, tablet game has the widest range, which involves all types of games that people can imagine. There are more possibilities to find a preferable combination of game and math. On the other hand, the game will have better transmissibility on the tablets. It could come into vogue among people rapidly. For the students, the reward mechanism in the game could encourage them to pursue the progress of learning.

Scientific EdTech, as a technology firm, believes the power of the technology. Although there may be hundreds of methods to enhance math teaching, the tablet game, which has been verified helpful for education, is springing up vigorously. And in comparison with the traditional media, the tablet has broad prospects. From the view of the company, they would like to start from the field that they are familiar with and dig deeper to fulfill the potential of the tablet game. The team has seen the defects of current tablet games and other technical methods. And we do think they could be improved and technology should be applied to education in a better direction.

ANTI-ADDICTION

Education technology is often justified on the grounds that it boosts lower-age and disadvantaged children, however, some risk still enters our life, for example, video game addiction. Although it is not yet recognized by the American Medical Association as a diagnosable disorder, video game addiction is a very real problem for many people. According to the University of New Mexico, recent studies suggest that 6 to 15 percent of all gamers exhibit signs that could be characterized as addiction.

Many different causes factor into video game addiction. One of the main reasons that video games can become so addictive, however, is they are designed to be that way. Video game designers, like anyone else trying to make a profit, are always looking for ways to get more people playing their games. They accomplish this by making a game just challenging enough to keep you coming back for more but not so hard that the player eventually gives up. In other words, success for a gamer often feels just out of reach. In this respect, video game addiction is very similar to another more widely recognized disorder: gambling addiction.

Like any other compulsive disorder, video game addiction can have severe negative consequences. For example, someone addicted to video games will often avoid sleeping or eating proper meals in order to continue gaming. While the short-term effects of this may include hunger and fatigue, it could eventually lead to a sleep disorder or diet-related health issues. And people struggling with video game addiction from the early age may be at a greater risk for depression, loneliness, and social anxiety.

Even an adult cannot withstand this significant harm, the small children would be the high-risk group. So while doing the project, our team was very cautious to protect children from the negative effect of the tablet game. For example, we removed any unhealthy elements like the violence from the game. And we built the background system to help the teacher and parents limit the screen time for the children. In our plan, we will launch our app in the school first. And the game was divided into several chapters. The time for each chapter is about 1 hour per day and lasts 10 school days to match the math curriculum time. Every new chapter will only be unlocked every two weeks to prevent children from overstimulation and obsession.

Scientific EdTech is trying to embed humanistic concern into technology and influence it to contribute to society better.

CONCEPT

◇

A tablet application which combines basic math

teaching and an adventure puzzle game
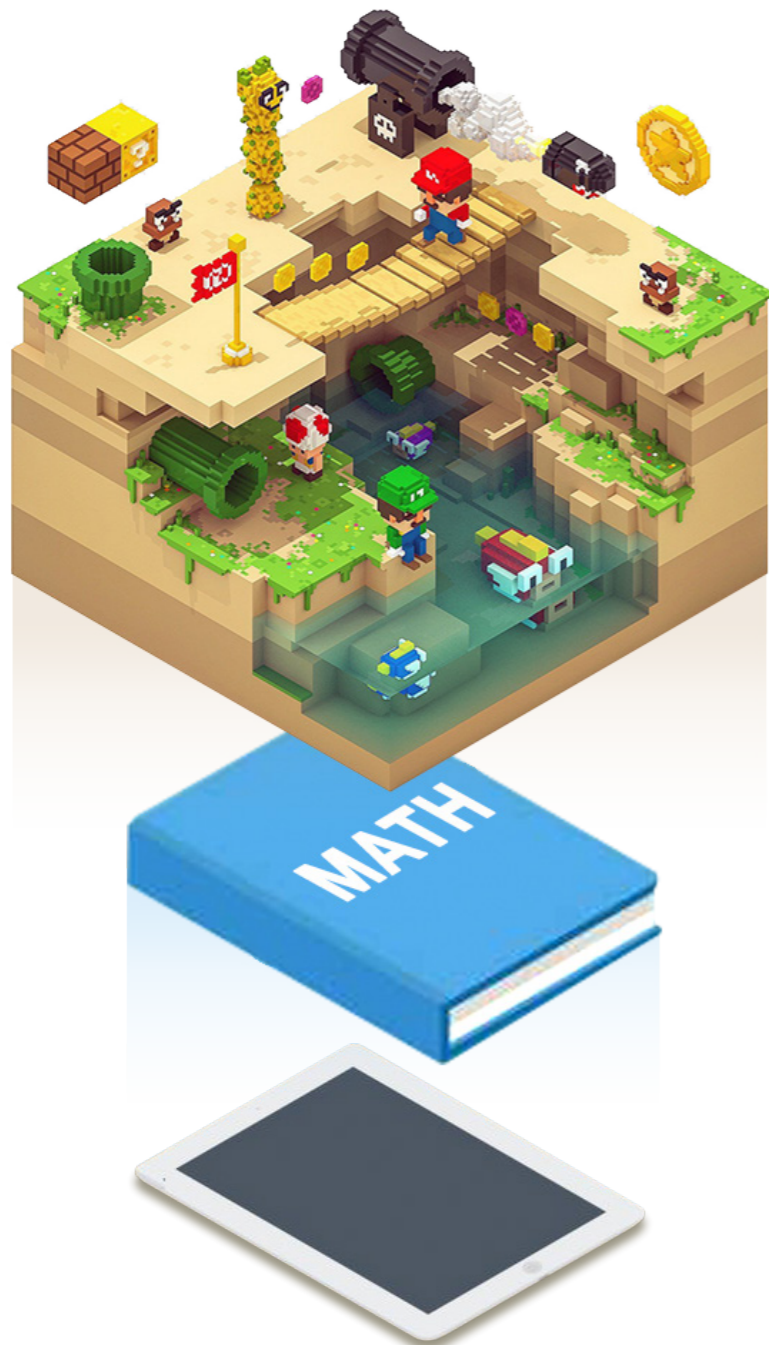
A complete educational game, a whole adventure spans academic years. The game will involve both linear and explorative experiences to trigger kids' curiosity and keep their passion of learning.

The math in the game will cover and match the full-year curriculum from 1 to 3 grade to be consistent with school education. In this way, the game could be blended into school education better. And AI will shuffle and select different tasks for fast and slow students.

The students receive tasks that are adapted to their needs while the game continuously measures the student's development. We set pre-test and post-test for each knowledge point in the game to make sure every student will reach mastery level.

In our game, there is a background system for teachers and parents to keep tracking kids' study. And in my concept, the teacher and parents will appear in the game as virtual characters whenever the kids need help. It is possible to give every kid special care in a virtual world.

I will also try further possiblities to teaching math in a more intuitive way. In virtual world, there will be a lot of opportunities to create better methods of teaching and learning.

DASHBOARD

Background system

PLANETJAKTEN

Search for student

Sylvia Falsetta

ALL | Class 1A | Class 1B | Class 1C | Group M3 Extra

22%

Student (all) statistic
Avarage improvements lorem ipsum dodlor sit amet.

22%

Mastery goal
Current module progress.
Estimated time to mastery:
Avarage 6h/sudent

M3 progress
52% of module completed.
⭐ 6 mastery achievements >
🔴 4 need attention >

● PLANETJAKTEN   ● NATIONAL CURRICULUM
MARS 2019
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

30 DAYS | SPRING SEMESTER | YEAR
APRIL 2019
1 2 3 4 5 6 7 8

M2 THE CLOCK | M3 THE GEOMETRY | M2 COUNTING

Students

PLANETJAKTEN

Search for student

Sylvia Falsetta

ALL | Class 1A | Class 1B | Class 1C | Group M3 Extra

< Back | Lisa Svensson

Planetjakten mastery score year 1

⭐ 3 M3 Mastery achievements
🔴 Task 4 title
🔴 Task 5 title
Struggling to achieve mastery
Add session time >
Handbook >

User Name: NameSurname
Password: OOOO

Groups
Class 1A
Group M3 Extra

GENERAL PLAN
MARS 2019
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

30 DAYS | SPRING SEMESTER | YEAR
APRIL 2019
1 2 3 4 5 6 7 8

M2 THE CLOCK | M3 THE GEOMETRY | M2 COUNTING

T1 T2 T3 T4 T5 T7 T8 T9 T10

Besides the children, our game has to cater the teachers and parents since they are the main consumer of our product. By our field test, we found they do care about the children's outcome after learning. Through the educational game, what they want to see is the children's learning status and progress. However, it is invisible in current games. So Martin(CEO) came up with an idea of Dashboard, which is defined by the rest of our team. Then we entrusted Zenit Design to undertake the UI design.

