

Technobothnia's Escape Room in a Box

Final Report

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Abstract

This project is about the creation of an Escape Room in Box for the Technobothnia laboratory complex, complete from the acquisition of information about the work done and parts needed, the fabrication and design of the individual puzzles and the box, to the validation and pilot testing of all fractions in several rounds. Further, the paper focuses on project management aspects for the planning and progression of the project. Finally, it includes a short conclusion focusing on possible improvements to be made should the project be continued by another team.

Language: English

Key Words: Technobothnia, Escape Room Game, Project Management

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1 Project Organisation – European Project Semester

The following project, Technobothnia's Escape Room in a Box, was executed in the framework of the European Project Semester (EPS) offered by numerous European universities. It gave students with a minimum of two scholastic years the opportunity to explore project work in an intercultural team. These teams consisted of three to six members of different nationalities using English as the main communication language. To give the students guidance, all teams were provided a supervisor from local companies, research centres, or educational institutions.

The EPS was designed to broaden the learned knowledge of particularly engineering students to give them a 15 week long insight into the modern, globalised workplace and working procedures.

In addition to the project work, students were provided with courses in teambuilding, project management, cross-cultural communication and English academic writing and the local language, in this case Swedish. This furthered the student's education and set a base for their collaboration and successful completion of their projects.

(European Project Semester, n.d.)

2 Introduction

2.1 Project Background

The Technobothnia Escape Room project was started in 2021 due to Covid-19. Neither student nor other groups were able to visit Technobothnia and could therefore not get to know the work and research that is carried out there. Further, groups were not able to get information on possibilities for study or cooperation with Technobothnia. Due to other responsibilities of the previous team, made up of Technobothnia staff in cooperation with lecturers from local universities, the game and the individual puzzles were not finished, some not started. The interactive escape room game originated from the wish to create an entertaining way to introduce the public and individuals to Technobothnia. In addition, the need to be on site or in big groups was eliminated as the game is played in small teams. For the closing of the project, it was passed on to a team of international EPS students, more under 2.4.

For not only the working team, but all stakeholders and interested parties to get a brief summary of the project, a Project Charter was formulated. It includes numerous details dealing with the project namely the general project information, the team, and scope. (Ray, 2022)

Table 1 Project Charter

1. General Project Information		
Project Name:	Technobothnia Escape Room in a Box	
Team leader:	Leah Ebert	
Sponsor:	Novia UAS, Technobothnia	
Date:	12.09.2022 - 14.12.2022	
2. Project Team		
Name	Title	Responsibilities
Leah Ebert	Project Manager	Accountable, responsible
Kiki Geurts	Designer, User Experience Coordinator	Responsible, informed
Albert Hernández	IT & Programming Expert	Responsible, informed
3. Project Scope Statement		
Project Purpose		
This project's goal is to finish the started project by building a fully functioning prototype of an Escape room in a box that players, especially school classes, can use to get to know the Technobothnia laboratory complex better.		
Objectives		
<ul style="list-style-type: none">• Acquire information & parts needed• Fabricate & design the box & puzzles• Validate & pilot-test the box		
Deliverables		
<ul style="list-style-type: none">• Get Oversight/Planning/Scheduling tasks and deadlines• General Execution Tasks (box, shopping list, budget etc)• Execution of fabrication of all puzzles (all tasks)• Testing of all puzzles (individually and as a whole)• (Thesis documentation, closure of classes, replication instructions)		
Scope		
This project will cover the fabrication of one singular finished prototype/box. The budget is around 1000€. The project deadline is 16.12.2022.		
Out of the scope of this project is building and creating things that can be bought ready and would be cheaper and quicker if bought. Also, extra tasks like building a website will not be in scope.		

In Project Management the term 'deliverable' is utilised to describe the specific steps one takes to attain certain set objectives. These objectives are the general outcomes, comprisable as the project goal or scope, that are worked towards over the duration of a project. (Project Management Institute, Inc., 2017, p.4)

This project's overall scope was to create a singular, entirely functional Escape Room box including all agreed-upon pieces and eight puzzles. Not covered by this scope was the building and creation of parts one could have purchased more inexpensively and faster. Additionally, excess tasks such as the creation of a website or fabricating digital certificates of participation for the players were out of scope. The broader objectives were arranged chronologically. Firstly, the working team acquired all information about the existing and finished ideas and tasks from the puzzle inventors. Further, all parts created by them were received. Secondly, the team had to see to the design and fabrication of the puzzles and the box. Lastly validation and pilot testing the individual games and the complete game had to be done in several rounds with special attention to the durability of the box and puzzle parts.

The project's objectives closely overlapped with its deliverables. In the beginning, the team had to get an oversight, plan, and schedule the course of the project. The fabrication of the game was divided in general execution tasks such as budget, schedule, or protocols and in fabrication of the puzzles. Next was the testing phase of all puzzles, individually and as a whole, projected. Deliverables that were not necessary for successful finalisation of the project while still needing to be fulfilled were the thesis documentation, closure of provided classes, as well as creating box replication instructions for the customer with sight on multiplying the game for smaller teams to play simultaneously.

2.2 Technobothnia

The mentioned customer for the Escape Room box is the institution Technobothnia. Technobothnia is stationed in Vaasa, Finland, and functions as a wide-ranged laboratory complex. In 1996, the three local universities University of Vaasa, Vaasa University of Applied Sciences VAMK, and NOVA University of Applied Sciences cooperated and founded the Technobothnia based on the following three guidelines:

- "provide a framework for high-standard education and research in the field of technology
- serve as a channel of cooperation between educational institutions, companies and other research institutes and technology centers
- offer research, and product development, as well as education, measurement and testing services to the private and the public sector"

(Technobothnia, March 29 2022)

Today, Technobothnia houses 25 laboratories on an area close to 8000 square meters, from spaces for Environmental Engineering to Electrical Engineering or Automation. (Technobothnia, n.d.)

As Technobothnia Coordinator, Stolpe was chosen as this project's supervisor. She organises all things concerning the cooperation of the three mentioned universities. This could be events at Technobothnia or welcoming visitor groups. Additionally, Stolpe is member in the Technobothnia steering group where all universities are represented, and she weighs in in issues such as budgeting.

Stolpe started the organisation of the project with the previous team of lecturers and was the one that initiated escape room idea.

2.3 Escape Room Background

Escape rooms are themes adventure games. Players are immersed into the story ranging from light-hearted Christmas themes to action-packed prison breaks.

In real-life escape rooms, players choose a room and meet their guide. This guide will keep a close look on the players and help with hints should they be needed. (Ascalon, 2022) In escape room boxes this is often a video or papers with generalised hints.

Once the players are ready to start the game, they usually get to watch a mission video, in escape room boxes they get to read a paper that describes the objective. These forms of media explain the world the team will be entering, what they are trying to achieve, and why the team only has limited time.

In real rooms, the players must search the room and look for patterns and connections between clues to escape the room. Through teamwork and communication with one's teammates, one can find the solutions to the puzzles and the way out of the room. (Ascalon, 2022)

When playing an escape room in a box players do the same. The difference is that players only have the box and its contents to rely on. The team must again find clues, solve the puzzles, and decode the game.

2.4 The Team

After taking over the project beginnings, the Technobothnia Escape Room in a Box project was sought through by the team members Leah Ebert, Kiki Geurts, and Albert Hernández from the countries Germany, The Netherlands and Spain respectively.



Figure 1 Leah Ebert

Leah Ebert studies Bio- and Environmental Process Engineering at the East Bavarian University of Applied Science Amberg-Weiden in Germany. In her studies, her interests lie in recycling/recovery of resources with focus on water treatment. For this project, she took on the responsibilities of project leadership as well as the execution of the puzzles. She has the greatest organisational and managerial skills and already existing experience in project management. Opposite to Albert and Kiki, Leah is a more strategical and matter-of-fact person.



Figure 2 Kiki Geurts

Kiki Geurts is a Communication and Multimedia student at Avans University of Applied Sciences in The Netherlands. Her interests lie in biobased design, durability, and material research. In the scope of this project, her focus laid on graphic design, concepting, creation and editing of video- and photography, and UX design. Kiki is a creative and artistic person with focus on diplomacy and a comfortable group dynamic.



Figure 3 Albert Hernández

Albert Hernández is a Computer Engineering student at the UPC in Vilanova i la Geltrú, Spain. He is predominantly interested in video games and their coding structures. In this project, he performed all tasks concerning programming for the created App as well as the console puzzle. Like Kiki, Albert is an imaginative person and trained at finding creative solutions for possible problems. Further, he is co-operative and highly diplomatic, feeling comfortable in the role of expert.

3 Game Overview

The Technobothnia Escape Room in a Box contains eight puzzles which are tied together by the last one. In the beginning the team thought to divide them into four smaller ones that seemed less time intensive for players, and four bigger ones that would take more effort. After developing and testing, the usage of this categorisation was stopped as users responded differently to the puzzles, and puzzles could not be easily differentiated into 'big' and 'small' effort and time puzzles.

Originally, the game was also sought to take players around 45 minutes to an hour to finish successfully. Finishing the puzzle with success entails that players do not need help, thus not need to use hints. After testing, more under 5, the game time had to be lengthened to around two hours.

In the following, the puzzles' gist will be described shortly to give the reader a fist idea of the game and help with orientation in the later paper. The puzzles are in the order they appear for players when playing the game.

Technical Drawing: The players get a technical drawing, see Figure 4, of a water tank that can hold approximately 30l. The drawing was expanded by handwritten notes, for example formulae. In addition, the upper left corner was ripped off, so players do not have access to the height measurements of the tank. Players must figure out the scale of the drawing.



Figure 4 Technical Drawing - Final Version

UV-Circuit: The players are given a plastic box on which they must close an electrical circuit. If they succeed, an UV-light bulb will turn on and reveal a code written in UV-responsive ink. Should they connect the circuit incorrectly, either no lamp or a red LED light bulb will light up.



Figure 5 UV-circuit box – Final Version

Console: In this game the users must first connect a small gaming console to a hand-powered crank and figure out the correct speed to produce the needed voltage. Another player then must finish the code of the game with the help of a coded message. After, they must play the game and get enough points to unlock the code for the next game.



Figure 6 Console Puzzle with Crank and Cable – Final Version

Toothed Wheel: For the Toothed Wheel puzzle, the players get toothed wheels of varying sizes and shapes and a base plate with fixed hooks. They then must fit the wheels onto the base plate by connecting the imprinted lines on the wheels. If they align the wheels perfectly, they see the code by looking through the included holes in the wheels onto the base plate.



Figure 7 Toothed Wheel Puzzle – Final Version

Ping Pong: Users are provided with a base plate and Ping Pong balls. They then must fit as many balls as possible onto the base without the balls touching each other.



Figure 8 Ping Pong Puzzle – Final Version

Cone: In this puzzle, players are provided a model of a cone with a cylinder attached. Further, they get various papers with possible outlines of the inner surface of the cylinder. They then must decide which surface drawing is the correct one for the cylinder.



Figure 9 Cone Puzzle – Final Version

Invisible Ink: In a multitude of papers the users must find a hidden code and decode it. This leads them to create a visibility mixture for an invisible code. There are different ways for the players to deduce the volumes for the mixture. Additionally, a chemical will be hidden in a puzzle box.



Figure 10 Invisible Ink Puzzle – Final Version

Robotic Arm: The puzzle that ties together the game is the Robotic Arm puzzle. Players get the code for a safe box in which the ready built robotic arm is locked. They then must find the codes hidden in some of the previous games and adjust the individual scales on the different parts. The robotic arm points then to the correct code on a base plate. Only if the players adjust the arm correctly on the base plate, they can find the correct code.



Figure 11 Robotic Arm Puzzle – Final Version

All codes must be put in a Web App on the included tablet. The App shows the players if the code is correct. It guides the players through the game with the help of videos, photos, and text formats and will allow the players to get two hints for every puzzle as well as the correct code should they fail the puzzle. The players get time penalties if they use hints or the solution. Further the users must wait after using the second hint and the solution after using the previous hint.

4 Project Management

4.1 Stakeholder identification

Stakeholders include all people, institutions, and other parties that have interest and/or influence in a project or are otherwise connected to it. These stakeholders have varying degrees of interest and influence on the project processes and finalisation. (Landau, 2022)

In the following, this project's stakeholders will be detailed with their job titles, the expectations of them and their contact information. Further, the severity of their interest and influence is noted and colour-coded from high (bright red) to low (light red).

In general, 16 Stakeholders were identified: The team, made up of Leah Ebert, Kiki Geurts, and Albert Hernández, the project team's supervisor Josefin Stolpe as well as the laboratory complex Technobothnia for which the team designed the box.

Further, lecturers Eija Iivari, Jyri Nieminen, Sami Korpiniemi, Hans Lindén, and Anders Skjäl, that contributed their ideas and expertise regarding their subjects and puzzles, can be named. Also, project advisors for escape rooms, Anu Kuivaniemi from the local escape room company "FindOut" and Hanna Hankaniemi from the University of Vaasa, were added.

The last stakeholders on the list were the EPS coordinator Roger Nylund, the team's host university NOVA UAS, and home universities Avans University of Applied Sciences (Kiki), UPC Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú (Albert), and East Bavarian University of Applied Sciences Amberg-Weiden (Leah), in short Avans, UPC, and OTH-AW.