Through Dashboard, the teacher has authority to view every student's status in learning process. Because the game tasks cover all learning modules such as geometry and counting, the teacher will get feedback that if the student is struggling about some modules. Then the teacher could give the student specific guidance. Dashboard is a platform where allows the teacher to pay attention on all students and help them in time.

GAME ART CONCEPT

CHILDREN'S ART STYLE PREFERENCE

Finding out how children's favorite game looks like is the first step. A test was conducted by Scientific EdTech team with 64 child participants from the local schools in Lund and Landskrona. The participants involved 33 girls and 31 boys (around 7 - 9 years old). I gathered a set of 24 images from storybooks, animations, and games, which cover a mass of popular art styles. And the children were asked to rate them on a scale from 1-5 (sad face - happy face).

The question that they were asked to respond to is: "How would you like to see these characters and this environment in a math learning application?"

Images were ordered based on average score (high to low), resulting in a top 7 and a bottom 7 list.

Finally, I compared their favorite game art style with some good examples on the tablet and summarized our guideline of the art concept.

Boys Top

4,50

4,34

4,33

4,03

2,71

2,58

2,55

Boys Bottom

2,05

Girls Top

4,52

4,30

3,68

3,52

2,58

2,45

2,38

Girls Bottom

1,72
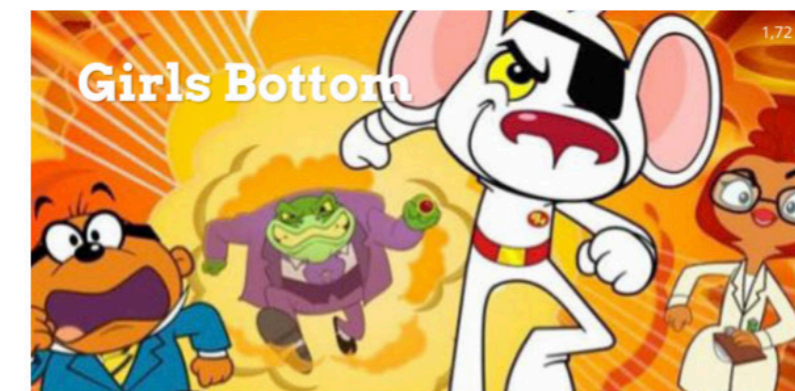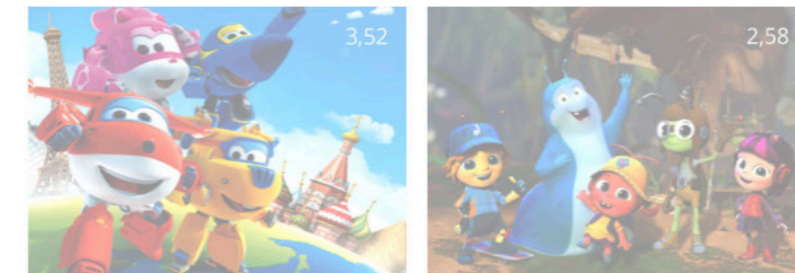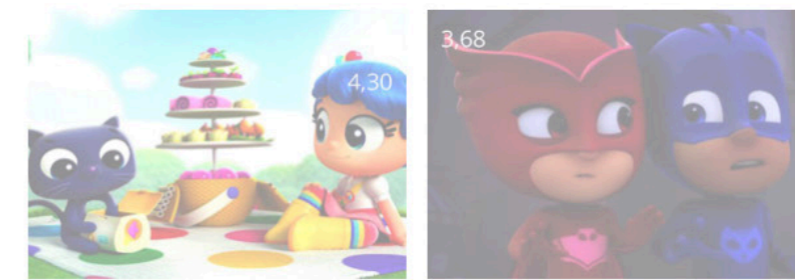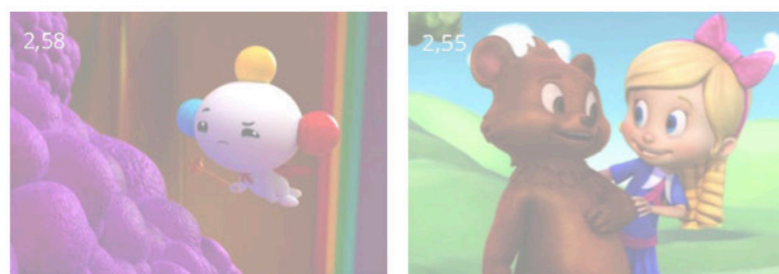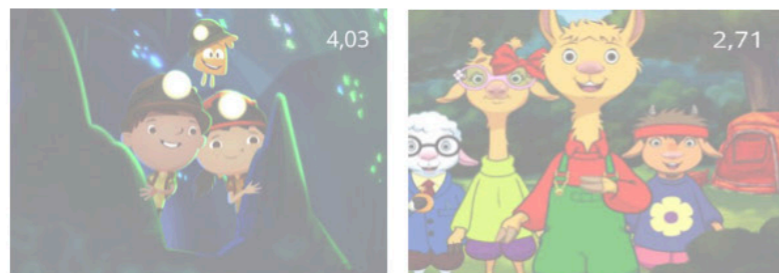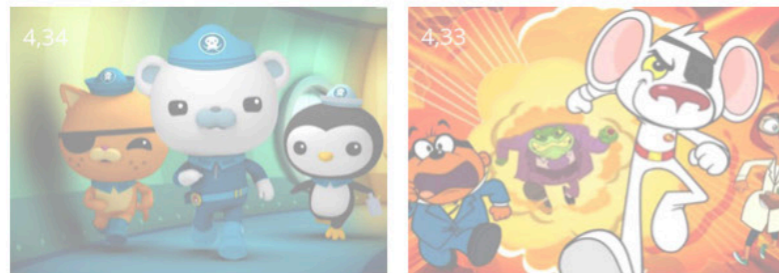
CHILDREN'S TASTE

For the environment:

◆ Low-polygon graphics with a focus on soft lighting rather than geometric detail
◆ Art style and story that attempts to take a leap from very childish to less childish content

For the character:

◆ Soft, textureless and almost tangible characters
◆ Large heads and/or eyes
◆ Non-human and human-like characters

EVALUATION

Nowadays, because of the fast development of the game industry, various games and comics are more accessible for children. The aesthetic appreciation of children starts to get rid of the old stereotype. The stuff with only childish aesthetics does not gratify them anymore.