Table 2 Stakeholder Overview

ID	NAME	TITLE	INTEREST	INFLUENCE	EXPECTATIONS	CONTACT INFORMATION
1	Leah Ebert	Project Manager			Finish Jobs at due date Finish Box Meetings	WhatsApp e-mail Microsoft Teams
2	Kiki Geurts	Designer User Experience Coordinator			Finish Jobs at due date Finish Box Meetings	WhatsApp e-mail Microsoft Teams
3	Albert Hernández	IT and Programming Expert			Finish Jobs at due date Finish Box Meetings	WhatsApp e-mail Microsoft Teams
4	Josefin Stolpe	Project Supervisor			Contact Person, Help overcome problems, Meetings, Provide tools, materials/budget for the project, Use finished prototype and replicas	In-person e-mail josefin.stolpe@nova.fi
5	Technobothnia	Sponsor End-user			Provide tools, materials, expert contact persons, and budget for the project; Use finished prototype and replicas	-
6	Eija Iivari, Jyri Nieminen, Sami Korpinen, Hans Lindén, Anders Skjäl	Lecturers			Provide information; Help with: games/machines/buying parts	In person or e-mail eija.iivari@vamk.fi jyri.nieminen@uwasa.fi sami.korpinen@vamk.fi Hans.Linden@novia.fi anders.skjal@novia.fi
7	Osku Hirvonen	Lecturer			Help with additive manufacturing and laser cutting	In person or e-mail osku.hirvonen@vamk.fi

ID	NAME	TITLE	INTEREST	INFLUENCE	EXPECTATIONS	CONTACT INFORMATION
8	Anu Kuivaniemi	Escape Room Advisor			Contact person for questions related to the general execution and storyline	e-mail anu@findout.fi
9	Hanna Hankaniemi	Additional Escape Room Advisor			Help with Storyline and how to make game playable and fun	e-mail hanna.hankaniemi@uwasa.fi
10	Roger Nylund	EPS Coordinator			Provide guest lectures, Support, Contact person	e-mail Roger.Nylund@novia.fi
11	NOVIA UAS	Host University			Accreditation & Support, Provide classes	-
12	Avans OTH-AW UPC	Home Universities			Accreditation & Support	-

The team's roles were divided according to the members' fields of study as well as personal expertise, more under 2.4. As Ebert, Geurts, and Hernández were the individuals carrying out this project, they had the gravest interest and especially influence on the project progress and finalisation. On a near as high level was Josefin Stolpe. Her heightened attentiveness and impact were based not only on her position as the group's supervisor but also as Technobothnia's coordinator. Expectations for her therefore overlapped closely with expectations for Technobothnia as an institution.

The five lecturers the team had contact to were Eija Iivari (VAMK University of Applied Sciences), Jyri Nieminen (University of Vaasa), Sami Korpiniemi (VAMK), Hans Lindén (NOVIA University of Applied Sciences), and Anders Skjäl (NOVIA). They provided the puzzle ideas and further information needed for their execution. Many had not only given the ideas for the puzzles but had already started with the creation of the necessary parts. More detailed information on this will follow in 5. To be mentioned specifically is Hans Lindén as he additionally helped the team by ordering necessary parts online as well as making purchasing parts locally possible.

Another lecturer to be mentioned is Osku Hirionen. He was the team's contact person for all questions regarding additive manufacturing as well as laser cutting. His interest was low for the project in general as he was not involved directly. His influence on the other side was higher due to him being the expert in the fields of additive manufacturing and laser cutting. His willingness and effort to help the team brought new ideas for possible executions and made the project go more smoothly.

Further, an advisor for escape rooms had been provided. Originally her interest and influence were ranked in the middle. This had changed due to unreliability from her side as well as poor communication, more in 4.2. She had then been removed from the active Stakeholder List but is still included in the list above for better oversight.

To have an additional insight and another point of view, Hanna Hankaniemi from the University of Vaasa was contacted. As she had experience in developing games for children and young adults, her expertise gave helpful insights, even though she had limited time capacity. Due to this she also had been ranked lower.

Roger Nylund had been ranked in the mid-range in interest as his intention as the EPS Coordinator was to see all teams successfully carry out their projects. He is rated lower in influence as he was mostly a person of support and organisational figure for the general EPS project, while not being directly involved in the project and active decision-making. Nylund was further the contact point of the team to the institution NOVA UAS in all questions regarding accreditation, lectures, and support. Would further guidance have been needed relating to these issues, the team's home universities would have been contacted.

The above list of stakeholders was always subject to change as the project progressed. The latest version from 12.11.2022 has undergone several alterations, especially in the severity of interest and influence of the stakeholders, and in the number of stakeholders. This was the case for Anu Kuivaniemi as mentioned above, and Hanna Hankaniemi, as her expertise will be needed in the later stages of the project when the puzzles can be modified for different age groups.

The contact information and ways of communication between the team and the stakeholders will be discussed in the following.

4.2 Communication Plan

The contacting methods can be seen in Table 2 in the last column.

The team mainly got in contact with the stakeholders by e-mail. This ensured a professional distance between all involved parties. To add to this, contact to all stakeholders either went through Ebert as team leader, or had her in CC. This measure further made sure that all meetings and questions are tended to, and no details got lost as well as stakeholders having one person to get in contact with instead of different ones for different topics. This was implemented after the team had not communicated clearly and scheduled two separate meetings with a stakeholder within a day.

Have the arisen issues been discussed within the team and questions surfaced were small and topic-specific, this team rule was disregarded.

The above-mentioned supervisor and end-user of the product, Josefin Stolpe had most contact with the team. There were weekly in-person meetings held with Stolpe to update her in a more direct and frequent way about all developments of the previous week. For optimal oversight and a guideline throughout the meetings, a protocol was created that was continuously updated. The protocol (see Appendix 1) detailed all puzzles as individual talking points as well as the general game, working hours of the team, and extras. These extras included all other tasks and information to keep in mind for the team, that did not fit the other categories. Stolpe received the protocol to be discussed one working day before the scheduled meeting. In the beginning, this was Fridays, as the meetings were scheduled on Mondays. Later on, the meetings were usually held on Tuesdays and the protocol was sent on Mondays. The protocols were sent via e-mail and meetings scheduled via Outlook Calendar by Ebert which included e-mail meeting invitations and reminders for Stolpe, Geurts and Hernández.

In weekly meetings without supervisor Stolpe, the team spoke about problems or questions that may arose. Further, the tasks to be completed by the individual team members in the following week were discussed. These meetings were discontinued as the project progressed to the ending phases in the beginning of November 2022. The majority of tasks had been divided and the team members were aware of their individual tasks and deadlines.

The team also had started a virtual whiteboard in a shared Teams folder. Every team member put in their own tasks and changed their classification from 'To Do' to 'Current' to 'Done'. This helped the team leader Ebert keep track of the team's progress and ensured that no tasks were forgotten. This measure also was discontinued for the same reasons as the weekly meetings were discontinued.

The above-mentioned shared Teams folder was used to collect all documents that were produced by the team members over the course of the project. This ensured oversight and accessibility for all team members. Also, working remotely was possible, as the team members Geurts and Hernández preferred that method.

Stakeholder 8, Anu Kuivaniemi, the escape room advisor, was contacted via e-mail several times before responding. A meeting was scheduled for 27 October 2022 in which the project idea and progress was explained to Kuivaniemi. She was unsure as to what her role was in the project and contacted Stolpe weeks later. Stolpe exclaimed the stop of cooperation due to Kuivaniemi's lack of collaboration and feedback. There was no further contact.

The other advisor, Hanna Hankaniemi, was also contacted via e-mail after failed communication with Kuivaniemi, and a meeting was held on 19 October. It detailed

Hankaniemi's experience with escape rooms and her enthusiasm to work with the project. Further, she expressed her lack of time to work with the team. She proposed to adjust the escape room box after the project's end to be in accordance with younger children.

Roger Nylund, the EPS coordinator, was contacted mostly via e-mail, just like the different universities NOVA UAS, Avans, OTH-AW and UPC. For them, different spokespeople were contacted depending on the issues occurring. To be mentioned is Chrysi Dresnali as NOVA's international office contact person for EPS students. She helped the team arrive in Vaasa and was open for all questions regarding the stay and studies.

4.3 Risk Management

In order for the team to prevent situations such as the lack of replies like from Kuivaniemi from hindering the project progress, all risks had to be searched out and analysed. Only after this work was done, the team was able to work efficiently and foresightedly, and risks were either completely avoided or at least their severity lessened.

This is not only in interest for the working team but also for other stakeholders. These wish a project to be executed as agreed upon, which is not possible if compromises in time, budget, quality, or scope level must be made. (Jenkins, 2022)

All risks that could endanger the success of this Escape Room in a Box project are detailed in the following risk register.

Table 3 Risk Register

ID	RISK	RISK IMPACT	RISK LIKELIHOOD	CONTROL DESCRIPTION	OWNER
1	Too much work for few people	1	2	Good division of work, no tasks that are out of scope, communication in team for overview and assistance when needed	Group
2	Overlooking smaller tasks	1	1	Create and continuously update good Gantt-Chart with all details and tasks	Leah
3	Losing track of budget/budget too small	1	1	Create budget and add all expenses continuously	Leah
4	Underestimating the time tasks take	2	1	Plan in more rather than less time for tasks	Leah
5	One of the machines needed is broken/group does not get access	3	1	Start early with 3D printing and laser cutting	Leah
6	Getting too detail-oriented, doing things that are out of scope	2	2	Use Gantt-Chart for clarity of what is in scope, communicate with team/check in with team manager	Group, Leah
7	Late/no replies from people the team depends on	1	3	Contact to supervisor for help, think of alternate advisors	Group, Leah
8	Consoles do not work	3	2	Order second/different console, preferably from EU country for shorter delivery time	Group, Leah
9	No backup plans in case puzzles do not work	2	3	Create detailed risk register for puzzles and think of alternate puzzles/ideas on how to make other puzzles longer/more difficult	Group, Leah
10	Ordering parts too late, the needed parts are not here to complete the project before the end of the semester	3	3	Order as soon as possible, create/3D-print parts by team instead of ordering (if feasible) or buy them in-store in Vaasa	Group, Leah

The risk register presents the risks, their identification number, a possible risk response, the impact and likelihood the risk has, and the risk ownership within the team. (Ray, 2021). The risk ownership assigns the risk to a responsible person within the project team. This person was responsible for observing the risk and, if necessary, avert it. The risk impact describes the severity of harm the risk would cause to the project, should it occur. The risk likelihood describes the likelihood of the risk occurring.

The risk impact and likelihood are colour-coded in the register from least severe (green) to very severe (red). The numbers in the columns 'Impact' and 'Likelihood' are distributed on a scale from one to three.

The risks were then added to a risk matrix (see Table 4) to further visualise their severity, also in relation to other risks. In the risk matrix, the impact is counted on the x-axis, likelihood on the y-axis. The numbers in the colour-coded fields (green/low to red/high) in the matrix correspond to the ID numbers assigned in Table 3.

Table 4 Risk Matrix

		IMPACT		
		1	2	3
LIKELIHOOD	1	LOW – 2,3 –	LOW – 4 –	MEDIUM – 5 –
	2	LOW – 1 –	MEDIUM – 6 –	HIGH – 8 –
	3	MEDIUM – 7 –	HIGH – 9 –	HIGH – 10 –

The categorisation and severity of all risks were subjective to the team.

Over time, tasks and their division got clearer, and the team started to fit into their roles. This on one side led to Ebert taking over more tasks, making the work division more uneven and therefore increasing the likelihood of risk ID 1 from 1 to 2. On the other side, this made risk ID 2 likelihood smaller, as Ebert was responsible for planning and organisation. She therefore had a better overlook on how long tasks take and how tasks follow each other. Also, the risk of getting to detail-oriented could be lowered by this.

Further, risk number four (One of the machines needed is broken/group does not get access) was avoided due to the help of Osku Hirvonen. Even though the team started laser cutting late in the project progress, he answered quickly and took time out of his day to aid and oversee the cutting process.

Other risks that did not occur were puzzles not working and while having no backup and ordering parts too late, so they do not arrive until the end of the project. The team decided to keep all puzzles and only change them slightly after testing to fit better for the players. There were no backup-puzzles needed. All parts also were ordered in time. The only items that were ordered later than ideal were the acrylic plates for laser cutting, but again thanks to Hirvonen, the laser cutting process was sped up and the base plates finished in time.

Two risks that did occur and at least slightly changed the course of the project were number 6 and 7. It was already discussed, that Kuivaniemi did not reply to several messages in the beginning. Further, she did not provide considerable valuable input. Therefore, the team had to see through the game storyline and puzzle development without help. This part of the project progress then had to be sought through rather rushed.

The other risk that occurred was that the console the team ordered and preferred did not work. The coded game was not playable on it. Due to the team expecting issues with the console game, three consoles were ordered to have backup consoles. Hernández was able to make one of them work with the game. Still, it took more time than planned.

The last risk to be mentioned is the budget. Especially the three consoles were greater expenses that the team did not expect in the beginning of the project. Nonetheless, the team kept a close look on the budget and was careful not to overspend. The budget will be detailed in the following section.

4.4 Budget Management

As mentioned, one projected risk was the budget, especially in the beginning as the team could not steadily guess the costs of the project. Thus, a budget plan with the help of a template from vertex42 (2021) was created.