Children can appreciate the beauty of geometry and the amazement brought by light and shadow. Their need for high-quality games is increasing.
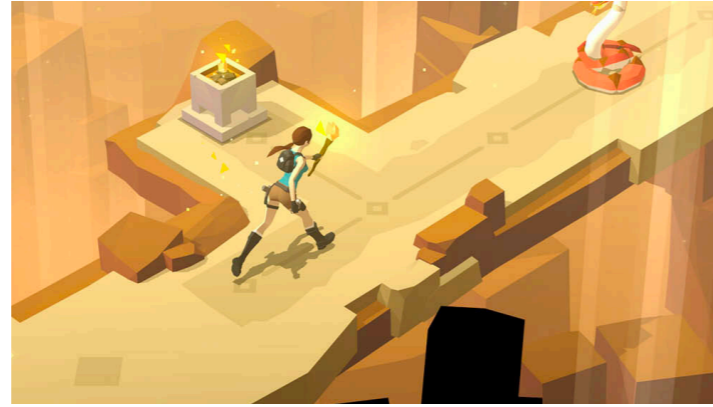
Compared to 3D game, 2.5D game may be rated lower on game immersion, but it would be easier for children to control the character's movements on tablet.
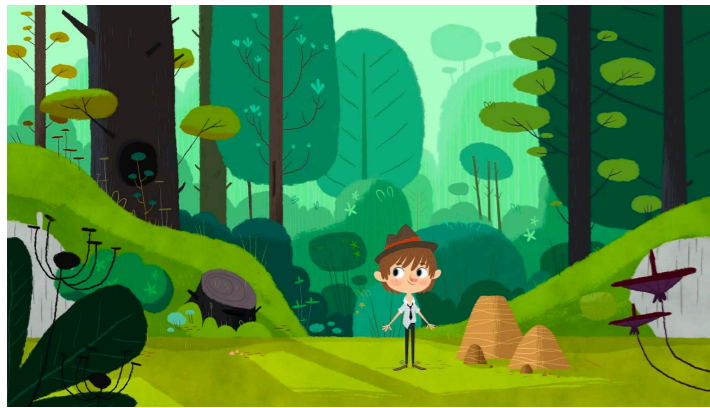
View comparison

Compared to horizontal view, 2.5D view has a better performance to show the environment around the player and make children feel they are in a "real world".

View & Texture comparison

Strong texture sometime makes the scene look dirty and it will also require plenty of time to build. And perspective will make some objects and roads invisible. Textureless and isometric will solve these problems.
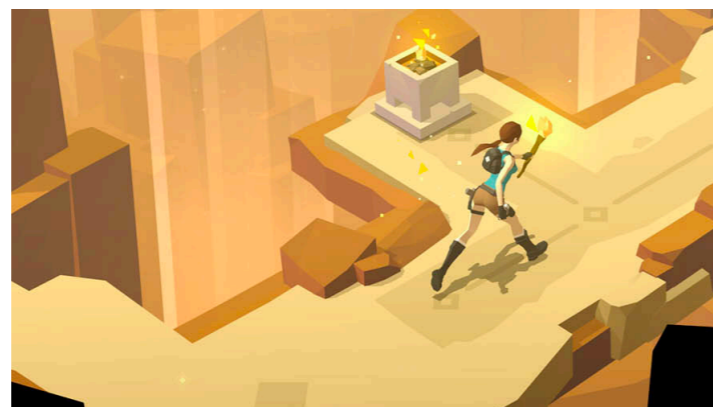
Lighting & Shading comparison

Normal photo studio lighting makes objects look hard with a sense of toy. However, the bloom lighting is more close to the lighting condition in nature, which makes the environment softer and more harmonious.

2.5D isometric view

Textureless and low-polygon scenes and characters with a focus on the color

Bloom lighting and shading

ADVENTURE STORY

PC moves to a new house with his/her family. Upon exploring his/her new room, PC finds a magic number line stick hidden somewhere. As PC picks it up from the ground, it calls PC to a new world where new adventures and companions await. PC will find out that his/her math knowledge might be the key to solving a big puzzle…

By using the magic number line(wand), PC will enter various worlds, which involve appealing landscapes in different isolated floating islands to show a great nature. And there is a force of evil existing which needs to be defeated by PC with math knowledge. It will trigger kids' hero complex and encourage them to continue the learning journey.

GAME DESIGN

Personal work

PREVIOUS IDEAS OF THE MAIN CHARACTER

raccoon

Animal-like character

The raccoon is a kind of animal with high intelligence. And its distinctive features like the shape of the face, the stripe, and the tail make a cute impression to people. However, according to our survey about the preference of the target group, the animal-like character is not so welcome. The human-like character could bring the players into the game world and give them a stronger empathy.

Human-like character

The character is a kid with the scholar suit. The hairstyle is the core element to define the gender of the player. By this way, boys and girls can create their specific characters. But after collecting user feedbacks, the character is considered to be a little childish.
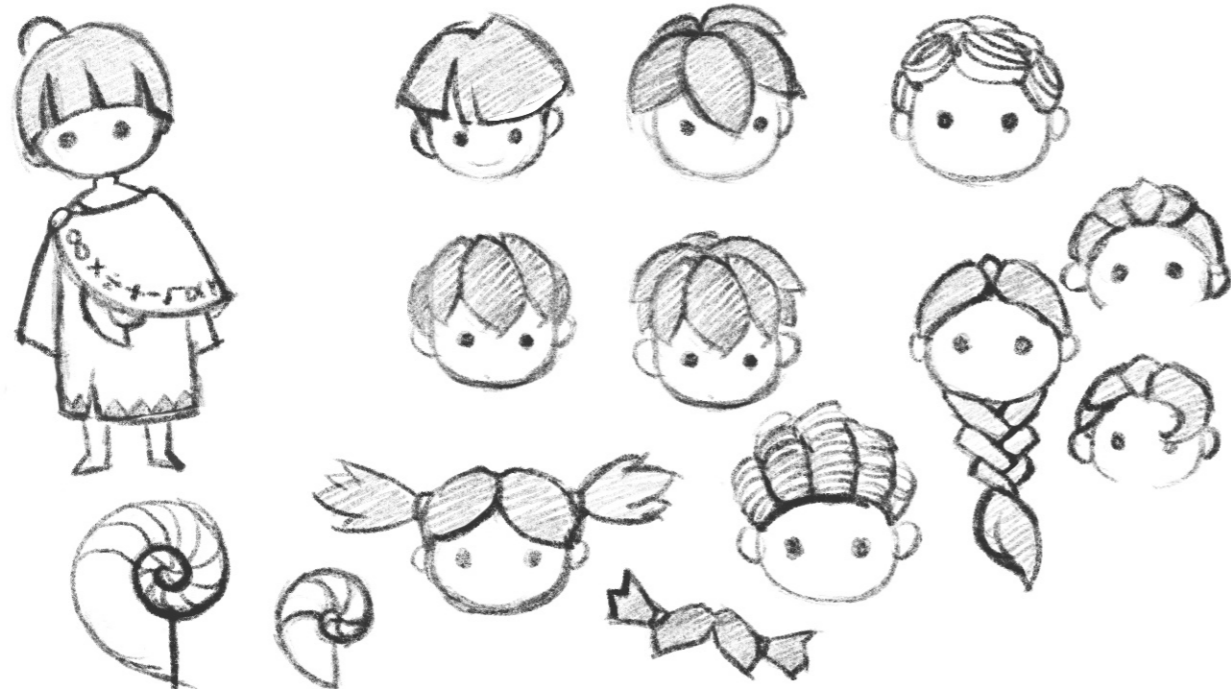
PREVIOUS IDEAS OF THE BUILDING ASSETS
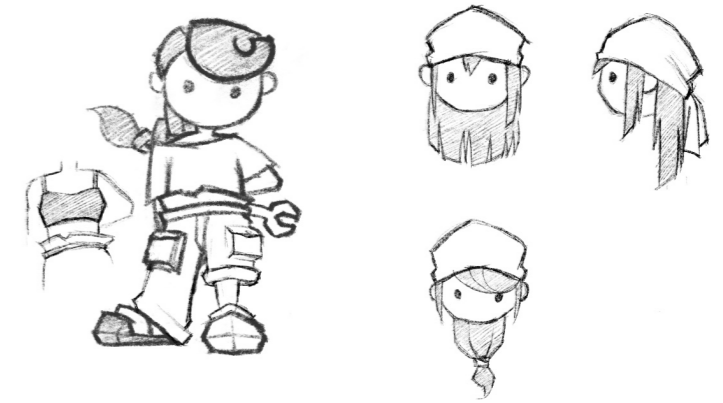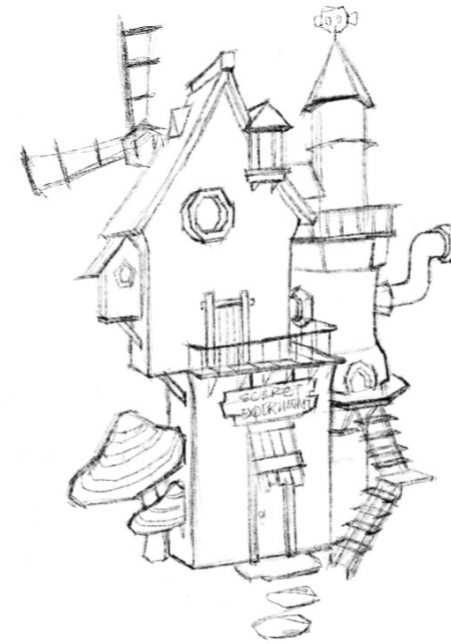
Matina

A machinist girl who loves nature and various machinery.

Matina's house(version.1)

Matina's house is one of the representative buildings in the game, which is an home-factory of a machinist. The house is modularized, which shows the professionalism of the machinist. But the drawback is that the complex structure will make many details invisible under the isometric view.
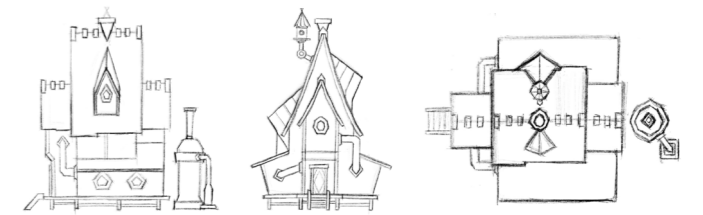
Matina's house(version.2)

The house was drawn in isometric view to reveal how it will look like in the game. However, as the main building in the scene, it looks ordinary and cannot catch the players' eyes immediately.

Under the game view

I drew several images of characters and building assets and sent out to the children in a primary school in Lund. After collecting their feedback, the concepts of following 2 images was selected.

From children's evaluation, a distinct love for these concepts was showed.
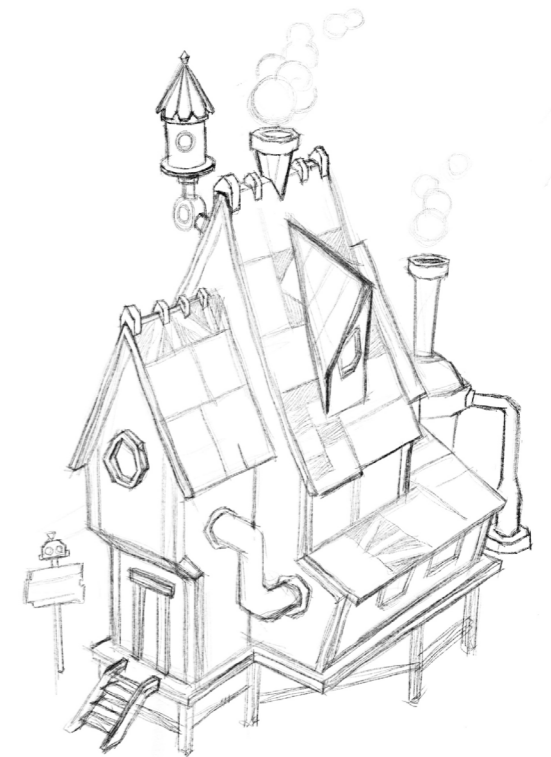
CONCEPT OF THE MAIN CHARACTER

The main character is a gender-neutral kid wearing a cloak. Because our target groups are 7-9-year-old boys and girls, the main character should not have a clear gender identity and look close to 7-9 years old. In this way, the player would have stronger empathy, which may help kids to enjoy the game better. And the cloak is a suitable element to hide the gender and fit our adventure story perfectly. On the other hand, the cloak would have better performance and more possibilities under the game's view. For example, the cloak could work as the wing to help the player to fly.

The main character, as the core of the game, should be the optical focus in every moment. So the color of it is bright and in strong contrast. Some mathematical elements are also applied to it in order to highlight the theme.

CONCEPT OF THE BUILDING ASSETS

The owner of the house is a crazy machinist girl who loves nature. So the house looks like a mix of wood material and steampunk elements.

GAME LEVEL DESIGN

Scenes sketches for
Chapter 7 of the game

5 **Tunnel**

2 **River**
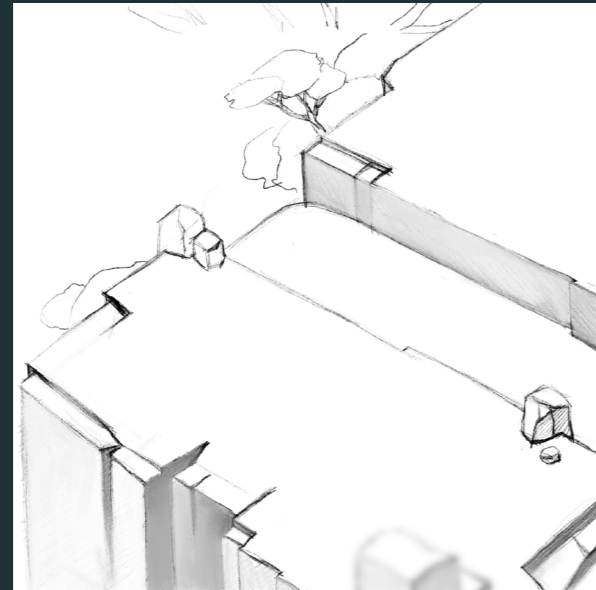
3 **Terrace**
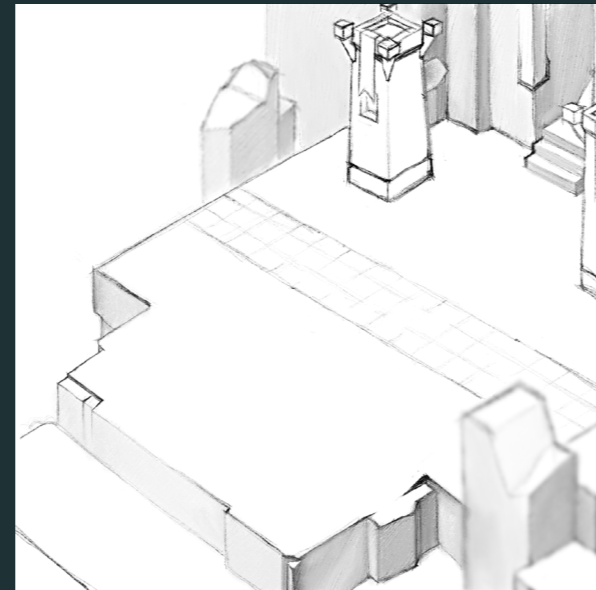
6 **Bridge**

4 **Ravine**
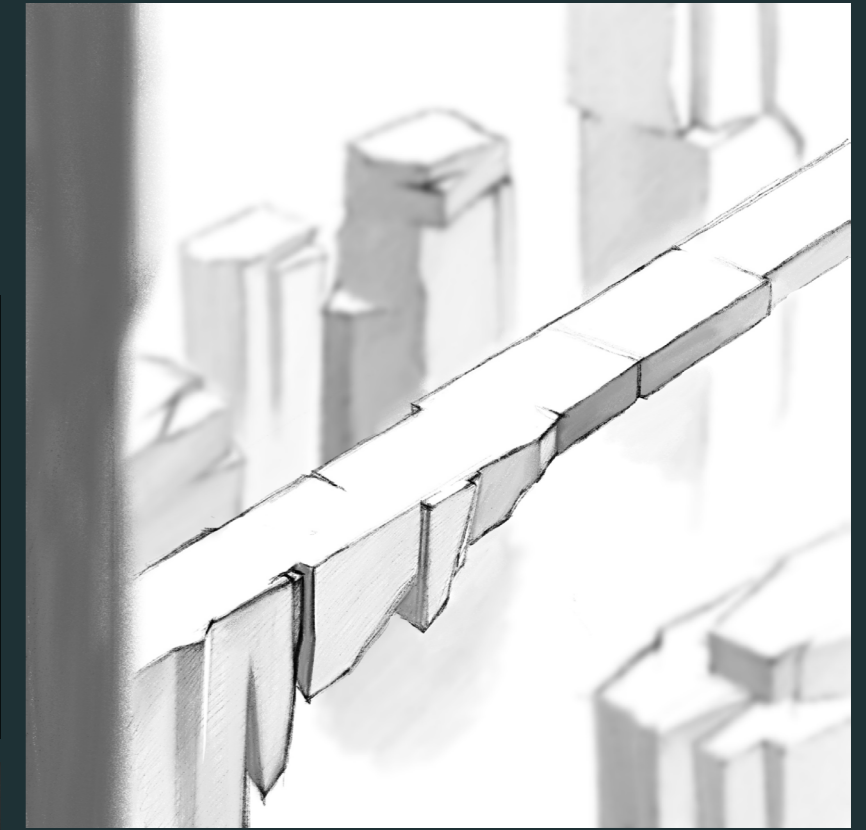
1 **Coast, Cliff**

Chapter 7

ADVENTURE IN THE MOUNTAINS

This part of the story happens on an isolated island with a varying mountain landscape, which includes seacoast, cliff, ravine, cave, snow mountain, and valley. And the geomorphic appearance varies with altitude.