It aided the team in monitoring incomes and expenses and their relation to each other. Further, it included the difference between the estimated and real expenses as well as spending information such as the store and the receipt.

The team was provided a budget of around 1000€. This benchmark did not have a clear upper boundary as the end product would be used as a marketing tool for Technobothnia. It was suggested by Technobothnia coordinator Stolpe to rather focus on high-quality results and user-friendly design then staying within the budget as there is a certain leeway the project works in.

Nonetheless, the team projected to stay within the suggested budget. This was due to the reason, that many items and processes were being supplied to the team and project for free. This included additive manufacturing and the necessary materials like PLA, or cables needed for the UV puzzle and soldering supplies. Also, in mid-October, almost all expensive items such as the consoles and the tablet were bought. Even so, the team's remaining budget at that time was around 500 €, half of the starting budget.

One thing the team kept in mind and kept a close look on over the duration of the project was the sum of small costs. The team noticed early on that these add up to big amounts, one might easily lose track of. Further, some items added or changed while the project progressed. Nonetheless, all items that money was spent on are in the Table.

As seen in Table 5, the team stayed under the provided budget and had € 263,08 left.

Table 5 Budget Plan

Project Budget: Technobothnia Escape Room Game in a Box

All numbers/values are in the currency €. Date: 12.12.22

BUDGET	Expected	Actual	Difference	
Budget given	€ 1.000,00	€ 1.000,00	€ -	
Total BUDGET	€ 1.000,00	€ 1.000,00	€ -	

BOX	Expected	Actual	Difference	Shop/Receipt
Tablet	€ 150,00	€ 129,00	€ 21,00	Prisma
Suitcase	€ 80,00	€ 129,99	-€ 49,99	K-Citymarket (see Page 2)
Backpack	€ 25,00	€ 19,95	€ 5,05	Minimani (see Page2)
Pencil Case 2x	€ 5,00	€ 6,95	-€ 1,95	Minimani (see Page2)
Pencils	€ 5,00	€ 3,10	€ 1,90	Minimani (see Page2)
Eraser, Ruler	€ 2,00	€ 1,85	€ 0,15	Minimani (see Page2)
Scissors	€ 3,00	€ 2,95	€ 0,05	Minimani (see Page2)
Luchbox/Bag	€ 5,00	€ 2,75	€ 2,25	Minimani (see Page2)
Batteries (4xAA)	€ 8,00	€ 6,95	€ 1,05	Minimani (see Page2)
Packaging/suitcase organise	€ 20,00	€ 24,99	-€ 4,99	Amazon: https://www.amazon.de/-/en/Organisers-Waterproof-Convenient-Compression-Travellers/dp/B07FPKQFPB/ref=sr_1_5?keywords=koffer%2Borganizer%2Bset&qid=1669211928&refresh=1&prefix=suitcase%2Borganiser%2Caps%2C160&sr=8-5&th=1 (no receipt)
Pen black	€ 4,00	€ 3,95	€ 0,05	Minimani (see Page2)
Pen white	€ 4,00	€ 3,20	€ 0,80	Minimani (see Page2)
First Aid Pouch	€ 20,00	€ 12,99	€ 7,01	Amazon: https://www.amazon.de/-/en/emergency-storage-portable-medicine-medical/dp/B09XV78K5X/ref=sr_1_30?keywords=erste+hilfe+box+leer&qid=1669038457&prefix=first+aid+box+e%2Caps%2C314&sr=8-30 (no receipt)
Total BOX	€ 331,00	€ 348,62	-€ 17,62	

ROBOTIC ARM	Expected	Actual	Difference	Shop/Receipt
Safe Box	€ 50,00	€ 45,99	€ 4,01	Amazon: https://www.amazon.de/-/en/gp/product/B01580FHA0/ref=ppx_od_dt_b_asin_title_s00?ie=UTF8&th=1 , no receipt
Safe Box new	€ 50,00	€ 28,95	€ 21,05	Amazon: https://www.amazon.de/-/en/youyeetoo-Lockable-storage-locking-medication/dp/B09FT81LSM/ref=sr_1_3?crid=17FGC2PSGB6DC&keywords=abschliessbare%2Baufbewahrungsbbox%2BPP%2Bmit%2Bcodeschloss&qid=1669038193&prefix=lockable%2Bstorage%2Bbox%2Bpp%2Bwith%2Bcode%2Bblock%2Caps%2C216&sr=8-3&th=1 (no receipt)
Screws + Screwdrivers	€ 33,00	€ -	€ 33,00	not needed
Additive Manufacturing	€ -	€ -	€ -	Technobothnia
Total ROBOTIC ARM	€ 133,00	€ 74,94	€ 58,06	

UV SWITCHBOARD	Expected	Actual	Difference	Shop/Receipt
UV-light bulb (3x)	€ 3,00	€ 1,07	€ 1,93	Starelec (see Page2)
UV pens + shipping	€ 20,00	€ 16,05	€ 3,95	kivenalla.fi (see Page 2)
Cables	€ 20,00	€ -	€ 20,00	gifted by Technobothnia/Sami
Cable Ports	€ 2,00	€ -	€ 2,00	Technobothnia
Light Switches (2x)	€ 4,00	€ 2,16	€ 1,84	Starelec (see Page2)
Additional batteries	€ 10,00	€ 6,95	€ 3,05	Minimani (see Page 2)
Box	€ 10,00	€ 2,75	€ 7,25	Minimani (see Page 2)
Total UV SWITCHBOARD	€ 69,00	€ 28,98	€ 40,02	

INVISIBLE INK	Expected	Actual	Difference	Shop/Receipt
Small spray bottle	€ 3,00	€ 5,10	-€ 2,10	Minimani (see Page2)
Brush	€ 3,00	€ 4,95	-€ 1,95	Minimani (see Page2)
Paper printing	€ 5,00	€ -	€ 5,00	Technobothnia
Additive Manufacturing	€ -	€ -	€ -	Technobothnia
Scientific book	€ 15,00	€ -	€ 15,00	From a friend of Josefin
Total INVISIBLE INK	€ 26,00	€ 10,05	€ 15,95	

CONSOLE	Expected	Actual	Difference	Shop/Receipt
RETROFLAG GPI Case	€ 100,00	€ 73,94	€ 26,06	Retroflag (See Page 2)
Retro Arcade for Education	€ -	€ 66,22	-€ 66,22	RobotShop (See Page 2)
GameGo Handheld Console	€ -	€ 42,75	-€ 42,75	RobotShop (See Page 2)
Shipping for Retro & GameG	€ -	€ 17,61	-€ 17,61	RobotShop (See Page 2)
Hand Crank	€ 50,00	€ 46,09	€ 3,91	Amazon: https://www.amazon.de/-/en/gp/product/B07WVD6VWB/ref=ppx_od_dt_b_asin_title_s00?ie=UTF8&pvc=1 , no receipt
Total CONSOLE	€ 150,00	€ 246,61	-€ 96,61	

BUDGET SUMMARY	Expected	Actual	Difference
Total Budget	€ 1.000,00	€ 1.000,00	€ -
Total Expenses	€ 765,00	€ 637,92	€ 127,08
NET	€ 235,00	€ 362,08	€ 127,08

Page 2 in the Table refers to a second page in the Excel file where all available receipts are added. It can be found in Appendix 2.

4.5 Schedule and Work Breakdown Structure

To not lose sight of the tasks that must be completed for the project and to have an oversight, a Work Breakdown Structure (WBS) was created. From this, a Schedule was planned. Both detailed the project's deliverables and belonging tasks. For a better organisational structure this project also included sub-deliverables.

The Escape Room in a Box project was divided into four main parts: Oversight/Planning, Execution General, Execution Puzzles, and Testing. While these deliverables were, with the exception for long-term tasks, in chronological order, the sub-deliverables were not and were fulfilled simultaneously by the team. The individual tasks under the sub-deliverables were planned to be fulfilled order to ensure a clean progress. While continuously updating both plans, this changed slightly, and some tasks are out of chronology.

All undertakings can be found in detail in the Work Breakdown Structure as well as on the Schedule, also called Gantt-Chart. While the wording of the individual tasks may change slightly, their core is the same and can be viewed as identical. Further, their order of appearance is matching, and individual tasks can be compared easily by their corresponding number. The number structure is as follows: either D for deliverable, S.D. for sub-deliverable, or T for task, and then a one to three figure number code.

For better oversight in this paper, the tasks in the following will be detailed based on the Work Breakdown Structure. The Gantt-Chart additionally illustrates the time frames in which the team fulfilled the individual tasks as well as deadlines the team met.

A complete version of the new Gantt-Chart can be found in Appendix 3.

The deliverable Oversight/Planning can be divided into the Sub-Deliverables Puzzles, Escape Room Game, and Rest.

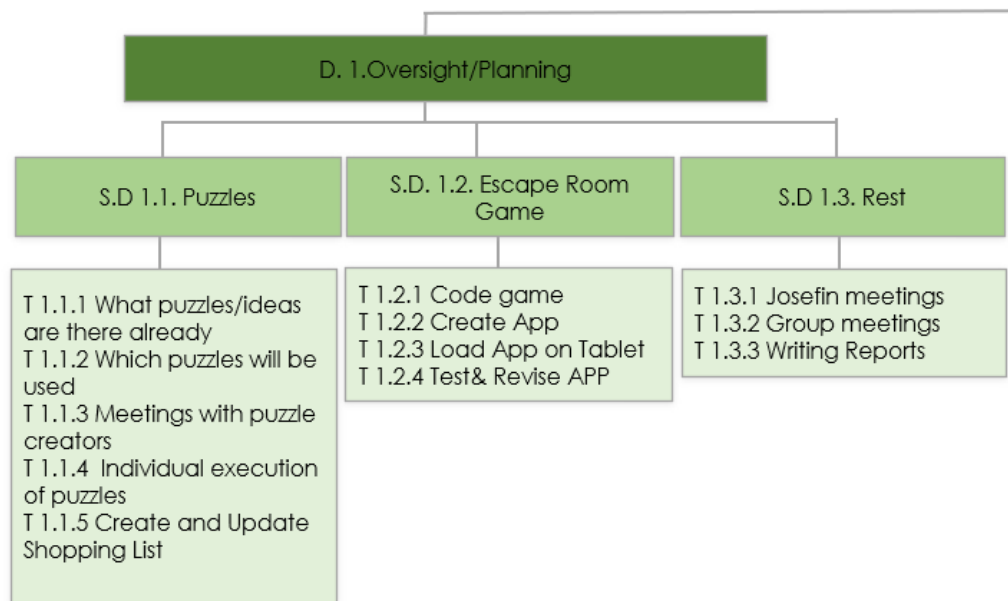


Figure 12 Deliverable 1: Oversight/Planning

In Puzzles one can find all tasks from starting point for the puzzles, getting familiar with the individual puzzles, their creators, and necessary things the team needed for their completion. Escape room games focused on the tablet game and the App and Rest are long-term tasks such as weekly meetings with the team's supervisor or writing reports, that do not fit into another category.

This deliverable was not changed in the duration of this project, as these tasks were either finished early on or were long-term tasks such as meetings with Josefin Stolpe.

Execution General is the deliverable that summarises all tasks that were essential for the over-all escape room game from start to finish. Its sub-deliverables focus on the overall happenings of the project, such as the storyline, media and design, and the box with its contents.

Storyline details all tasks the team took from creating a storyline to thinking of hints for the players. Media/Design are the tasks dedicated to videos, the video game, and all other forms of media. The last sub-deliverable in this category is the box in which the game is stored. It includes tasks from the decision on how to pack the puzzles to researching and buying a tablet to assembling the final box.

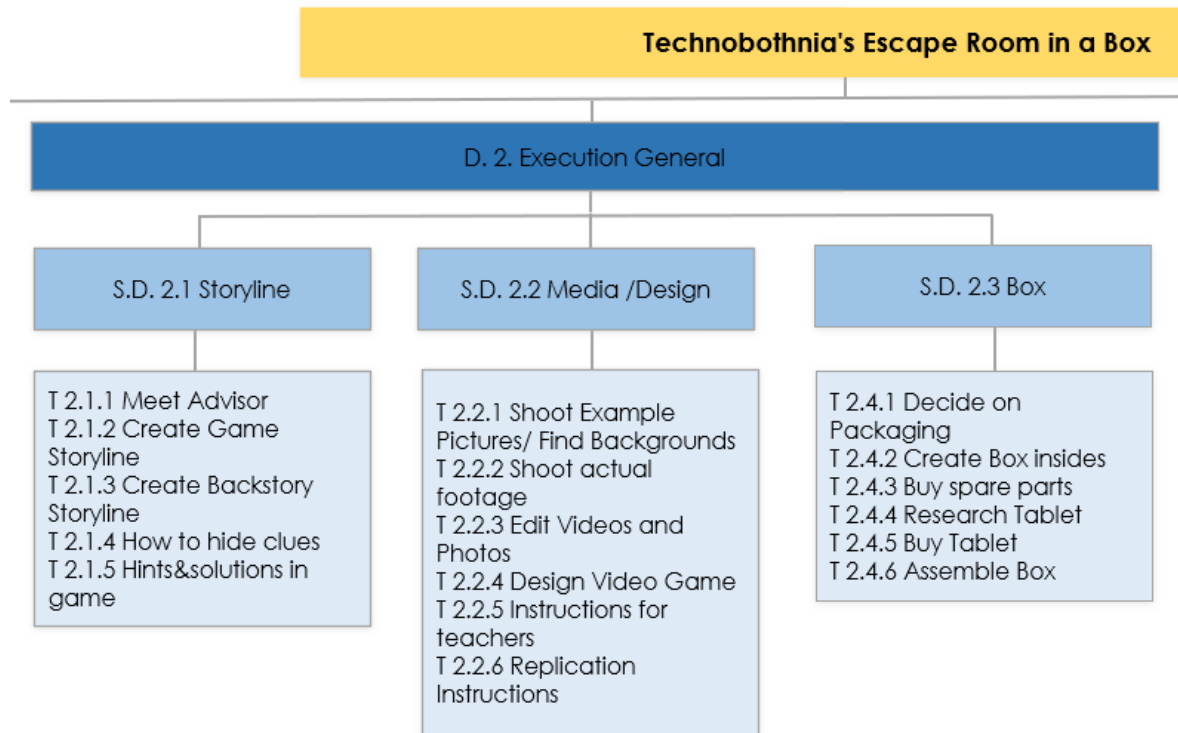


Figure 13 Deliverable 2: Execution General

Deliverable two was also not changed much in the duration of the project. The only updates the team made were to add replication instructions for Stolpe to S.D. 2.2. With those, she will be able to replicate the box to make it accessible to more people and to replace damaged or lost items. Further, buying extra parts was removed as a task from S.D. 2.3 as the team decided to not make the game even more difficult for users to play. Also, decorating the box itself was deleted, as it is an extra task. The team wanted to rather focus on the necessary tasks.