The player must get through it by finishing math tasks. For example, answering a question to activate a special vehicle for climbing. And the player will also meet friends and enemies to trigger some short plots.

Generally, it is a linear experience that is easy to follow. But there are also some areas where children could explore around and find secret rewards.
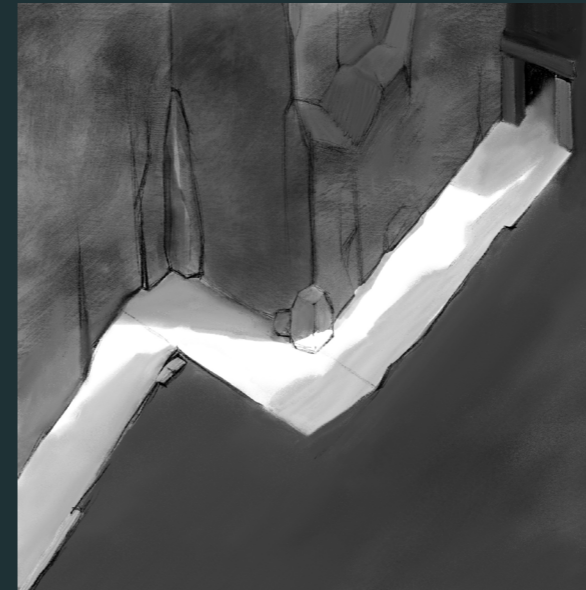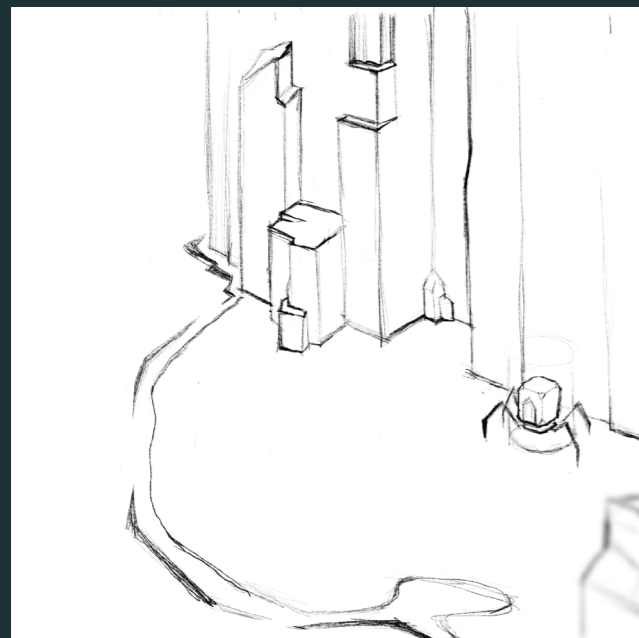
9 Yeti's cave
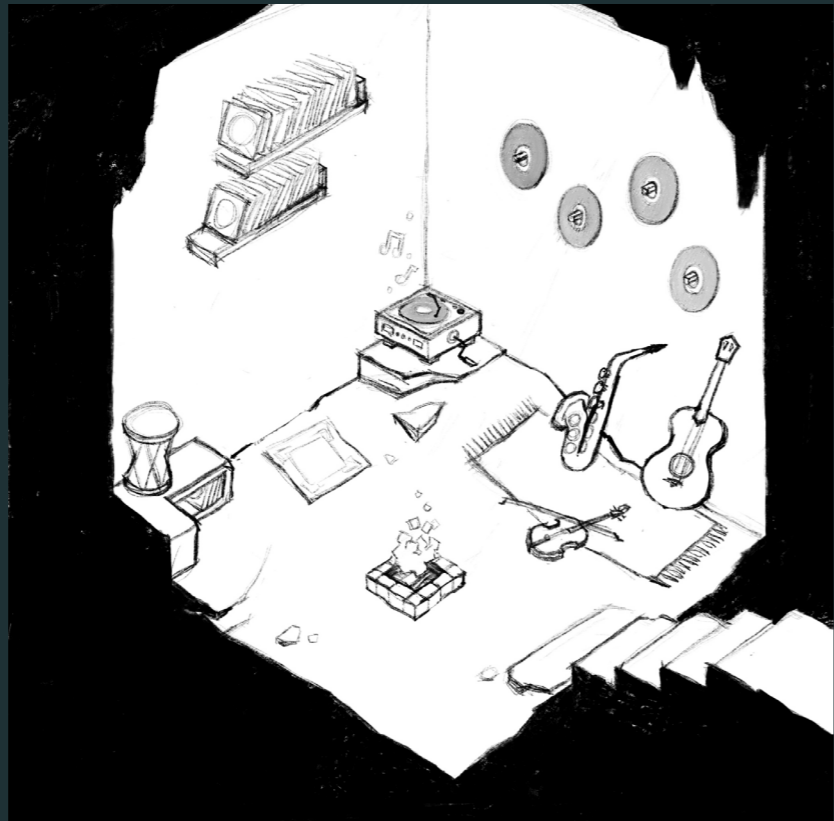
9 Snow mountain 1
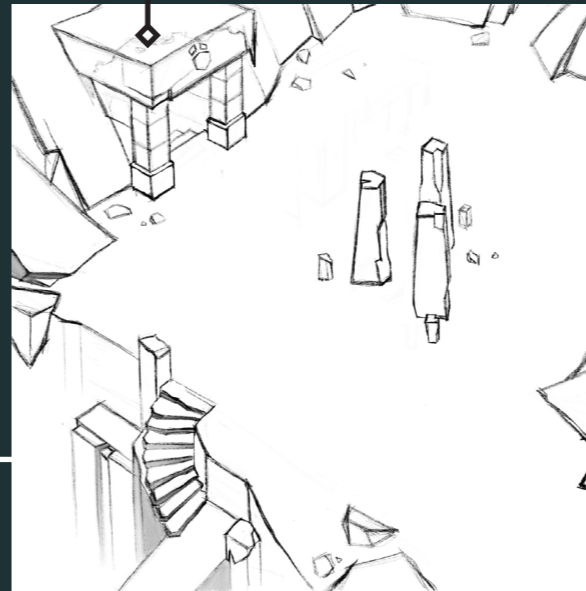
10 Snow mountain 2
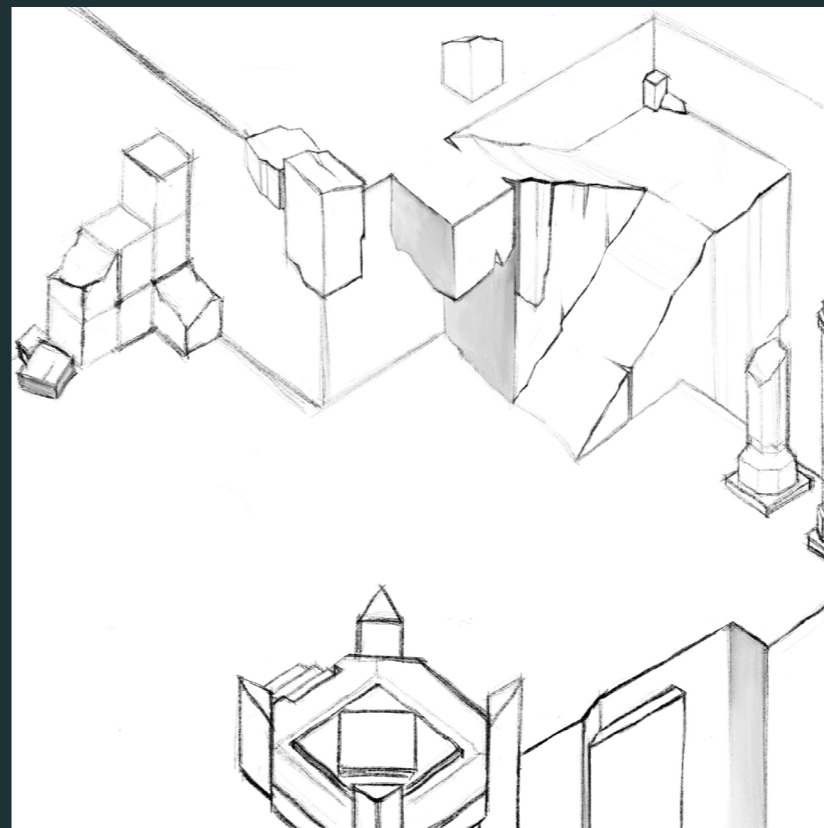
11
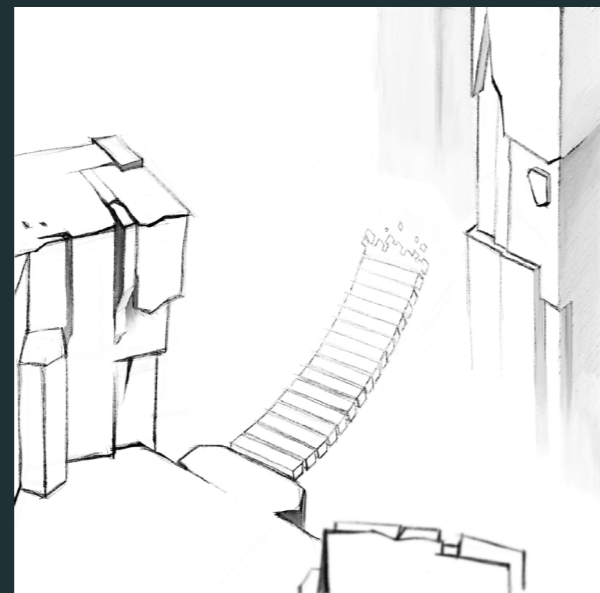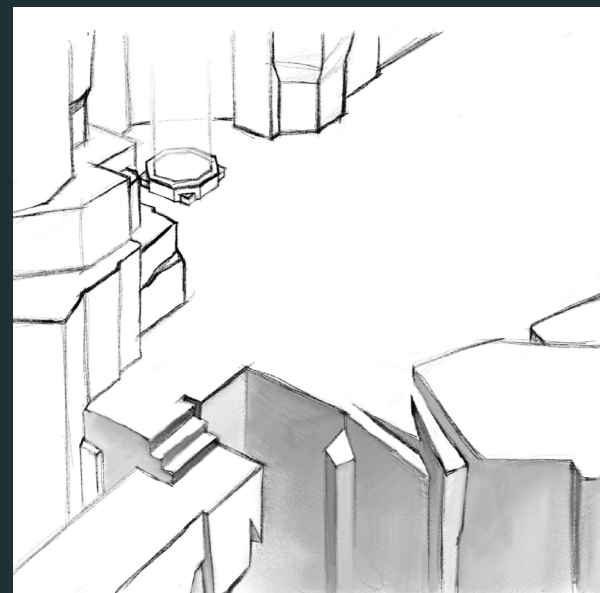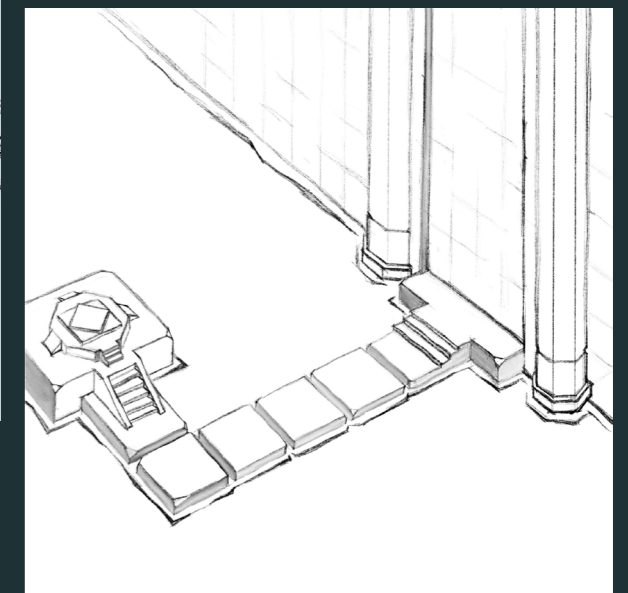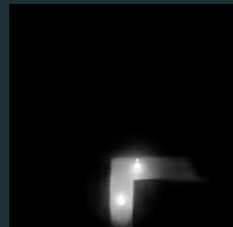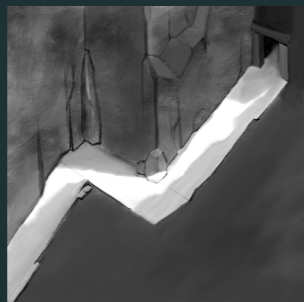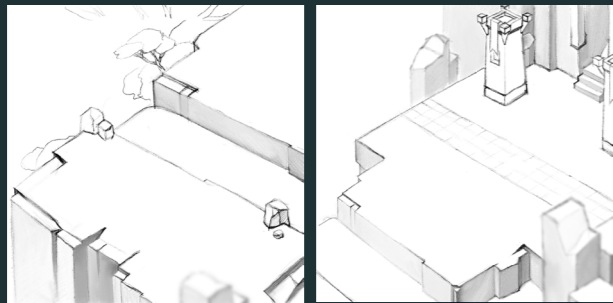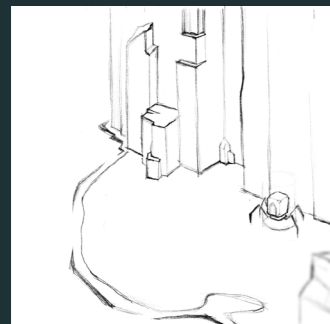