In the following, deliverable three Execution Puzzles, will be detailed. The below figure details puzzles one through four and their belonging tasks. All puzzles are in order of their appearance in the game and are detailed in their own category for a better overview.

Most sub-deliverables have the same structure: First, the team got in contact with the puzzle creators and then divided the work that was left to do into small individual tasks.

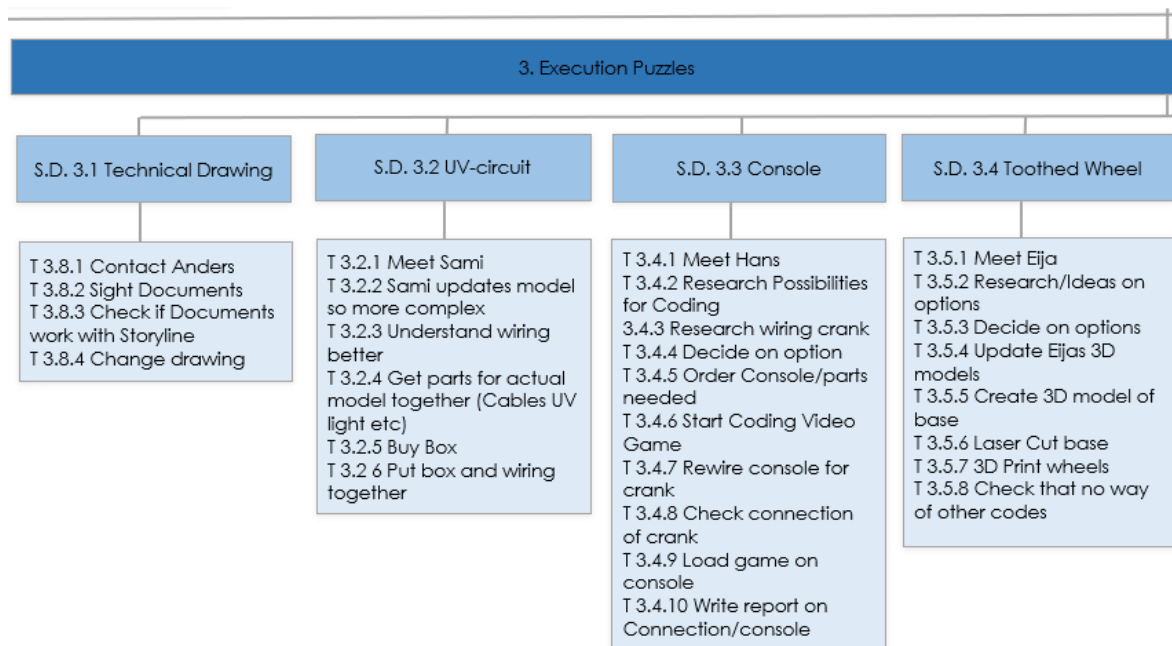


Figure 14 Deliverable 3: Execution Puzzles – Puzzles 1 to 4

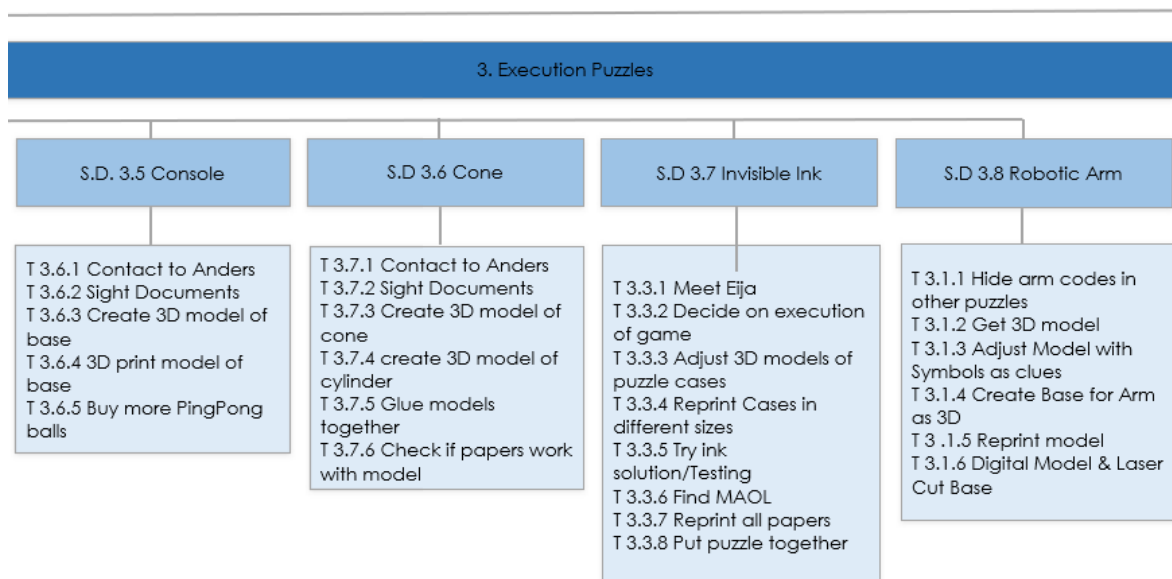


Figure 15 Deliverable 3: Execution Puzzles - Puzzles 5 to 8

The three puzzles S.D. 3.1, 3.3, and 3.6, were mostly done at the takeover of this project team. Therefore, the tasks for these puzzles majorly centre on fitting them into the storyline, while the other puzzles have more tasks focusing on the creation on parts.

In this deliverable, few changes happened between beginning and end of the project. The only notable differences are the execution of the tasks themselves, for example buying a

box for the UV-circuit rather than laser cutting one or getting the chemistry book MAOL taulukot rather than printing papers off the internet. Further, the team decided to write a short report on how to code the console game.

The Robotic Arm is one of the more important puzzles as it connects all previous puzzles and ties the escape room game together. Therefore, it was completed last when the other puzzles were finished.

The last deliverable Testing was highly important for the project. The testing phase can be divided into two types of testing, Individual and Group User Testing.

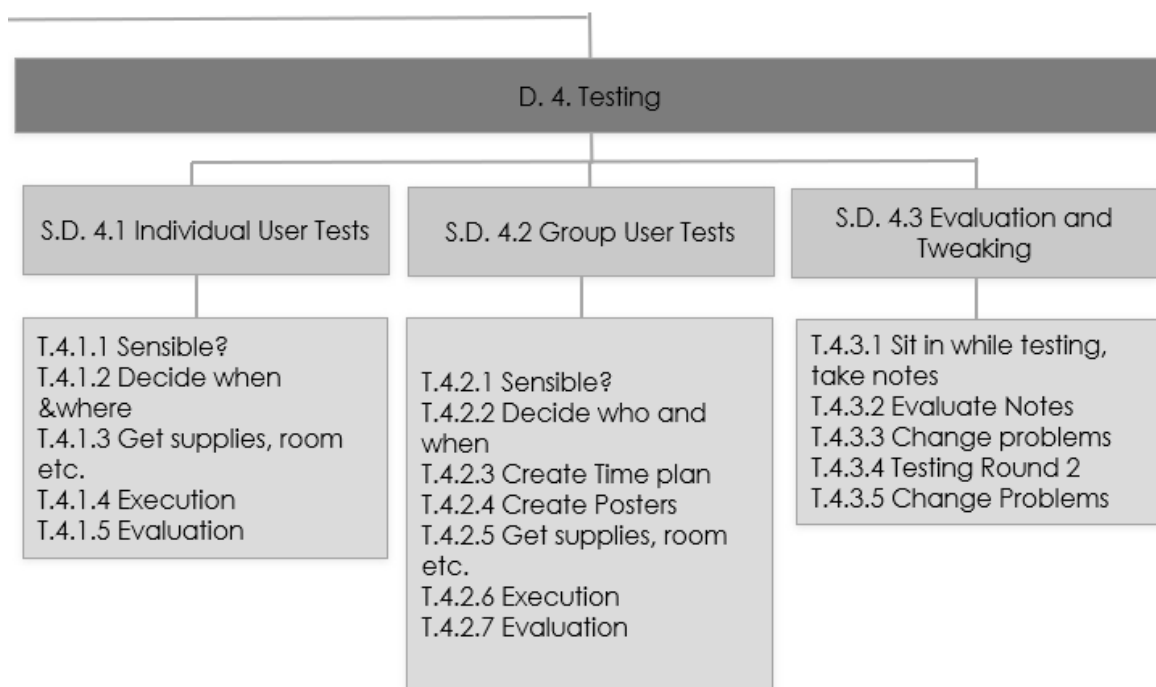


Figure 16 Deliverable 4: Testing

The only items on the WBS that changed were that the participation incentives were left out and evaluation sheets were not used, more on the latter in 4.6.

The first testing phase was planned continuously over the later stages of the project phase. The individual puzzles were tested on other EPS students to ensure all are playable and fun and to avert crude mistakes in continuity and logic in the puzzles. In the second testing phase, Group User Testing, the finished game and box were tested. While testing, the team took notes (see Appendix 5) that were evaluated and after, the puzzles were adjusted accordingly.

The team started testing relatively late, compared to the planned timeline. Originally, it was scheduled to start testing the puzzles in the first round on 14 November and in the second round on 28 November 2022. Due to delays in the creation of the puzzles, that means for example late delivery times of ordered items, the testing phase was pushed back to the dates 2 December and 4 December 2022, see Gantt-Chart in Appendix 3 and 4.

Upon comparing the original and the latest versions of the Gantt-Chart, it is visible, that not only the testing phase, but also several tasks for many puzzles have been delayed. One reason was, that the division of tasks was uneven between the team members. In the progress of the project more and more tasks' responsibilities changed to Ebert. This can be observed in the column Task Ownership in the Gantt-Chart. A similar dispersion can be noticed in the kept working times file, see Appendix 6. The team noted down their working times for the whole duration of the project, complete with a short description of the tasks that were done. While Ebert worked 6:59h per working day during the project, Hernández worked 3:40h and Geurts 2:10h. The dispersion was also encouraged due to the lack of specialisation tasks in programming for Hernández and design tasks for Geurts.

Nonetheless, all puzzles and their tasks were completed and the Escape Room in a Box was created and tested. More on the testing will follow in the next section.

4.6 User Testing

It is crucial to user test a product or service such as an escape room before making it accessible to the public. User testing should give developers impressions about their ideas and concepts from a user perspective, as well as illustrate in-depth information on the interaction of users with the presented product. This shows inconsistencies and issues the product has and helps optimise it. (Adobe, 2021)

Especially for the escape room, testing helped the team understand the reasoning behind the players' behaviours and their way of interaction with the puzzles. The team was able to notice players playing the game differently than suspected and planned. This helped change the puzzles to have more user-friendly design.

The team decided to test the game in two different phases, as mentioned under 4.5. Firstly, the individual puzzles and secondly, the whole game. It was determined to undergo testing by letting players play the puzzles or game while critically watching them and their behaviour. With the player's consent, videos of them playing the puzzles as well as detailed notes on their behaviours and testing times were taken (see Appendix 5). As mentioned under 4.5, the team decided against using survey forms. Not only would the testing have taken even longer for players, but also the team thought personal contact to the volunteers to be a better way to get the needed information. This means that the team rather asked the players general questions in a colloquial style after the testing was finished. The

questions were phrased similarly to the created surveys in Appendix 7. Further, the team asked players to voice all their thoughts as well as questioned them on their ideas, feelings and impressions while playing.

Individual Testing was planned to happen as soon as the first puzzle was done. The team's idea was to test simultaneously to creation to ensure the puzzles are playable and enjoyable. This would have given the team valuable input on the individual puzzles as well as information on the issues that would have been looked at closely in the creation of other puzzles. However, the team only started the testing of the individual puzzles in the beginning of November. One reason was, that it was planned to test the individual puzzles on the other EPS students who themselves were busy working on their projects. Another reason was the fact that the majority of puzzles were time-intensive to create and therefore were not finished until the end of November or even the beginning of December. This meant that testing of those puzzles had to be pushed back. Further, the inhibition to test unfinished puzzles prevailed in the team.