7 Valley

8 Canyon
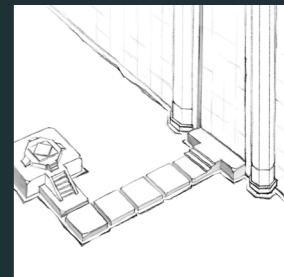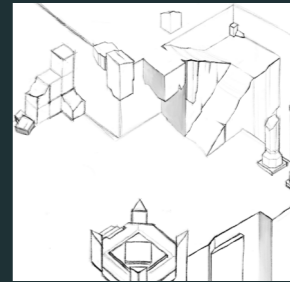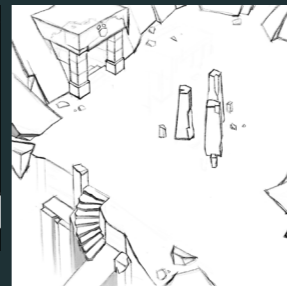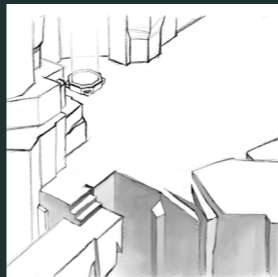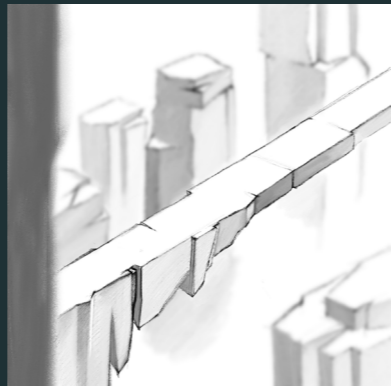
The geomorphic appearance
varies with altitude.

SAMPLES OF SCENES

———◇———

GAME PLAY

GAMEPLAY

The player reaches the coast and needs to finish the first math task to load the spider-like climbing vehicle to climb up the cliff.

CONCEPT

The scene is more linear than exploratory since it is just the beginning of the chapter.

I extracted color from real grassland, coast, ocean, and rock to put in this scene with the real lighting effect. In this way I built a convincing attractive world. I hope children will fall in love with both the inner world and real nature.

GAMEPLAY

The ground is rugged so player can only walk by
the climbing vehicle. And player will also need
to finish math tasks to activate jumping function
of the vehicle so that player can jump over the
waterfall. The main task is defeating mouse
soldiers, the guard of the evil kingdom, to get into
the narrow passage.

CONCEPT

Player can walk freely in this scene and explore in
some hidden areas to find extra tasks and bonus.

The scene is built by different blocks. It is an
effective way to build scenes in lower cost and
less time.

GAMEPLAY

Here player walks between the ravine and finds the road is blocked by a green jelly-like stuff. And the climbing vehicle is equipped by a laser gun. Player need to activate it to melt the green stuff. The chest at the corner has extra task and gift inside.

CONCEPT

The chest is a way to put extra tasks into the scene to make sure kids do enough math training beside the main mission.

5 + 4 = ?

GAMEPLAY

The player reaches the narrow bridge upon the cloud. Here he/she need to answer math questions continuously to activate the wand to crash the coming fireball.

CONCEPT

The amazing landscape in game is the key to motivate children to continue the journey and exploration. And I added different types of math task into the game to give children all-round training. The task in the image aims to improve the ability of fast calculation.

8   7   9

CONCEPT

This scene is big and allows children explore a little. Children are curious about everything. Giving them freedom and surprise is also something I kept in mind while making the inner world.

The surface landscape varies with altitude. It is important to make scenes to stay attractive for children.

GAMEPLAY

The player reaches Yeti's cave and repairs the vinyl player. Then Yeti will start dancing with music and every instrument will come into alive.

CONCEPT

It is an amazing secret place that forms a strong contrast with the cold outside. Everything happens here is total out of reality, which will be directly appealing for children.

SCENE CONCEPT DEVELOPMENT

SCENE 3, CHAPTER 7
In the former version, the map is small. Based on openness considerations, an adventure game should involve some interesting areas for exploration. So I broadened the map and added some hidden passages to increase the openness of the world. And the waterfall and vegetation were also added to improve the diversity of the landscape.
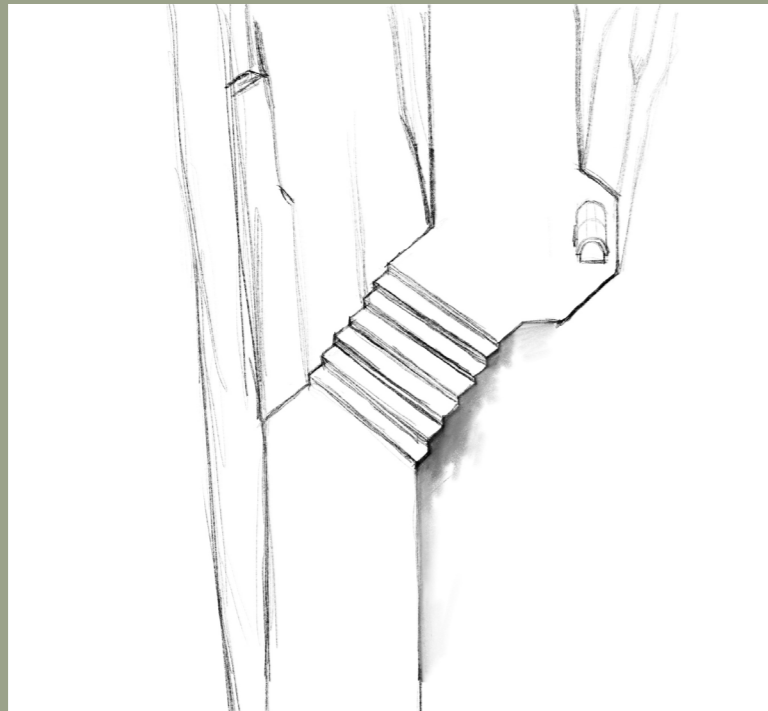
SCENE 3, CHAPTER 7
In version 1.0, the perspective of the scene was completely different from other scenes. It made the players confused when they entered. In version 2.0, the scene was too dark, which caused many details missing. So the problems were fixed in the final one.
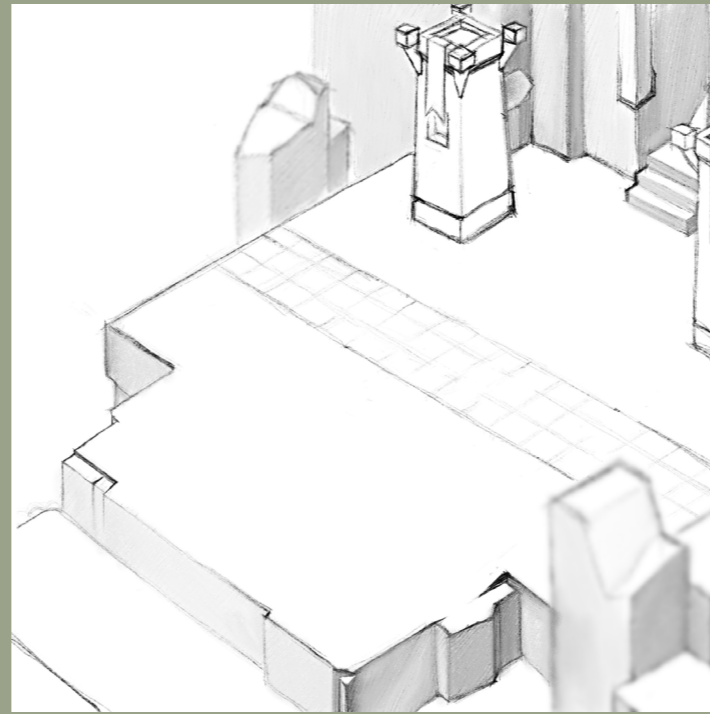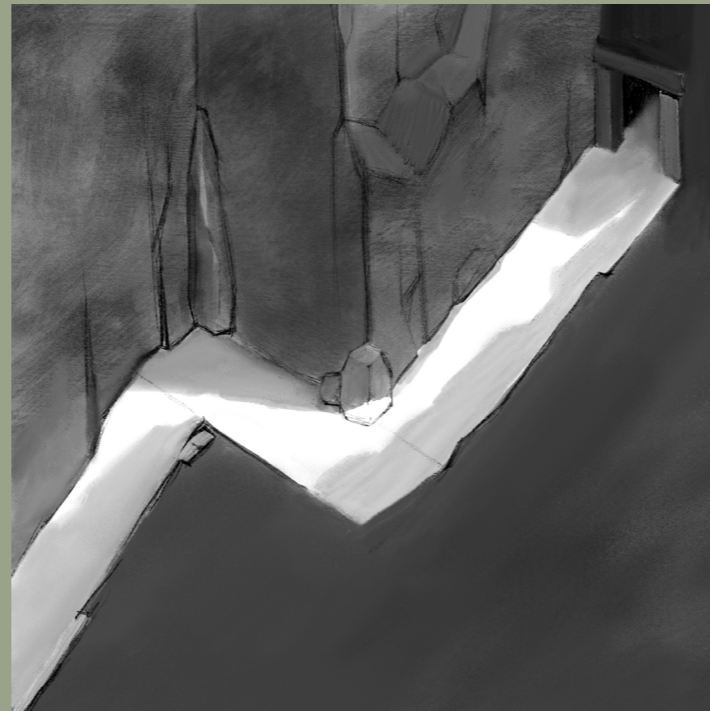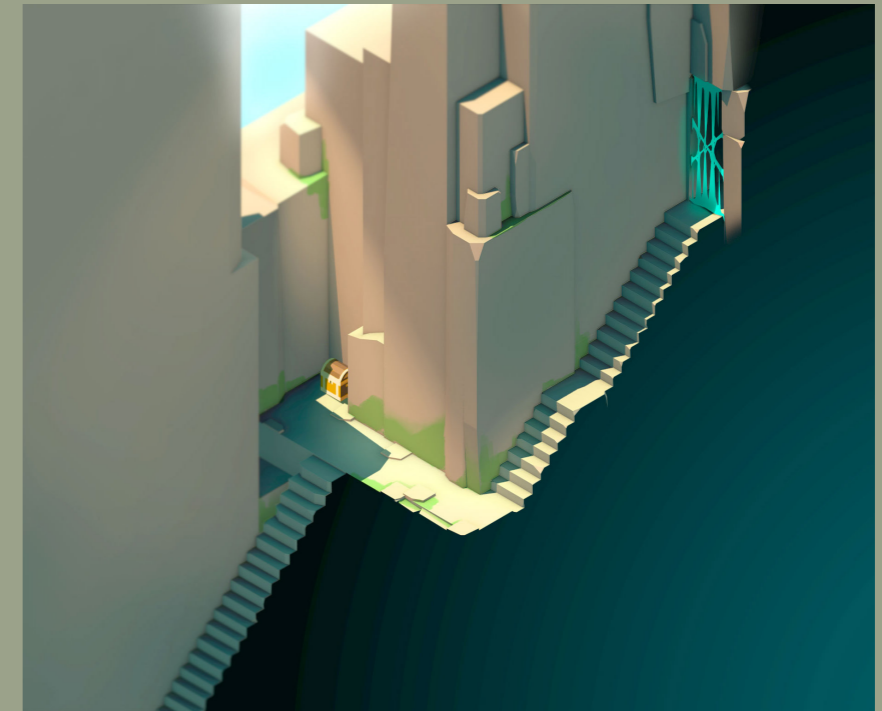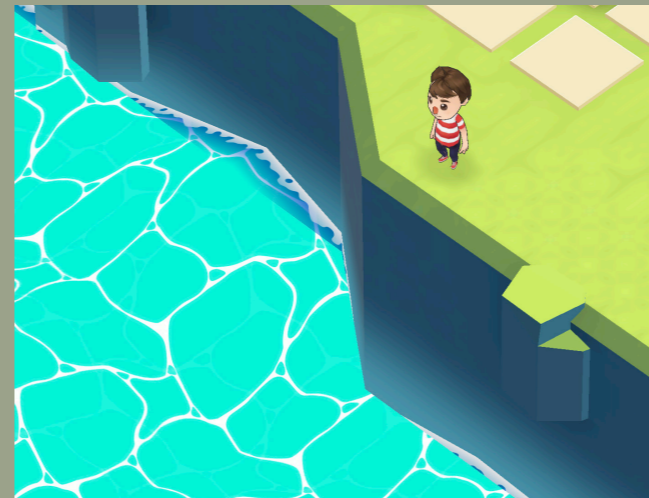
1.0