The same perfectionism was also the reason why general testing was started late in comparison to the planned date. This led to the team not testing on many player groups and only on few different demographics. It was planned to test from the middle of November until the end of the project. Further, the team wanted to organise testing days with students from Technobothnia and the surrounding universities as well as staff. It was thought to use posters and incentives such as a patch to get people and teams to sign up for testing.

While the team found the individual testing not as helpful for the creation process, the general testing raised several issues that needed attending to. General testing furthermore indicated to the team that the playing time had to be extended and that the difficulty levels had to be adjusted in some puzzles. More about the result from testing will be detailed in the following section The Project Timeline.

5 The Project Timeline

5.1 Storyline and Theme

A storyline is a sequence of events that ties together as one story. (Vyond, 2022) An escape room can be described by that. The individual puzzles and their order can be one storyline. It then incorporates the general theme of the escape room.

The theme was provided to the team by Stolpe. Her idea was to set the game at Technobothnia. Students want to prank their lecturers and test them to see if they know about the subjects they teach in. The students accidentally mistook the dates and instead of locking in the lecturers on a teacher teambuilding event, they lock in school students that came to visit Technobothnia.

To visualise this storyline, a storyboard can be used. In sequenced squares, illustrations or pictures depict how a form of media such as a video will unfold, shot by shot. Underneath the squares, a short text describes what will happen in the individual shots or a first dialogue can be recorded. (Vyond, 2022)

Creating this storyline not only helped team get a clear oversight of which shots are needed while filming but also aided stakeholders. Especially Stolpe was able to understand the vision more easily and give early feedback for adjustments. This prevented re-filming and spending needed time for other things.

In the following, the first version of the storyline for the escape room game will be presented. The basis idea was for the puzzles to take tuns based on their difficulty levels. It was thought to keep the players interested by alternating between more and less challenging puzzles. To be mentioned is also, that the team used simple sketches and handwriting for this first version of the storyboard.

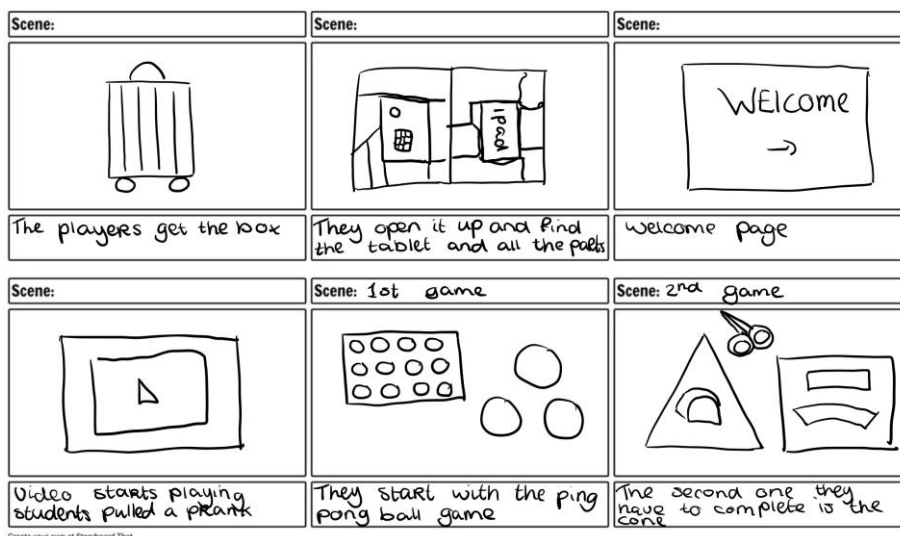


Figure 17 Storyboard Version one – Part one

Players first get a suitcase containing the game, complete with the tablet and all parts for the individual puzzles. Upon turning on the tablet and opening the app, players are greeted by a welcome page. The first video starts playing and the escape room's story is introduced.

Once the first game is started, a counter starts running. Players will receive a video or a picture with a short text explaining the puzzle. This applies for all puzzles. The first game is the ping pong puzzle followed by the cone puzzle.

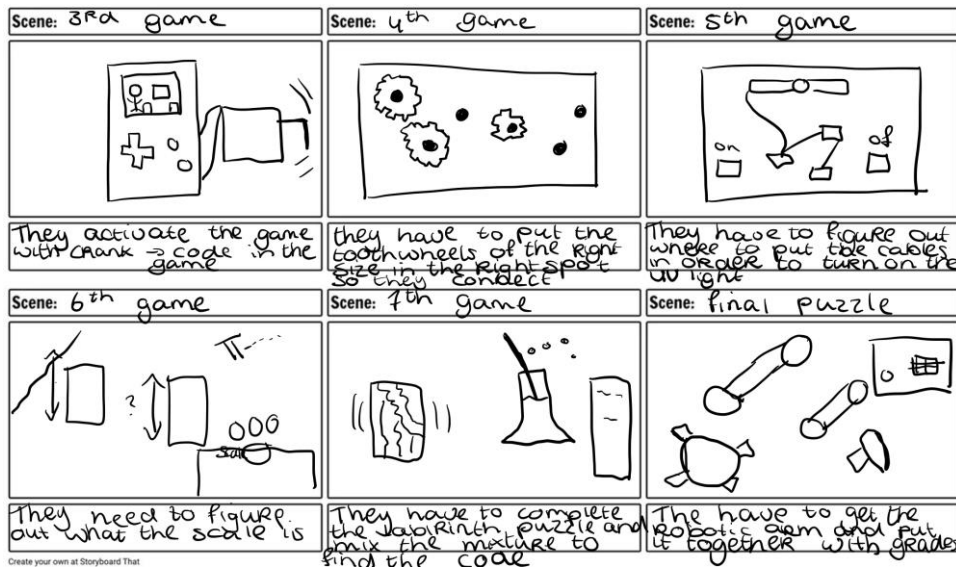


Figure 18 Part 2 Storyboard Version one – Part two

Next, the console, the toothed wheel, the UV, the geometry, the invisible ink, and lastly the robotic arm puzzle are played.

The team planned to incorporate videos into the app for the game. This was to help players navigate through the game not only by illustrating for them the real walking ways between laboratories but also to give them hints as to what parts were necessary to play the individual puzzles as it was planned to hand users the box not pre-sorted, more under 5.3.

As discussed under 4.2, the team did not get a reply from the escape room advisor Kuivaniemi. This led to the need to finalise the video storyboard without external help and input. The following second version of the storyboard was created for the game.

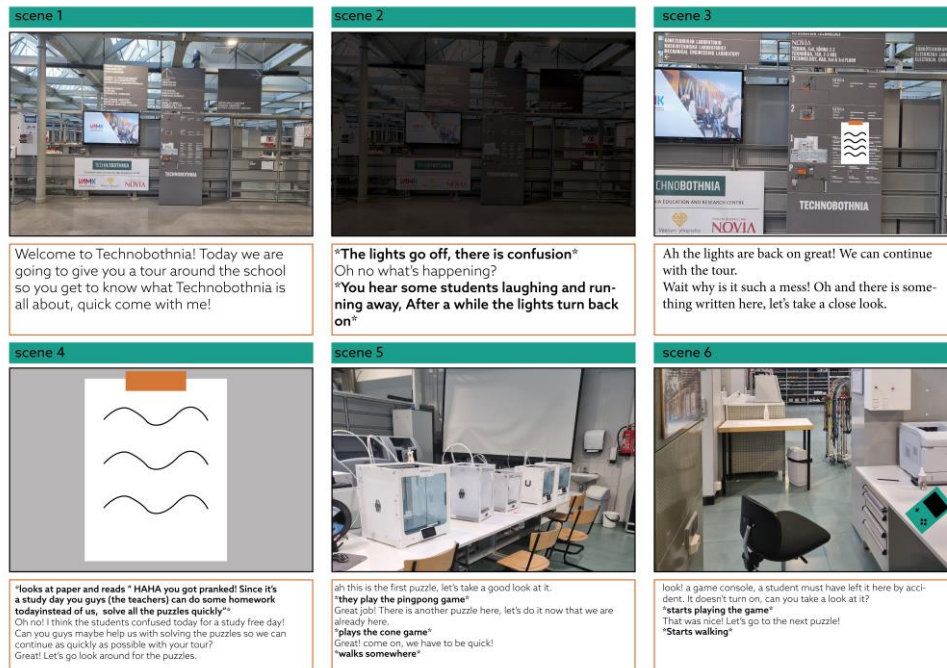


Figure 19 Storyboard Version two – Part one

This storyboard focuses on the sequence of the puzzles rather than on the general game. It follows the videos the players will get to watch on the app while playing.

The game and therefore the video starts at the main entrance of Technobothnia. Josefin Stolpe narrates a short introduction (scene 1). As videos are without sound for accessibility and easy replication in all three required languages Finnish, Swedish, and English, the team decided to add subtitles. They are displayed next to the videos on the tablet screen.

In scene 2, Stolpe notices the lights tuning off. This effect was edited as to not disturb the procedures in Technobothnia on filming day. As the lights turn back on, Stolpe spots a note on the information board (scene 3). It details the background of the fame and the objective the players must follow (scene 4).

The video then follows Stolpe as she makes her way to the 3D printers where players do the cone and the ping pong puzzle (scene 5). The location was thought of due to the reason that both puzzles were made possible by additive manufacturing and 3D-printers. In the next laboratory, players then find the console and crank for the next puzzle (scene 6).

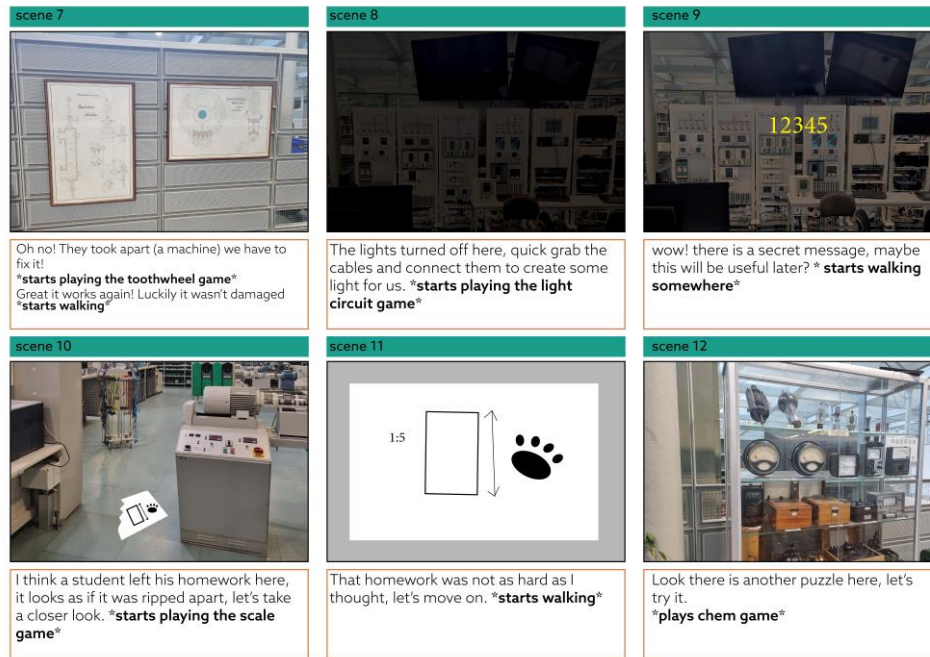


Figure 20 Storyboard Version two – Part two

In scene 7, the video follows one of the corridors in Technobothnia where players must solve the toothed wheel puzzle. After, the video displays the lights going out again. Players must connect the circuit and restore power for Technobothnia (scene 8). In one of the corridors on the way to the next puzzle, players then find a secret code they must use later. The video then displays a piece of paper on the floor (scene 10), the technical drawing puzzle (scene 11). When entering one of the rooms, the video finds the invisible ink puzzle players must finish.

Not included in this rudimentary version is the end where players must use the secret code to open a safe and find the arms of a robotic arm. They then must play the robotic arm puzzle.

This was not the final version of the storyboard and was subject to change. The eventual storyboard that was decided on by the team in agreement with Stolpe will be detailed in the following.

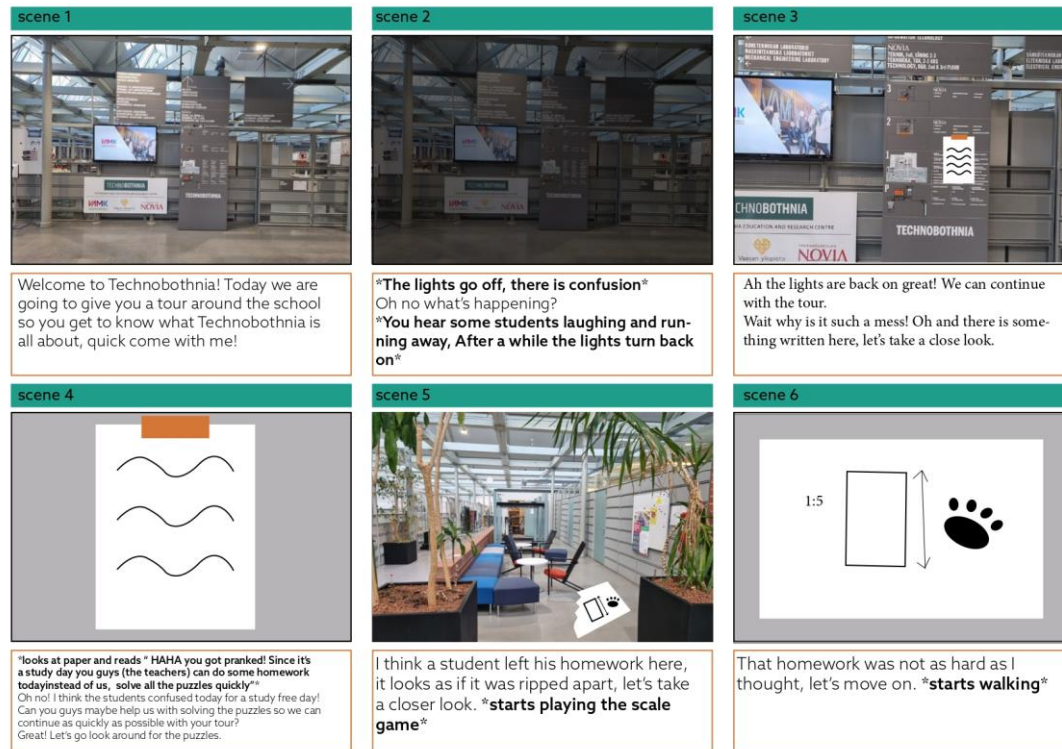


Figure 21 Storyboard Final Version - Part one

Scenes one through four stayed the same. The changes mostly stem from the modification of the puzzle order. The video first leads Stolpe to find the technical drawing puzzle at the entrance of Technobothnia (scene 5 and 6).

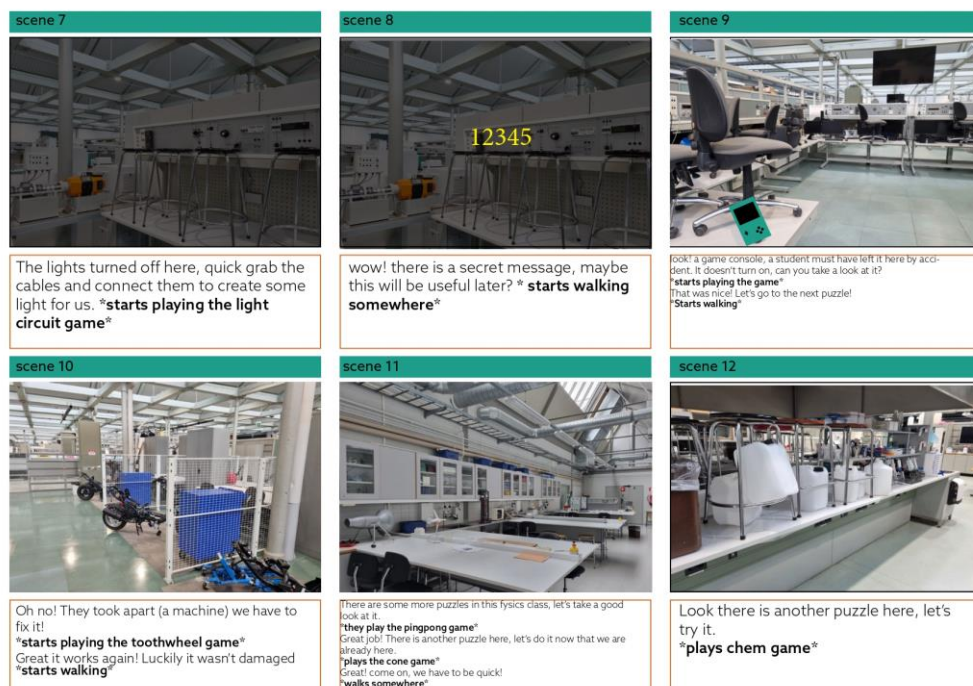


Figure 22 Storyboard Final Version - Part two

The video depicts Stolpe running to the Electrical Engineering laboratory where the UV-puzzle is ready to be played (scene 7). Scene 8 that reveals the secret code was pushed in to be directly before the robotic arm game in the real game. Due to a lack of time, the storyline was not updated to include this small change.

The video then goes on to the console puzzle (scene 9) and follows Stolpe to the Mechanical Engineering laboratory for the toothed wheel puzzle (scene 10). Further Stolpe is to be seen who runs to the physics classrooms. Players must then play the ping pong and cone puzzles. (scene 11) Scene 12 leads the players to the Environmental Engineering laboratory for the invisible ink puzzle.

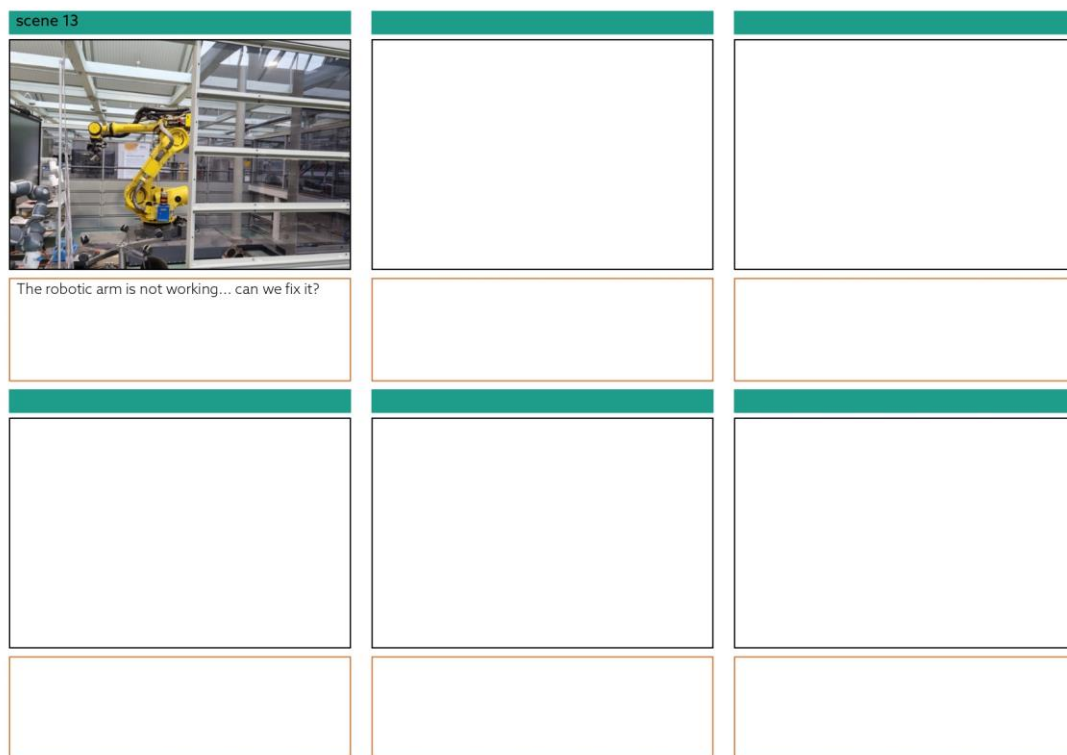


Figure 23 Storyboard Final Version - Part three

The last puzzle then is shown in the last scene 13. Players must play the robotic arm puzzle.

The changes in location were suggested by Stolpe as she did know most about Technobothnia. The team agreed with her proposal and changed the storyline accordingly. The videos further were edited to include photos of the Technobothnia map for more transparent pathways Stolpe takes in the videos.

5.2 Design/Media

Next to the videos, more forms of media were produced by the team. Most notably the app the players play the game on.

The team received a first layout proposal from Stolpe made with PowerPoint. It painted a rudimentary picture on how she wanted the app executed.

The group updated this version by starting with a style guide. Style guides are documents that provide clear guidelines for the representation outwards of a brand or institution. These guidelines can for example be colour or font rules. This ensures, even multiple and external contributors create clear and cooperative designs that are in accordance with the client's design. (Tuttle, 2021)

To create the style guide, the group examined the Technobothnia website and the code attached to it to find the used colour codes and fonts. Then, a canvas was created, as shown below.

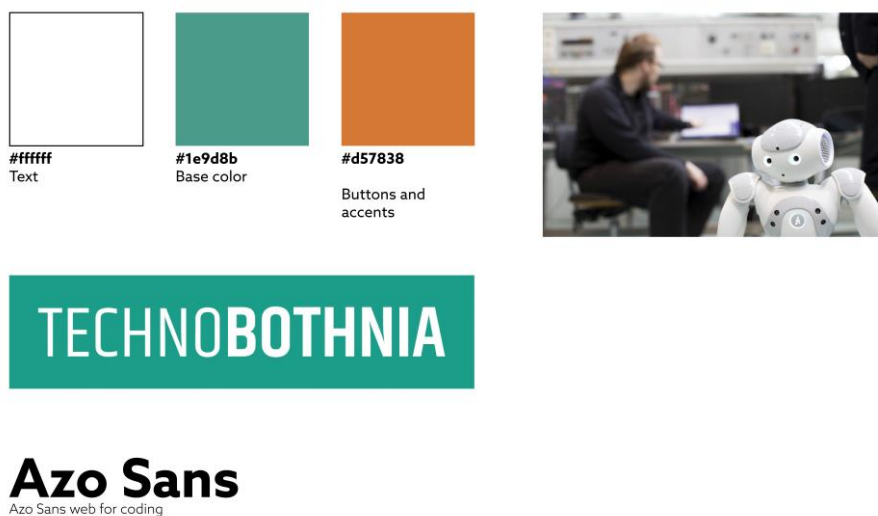


Figure 24 Style Guide

This style guide was then used for the app. As seen in Figure 24, the colours and font were kept the same. The design of the app was updated several times while keeping in mind the stakeholders' wishes.



Figure 25 Exemplary Screen from the Web-App – Starting Page

The screen in Figure 25 is the first screen players see when opening the app. It shows different language settings one can choose from. As the team is English-speaking, the app and all materials were created foremost in English. Stolpe volunteered to translate the game after the finalisation. Her main goal was to have the game finished and playable in English.

After conversations within the team about the design and layout of the app, buttons were placed more conveniently and made bigger for easier operation. Further, a timer was added to the top right corner of the screen for players to be able to keep track of how long they need.

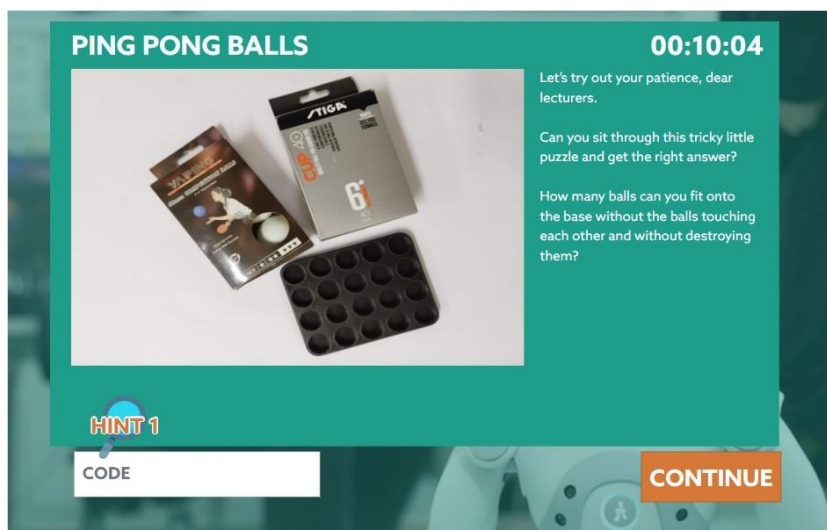


Figure 26 Exemplary Screen from the Web App - Ping Pong puzzle

On the screen one can also see a button with the scripture 'Hint 1'. Players can use hints should they be stuck in a puzzle. The group decided to offer users two hints and the solution. They can only use them in order and additionally must wait between using them. Hint two will only appear if hint one was used.

All screens of the app can be found in order in Appendix 8.

Another item created was a poster for the general testing. The idea of the team was to invite students and staff of Technobothnia to play and therefore test the game and its playability. As other students, friends of the team, were enthusiastic about trying the game, this idea was discontinued. Nonetheless, the poster was used as signs to lead the testers through Technobothnia towards the testing room.



Figure 27 User Testing Poster

One can also see the added post-it note on the poster. The team thought to offer volunteers a patch as incentive to participate. Patches are popular items especially for university students to collect in Vaasa and all over Finland, as they are added to students' overalls. As mentioned, friends of the team volunteered, and the patches were not needed. The note on the poster was taped over with a different note saying 'come test it with us!'.

5.3 Box

In the following, the Escape Room box itself will be talked about. First, the team decided, after careful consideration of all options, to use a shelled suitcase for packing the game. This ensured the safety and effortless transport of all games. Especially in sight of the uncertain weight of the games early on, the team opted for the suitcase as it had wheels and accessible handles. Other contenders such as a plain cardboard box or one out of wood similar to a treasure chest were rejected due to their inaccessibility. The chosen suitcase, see Figure 28, was expandable, should the size of the puzzles be bigger than expected. Further, it does not open through the middle but on the top. This makes organisation of the suitcase more convenient and helps players find the items needed faster.