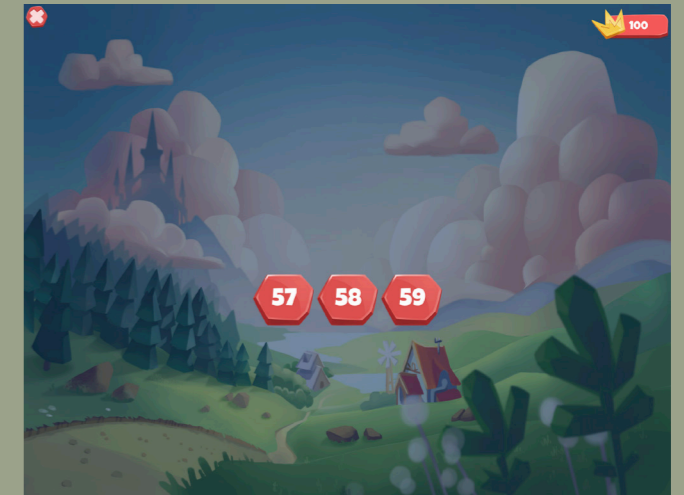**Final**

1.0

2.0

Final

Click-to-Move is an issue on tablets/phones as it is not immediately understood. We have to use another control mode or show instruction in the beginning.

Testers were curious about the water and the house. They want to go in. In the next version, the brightness and contrast of the water will be lowered to move children's focus on the game process.

Some testers did not fully understand the intention of the tasks. The instruction about the math tasks needs to be improved.

USER TEST

We invited 50 grade 1-3 kids from a local school to test the first version of the demo. The content of the demo includes the essential characters and environment assets, 2 math tasks, and fundamental UI assets for the first scene. Every kid supposed to start the game from the birth point and finish all tasks found on the map. And we collected user information during the procedure. Finally, we found some problems that we needed to pay attention to and planned to solve them in further process.

Testers kept pressing the zoom buttons several times after they stopped doing anything (could not zoom in or out more). Pinch-to-Zoom might be a better choice.

Testers tried interacting with the robots and asking if they would do something in the future. Some assets may need to be redesign to reduce the misunderstanding.

FURTHER EXPLORATIONS

Can teachers and parents take a role in the game? For example, the teacher may appear inside as a NPC like mentor, who is a spirit. So he/she can pop up no matter where and when kids need him/her and give kids the right guidance. And parents may become a companion of the player to face the challenges together. In this way, children will have a stronger bond with teachers and parents. It will give their study a positive influence.

GRASS IS EATEN UP!

Please build a new square fence with the same circuit as the old one.
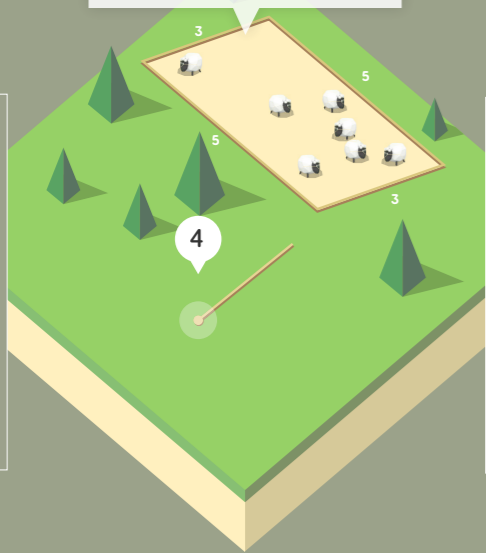
Explore new types of math tasks. For example, blend a geometry problem into a farmland task. The purpose is inducing the player to draw a square with the same perimeter as the parallelogram in a specific occasion. In this way, I aim to explore how interesting math could be. And children may also enjoy the new form of math teaching. Furthermore, their ability of using math to deal with real problems will be improved.

O 2 O

Online-To-Offline mode could be applied to our game in the future. Children could not only take the math adventure online but also join some extended activities offline. Therefore, children could avoid indulging in the virtual world and move more attention to the real world.

DISCUSSION/ REFLECTION

The core of the project is triggering children's motivation of learning math. The reason behind the situation that Swedish children have low math competence is decreasing attraction of original math. Children need to learn in an environment where could motivate them continuously. And game is one of ways to offer kids this kind of environment as it is appealing and relaxing for kids. On the other hand, the tablet game, as a digital learning tool, has more possibilities to offer better learning and teaching experience such as interesting trainning and interactive teaching compared with traditional methods.

In the project, the background system connects students, teachers, and parents better. Math knowledge works as "force" in Star War. The player uses it to solve difficulties and continue the adventure. So how to make an attarctive adventure and interesting tasks would be the key.

There are some important points of developing a good mathematical game. Firstly, fantastic visual feeling and spatial change should be the charm of a puzzle game. During the game process, the scenes and story should be able to surprise the players so that they will be interested to continue. Especially the moments when the players solve every puzzle, letting them feel the amazing visual performance of the scenes and a big jump in story is necessary. The second point should be the interesting puzzles and attractive rewards. Sufficient training should be guaranteed. Meanwhile, They are all important stimulus to remain the players passion and bring them a sense of achievement. Thirdly, the game world is virtual and gap between the virtual world and the real world exists objectively. The game design art is transferring real objects into the virtual world and giving them a different aesthetic feeling.

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