Figure 28 Suitcase

The insides of the box were also discussed amongst the group. To prevent breakage and to make assembling and disassembling the parts from the box simple, the team had the idea to carve out the shapes of the individual parts from big Styrofoam pieces. These would have been working as shock-absorbers and stopped parts from moving around the suitcase. This idea had to be paused due to the limited time for the project and replication problems. The team stumbled over the problem of how to explain the carving process for replications or how to create models for it. The idea also included putting all parts in the box without order so parts from the same puzzles were not situated next to each other. This was discontinued

as it would have made the game too time-intensive for players and small items would have gotten lost easily.

It was then decided to package all belonging parts of the individual puzzles together in singular suitcase organiser bags, see Figure 29. This not only helps the players find all necessary items needed for the puzzles but also aids in keeping track of all items. A list of all items included in the box can be found in Appendix 9. One important item included are the player instructions that are also added. They include details about how to set up the game and a checklist for the time players put the items back in the box. The instructions can be seen in Appendix 10.



Figure 29 Suitcase insides with Suitcase Organizers

Furthermore, the team ruled to provide the players with spare parts, for example spare batteries, cables, or screws, to ensure a smooth playing experience. These spare parts are packed in a first aid pouch that can be accessed by the players at all times.



Figure 30 First Aid Pouch – closed



Figure 31 First Aid Pouch – opened

The pouch includes an extra set of batteries, screws, cables and much more that players may need to substitute.

The team also played with the idea to include extra parts that are not necessary for the completion of the puzzles but will make the game a little more difficult to play. These were for example extra cables for the UV-circuit puzzle. One problem the team kept a close look on is the tightrope walk between making the games hard and keeping them fun to play. To not make the game too demanding, testing was carried out and it was found that adding these unnecessary items should only partly be included to keep the game playable and fun for players. This is for example extra cables in the UV-circuit puzzle.

A task the team was not able to finish was the decoration of the outside of the box to fit the theme of the escape room and the design of Technobothnia. Ideas included vinyl printing the Technobothnia logo or making the suitcase look vintage and worn out.

One important task categorised with the box was the tablet. It was decided that the implementation of the application would be done on a tablet as it is more portable and smaller than a computer, which allows it to be stored with the rest of the escape room components more easily. In addition, it could also allow players to carry it around the Technobothnia facilities while playing, should the game be developed further in that direction. This decision had already been taken before the team started working on the project.

In the search for the optimal tablet for the escape room box, the team needed to determine the necessary requirements for the tablet. It was decided that the most important values needed, were a minimum of 10 in screen diagonal, affordability (maximum 150 €), and wide availability. Processors and other technical values were disregarded, as for the use of this escape room a rudimentary tablet would be fit enough. After scoping the local shops, the team found the Lenovo Tab M7 Gen 3 WiFi for 129 € at Prisma.

Further, the tablet requires no internet connection to play. Due to Technobothnia's connection being highly irregular as many people are using it, this decision was made. Also, as mentioned above, should players ever be moving around the facilities they may inadvertently lose connection and the game may stop working. For all those reasons, the option of using a normal website to host the game was discarded. As in the previous case, this decision was taken before this project team took over.

The biggest hurdle the team faced while creating the app, was that the Technobothnia coordinator Stolpe requested a score list with the times the different player groups took as an add-on to the application. This was difficult to execute without an internet connection. After a meeting with the consultant Jyri Nieminen it was decided to use the cookies of the browser where the game files are opened, since managing files is more complex and would require the game to be an application.

The team together with the consultant Jyri Nieminen further decided to use an Android tablet. It is more customisable than IOS, which is more restrictive with its applications. The team wanted to avoid possible future problems in case the html used as a base had to be moved to an application. Also, IOS tends to have higher prices, which would affect the budget and make replacement more difficult.

The decision between using files or apk had to be made. First, an attempt was made to pass on the files used to display the application on the computer. After trying different file managers, the best approach allowed the application to open as desired (full screen, landscape and without toolbar), but required some configuration each time the tablet was turned on. One positive side was that this option allowed the use of cookies. Secondly, two programs were tested to convert the application from html to apk. The first one, although it met all the requirements, did not work properly with the app's files. The second worked as desired with a simplified version of the application. It is a simplified version because the full size of the escape room application is too large to use the program for free. Using this method, the cookies for the score board add-on do not work. Despite this, the chosen alternative was to create an apk.

The apk offers the best results without needing preparations on the tablet. This makes it easier to use and simplifies the manuals for the players. Moreover, the score board is an addition that, although important, is not a priority to the team. Due to the above, solutions were sought to be able to implement the score board despite the lack of cookies. In the end, the idea was that, in the case of play without internet access, players receive a message indicating that they can take a screenshot of their score. Stolpe, as the future responsible person for the escape room, can review the screenshots on the device and enter the scores into a database manually.

To facilitate this data entry, the team created an accompanying application. There it is possible to view all entries in the database and insert new entries. This can be done in bulk by using commas to concatenate values. Finally, entries can also be deleted in case a mistake is made when entering them.

For the development of the requests to manage the score database, a server of the team's computer consultant Nieminen was going to be used. Due to communication difficulties with the aforementioned, the team decided to implement the requests using a local server for the time being. This means that a future project team or Nieminen will have to modify the application code with the data from the new server.

For the rest of the puzzles, the replication should be relatively easy, as all files have been compiled into one folder and replication instructions have been created. They contain all details one needs for successful building of the puzzles, see Appendix 11.

In the following the individual puzzles are described in their appearing order in the game, starting off with the Technical Drawing puzzle.

5.4 Technical Drawing

This puzzle, among two others, was created by Anders Skjäl, a lecturer in the field Technology and Seafaring at NOVA UAS. Skjäl provided the original technical drawing as well as a first draft for the puzzle paper. The original drawing was created by Tobias Ekfors, another NOVA UAS lecturer and dimensioned for an A3 paper. The puzzle draft included a shape of a dog paw printed over the scale of the drawing, covering it. Further, the removal of the height dimensions by ripping the top left corner of the paper was proposed by Skjäl. Both ideas are shown in Figure 32, the rip indicated stylistically. A possible storyline presented by Skjäl is the following: A welder must build a tank with a volume of 30 l for a customer, but the welder's dog destroyed parts of the technical drawing. The players then have to conclude the scale. Skjäl further proposed to give players a variety of scales to choose from. The correct answer he suggested was a scale of 1:5.

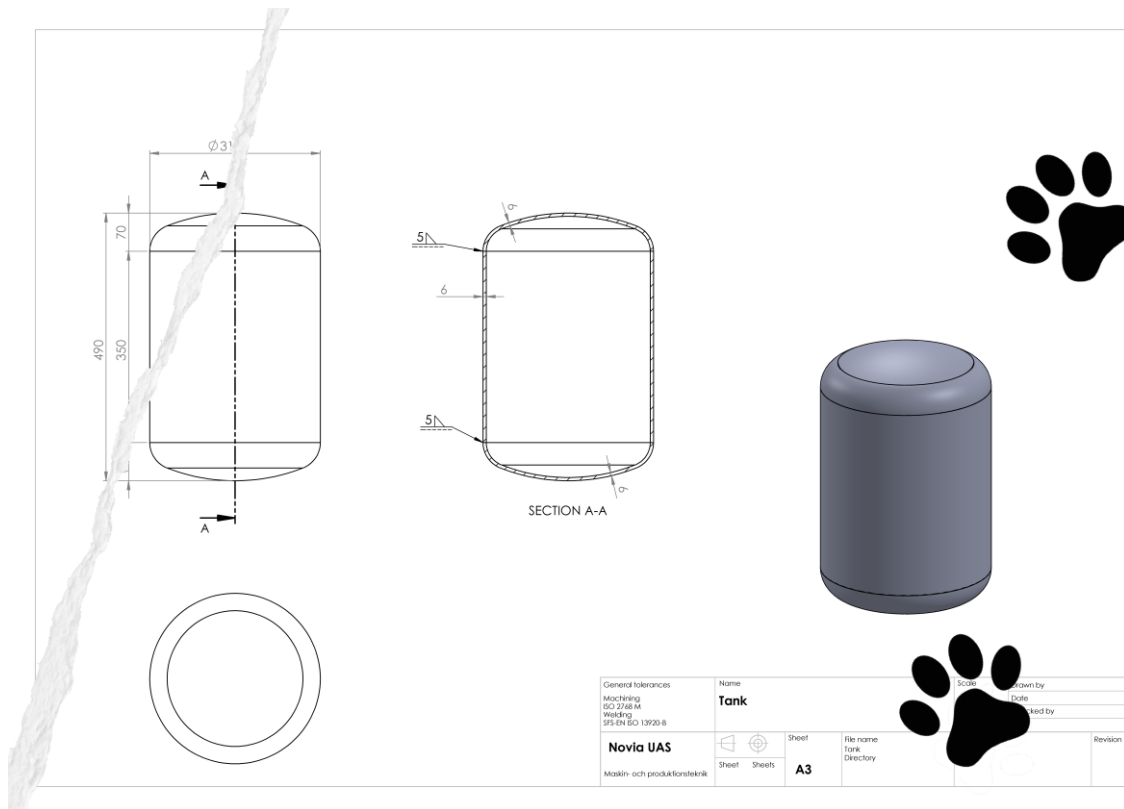


Figure 32 Technical Drawing first draft by Anders Skjäl

The team decided to keep the general puzzle idea unchanged, however alter the design and storyline to fit better with the general story of the escape room game box. The modifications still included the removal of dimensions and the scale but not by the means of a paw print. The story followed then the idea of a student getting the homework to find the scale and them mistreating and ripping the paper. The student already made some marks on the paper, adding formulas they think might be helpful as well as the volume and other dimensions. The players will then find the paper and will have to finish the homework. The latest version is to be seen in Figure 4, not including the rip of the top left corner.

After testing the original puzzle version by Skjäl, the group also decided to blank out some other dimensions users found too confusing as well as changing the solution. As mentioned, proposed was 1:5. Due to inaccuracies in the triangle ruler the players were provided with, they measured a distance of 1 mm for one that was labeled as 6 mm, giving them a scale of 1:6. To give players a fair chance the solution was changed to 1:6.

After these changes, the team finished the puzzle by reprinting the technical drawing on an A3 piece of blank white paper and ripping of the top left corner, so no height dimensions are visible.

5.5 UV-Circuit

The UV-Circuit puzzle idea was created by Sami Korpiniemi, a lecturer from VAMK. He created a model out of cardboard and after a first meeting with the team he updated it to include more difficult connections the players would have to connect. He added a second light switch as well as making the circuit similar to one that can be found in a hallway. One can turn on and off the lights with two distant light switches instead of only one. The model's front- and backside can be seen in Figures 33 and 34.

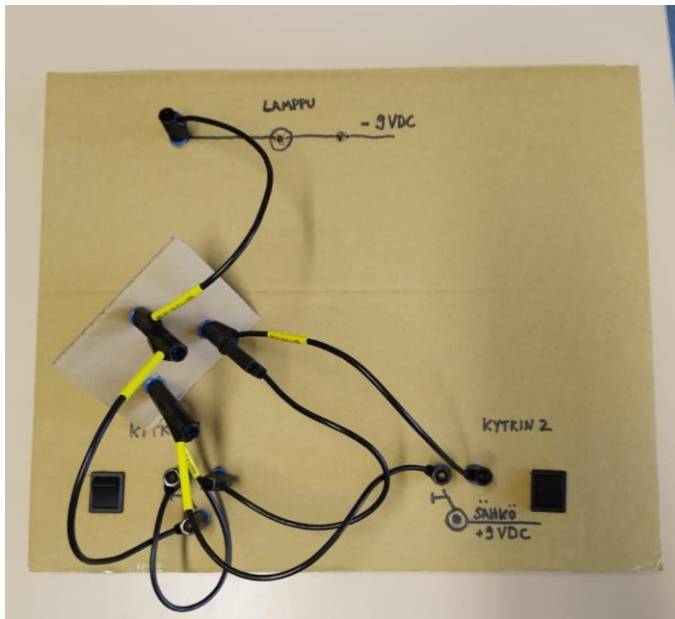


Figure 33 UV-circuit Frontside – First Version

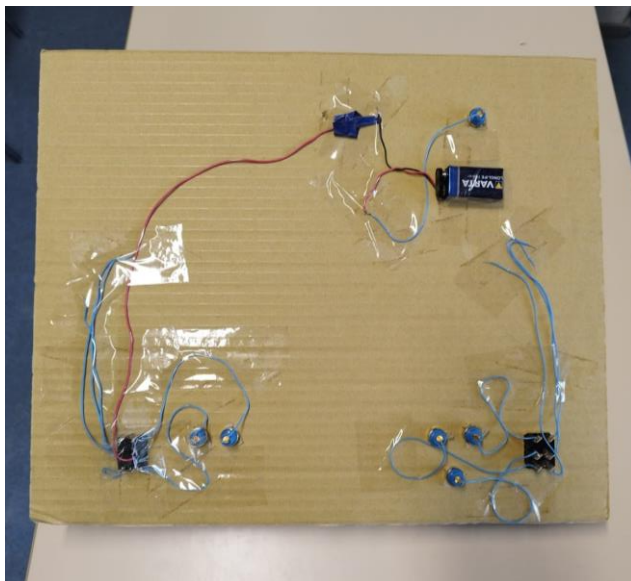


Figure 34 UV-circuit Backside – First Version

The team liked the idea, but after reviewing it found that the players could connect only two ports with each other and turn on the lamp, not using the hallway circuit and therefore making the puzzle fairly simple for them. To combat this the group created an entirely new circuit plan, to be seen in figure 35 and 36. Players will have to connect two cables in the circuit and turn on both light switches. Only if they connect the right ones, they will be able to turn on the correct light. If they connect the circuit wrong, either no light or the wrong included bulb will shine. The correct light mentioned above is a UV light bulb. Will the players not be able to turn the bulb on, they will not see the code written in UV reactive ink.



Figure 35 UV-circuit Box outside – connected



Figure 36 UV-circuit Box inside

The team then acquired all necessary parts such as the UV and LED light bulbs, cables, light switches, and batteries, as well as the box. In the beginning the idea of building a box out of wood was brought up, but due to inexperience of the team with wood laser cutting, the idea was discontinued. Printing the box with additive manufacturing was also not considered as it was thought to be a waste of material and time. Instead, the team opted to buy a simple lunchbox. They are widely available, therefore easily replaceable, and sturdy enough to withstand rough players. For this latter reason, a box without clasp was chosen as well.

After obtaining all parts, some bought and other received for free from Technobothnia (more under 4.4 Budget Management), the box was built. Further, several UV-reactive pens were ordered to assure the workability of at least one. When testing, only one was found to work as intended. The main testing values the team paid attention to, were the visibility under the UV light and non-visibility under sunlight, its ability to stick to the lid of the box while making sure it will not blur. With this pen, the code was added to the box, close to the UV bulb to ensure proper visibility.

To grant the players a hint on how to connect the circuit, a drawing of the circuit was added to the box, as seen in Figure 37. Adding this hint was carefully considered. On one side the players would have to guess the connections and find them by pure luck, on the other, the team thought the game to be solved almost effortlessly with the drawing. After testing and seeing the way players interact with the game and possibilities of connecting they come up with, the team decided to add the drawing in black and white as users were mostly confused by the colours. It was printed on sticker paper and was stuck to the bottom of the box.

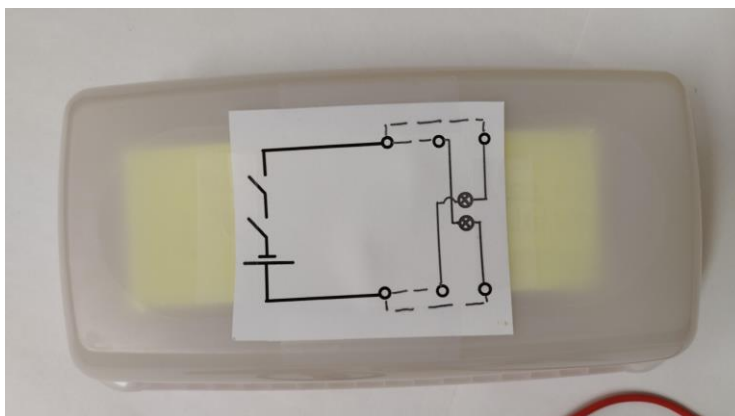


Figure 37 UV-circuit Box underside

Further, there was another sticker added, this time to the insides of the box. While testing, the team found, that the visible metal parts on the inside can get hot. To keep the risk of burns to a minimum and to warn players to caution, the writing is in big, bold letters, as seen in Figure 38.



Figure 38 UV-circuit Box insides with Caution Sticker

The same issue as with the other puzzles, durability, arose in this puzzle. Focus lay on the UV light bulb as these are not as robust as LED ones. (Sood, 2016) It was agreed upon to use the UV light bulb even with the risk of them getting destroyed. Not only would the team have had to come up with a different idea to hide the code but also players would not have had a puzzle experience as compelling.

Another idea that was brought up was also discarded in the name of durability. It was to scale down the circuit to a breadboard and use smaller cables. This would have looked more appealing and would have saved space in the box but would also have been at greater risk of getting destroyed if handled roughly.

5.6 Console

This puzzle was entirely created by this project team, as only the idea was provided by Hans Lindén, a NOVA lecturer. After meeting Lindén the final idea was for users of the escape room box to first complete part of the code for the video game using a story, they can find included in the box, see Figures 39 and 40.



Figure 39 Story for Coding - Page one

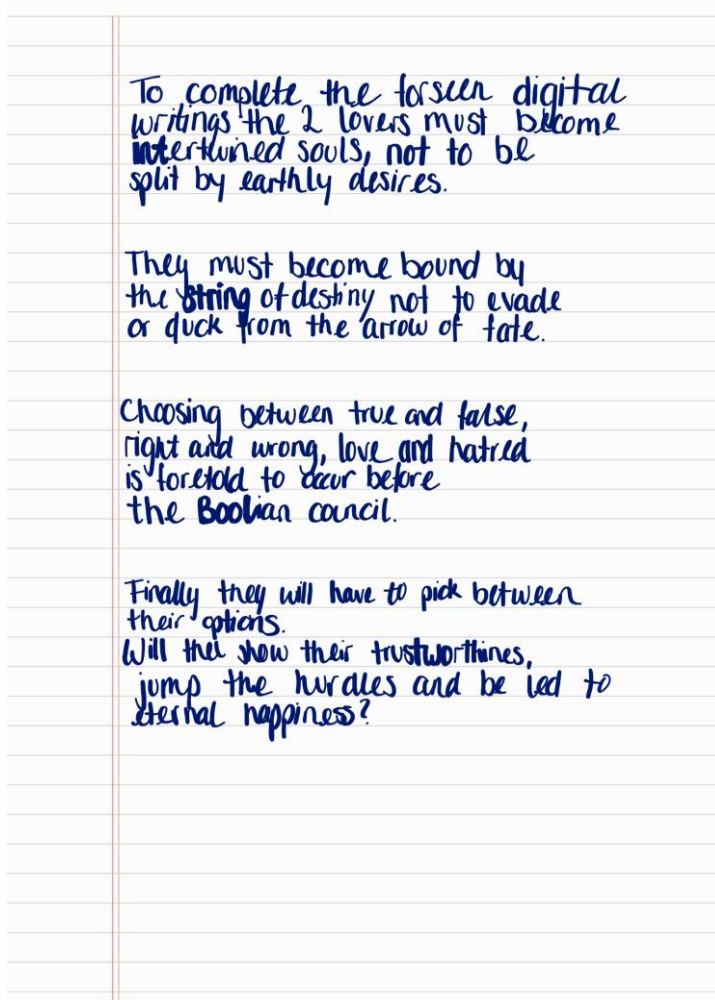


Figure 40 Story for Coding - Page two

Then, the team started the research into consoles. The team's requirements for the console were that it must be easily programmable and uncomplicated to add a customised video game. The console itself must be replaceable in case of malfunction or breakage and it must be as impact and misuse resistant as possible.

Considering the possibilities for coding, the platform and language for programming the videogame had to have enough documentation to allow a quick implementation on the console. It also had to allow changes to be made efficiently throughout the development process. Microsoft MakeCode Arcade was chosen for this purpose. (Microsoft, n.d.)

The first option considered, a case in which the team could insert a Raspberry Pi with the video game file on it, was found. A Raspberry Pi (see Figure 41) is a board that contains all the basic components of a computer: memory card, processor, LAN and WIFI internet connection, USB ports for connecting peripherals, audio and video output and a power input. There are several models but for the console the simplest model, Raspberry Zero, works. It was not only most inexpensive option, but also the smallest to fit inside the case. (Raspberry Pi, n.d.)



Figure 41 Raspberry Pi Zero

It was thought to fit the Raspberry Pi Zero into the Retroflag GPi Case, see Figure 42.



Figure 42 Retroflag GPi Case

This was the team's favorite option, because its design would have fit smoothly in the escape room story and because it has removable batteries. This would have made a soldered connection to the hand-crank possible and therefore would have added another layer of difficulty for users. Due to the complexity of the coding, the team could not get the case to work with the coded game.

As risks like this were expected by the team (see 4.3 Risk Management), two other consoles were ordered. One was the Retro MakeCode Arcade for Education, see Figure 43. It is a complete game console in which the video game (exported from MakeCode Arcade) can be inserted via USB.



Figure 43 Retro MakeCode Arcade for Education

Due to the console being made for children, it is more robust and more easily codable. It is directly linked to a game programming site, ensuring full compatibility. Further, it also needs less modifications to get the console to run, as there is no need to prepare and then insert a Raspberry Pi. (ELECTFREAKS, n.d.)

The last console ordered was the GameGo Handheld Console, see Figure 44. While being the cheapest option out of the three, the team found the console to not be visually appealing. Further, the game was too big and complex for the console. It kept running out of memory and then stopped working.



Figure 44 GameGo Handheld Console

The team decided to use the second option, the Retro MakeCode Arcade for education.

The players find the console ran out of battery. They then must connect it via an USB-cable to a hand-crank, see Figure 6.

The game itself makes players run to find coins. If players kill enemies, more points can be collected. The team also designed an avatar for the game that looks like a scientist in a white laboratory coat.

As described above, users must code the rest of the game using the written story and then play the game. Before testing, they had to reach 100 points while playing the game, which was only reachable if they followed the direction of the arrows added. Many players found that to be difficult, so the needed number of points was lowered to 90. It was not lowered more, as players can find an item in the game that is worth 50 points. The team did not want to make the game too easy for the players.

Once users gain 100 points, the console hands them the code needed to progress to the next puzzle, the Toothed Wheel puzzle.

5.7 Toothed Wheel

The following puzzle was created by Eija Iivari, a lab analyst from VAMK. While awaiting answer from Iivari in mid-September, the team devised some possibilities on puzzle executions. These involved creating visual models (see Figure 45). The overall idea was to provide players with a base board and different sized toothed wheels they must align on the board correctly to find a code. One idea incorporated the individual wheels to be labelled with numbers. Once aligned on the board the code will be visible. Another played with different colours the players would have to align and calculations they would have to do in order to figure out the correct code.

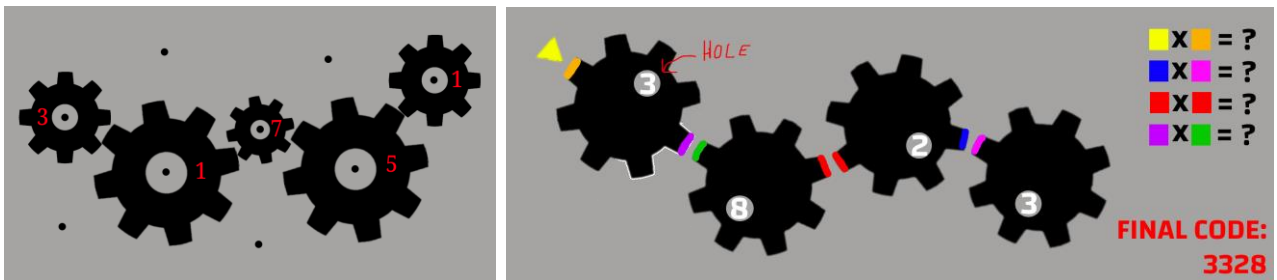


Figure 45 Team's ideas for the Toothed Wheel Puzzle

Upon receiving message and the produced model from livari, the team decided to review all models to find the optimal choice. livari's model consisted of a wooden base with six hooks the wheels can fit on. Two additional hooks were added. Furthermore, she provided models of the toothed wheels in different sizes, colours, and thicknesses. Her model did not include a hidden code though.



Figure 46 Toothed Wheel Puzzle – Version one after livari

After reviewing all model possibilities, the team decided to reach a compromise. The model that would be used going forward was a laser cut, plastic base plate with the exact number of hooks needed, attached. On the base are numbers and letters engraved. Further, the team added wholes and lines to the toothed wheels. If aligned in the correct order and place, the lines connect and the wholes lead to a code on the base plate. Additional ideas such as adding different codes to the wheels themselves were discontinued as to not make the game too difficult for the players, hence why the team also decided to only add few extra wheels in sizes way too big or small to be used on the board.

livari did also provide the team with 3D models of the toothed wheels, however the team could not use them. They were received as 3D-printing stl files that could not be changed. The team then decided to create their own models via creo 7.0. These can then also be converted into stl files for additive manufacturing while retaining the original version for possible later changes. Furthermore, the base was created in creo 7.0. and Gravostyle 7. The latter program file was then used to cut and engrave the base onto an acrylic plastic sheet. Hooks for the wheels to fit on were drawn in creo 7.0, converted into a stl file, and 3D-printed. They were then glued on the base. The team chose this time- and work-intensive method, as it gave the puzzle a shining finish and added value to the product. Further, engraving the numbers assured visibility and readability for the users (see Figure 47).



Figure 47 Visible Numbers on Toothed Wheel Puzzle Base Board

The wheels were printed in different colored PLA on the Ultimaker 3 and Ultimaker S3. The colors were black, grey and silver metallic and simply served design reasons. Further, PLA was used as it is strong, easy to use, and relatively cheap material.



Figure 48 All Toothed Wheels included in Toothed Wheel Puzzle

The idea by Josefin Stolpe to print the toothed wheels via metal additive manufacturing was declined after careful consideration by the team. It generally is more difficult and costly to use metal printing, as well as adding additional weight onto the finished box. The team decided to stick to PLA printing and ensure indestructability by making the wheels thicker and adding more infill into them (40%).

The final version of the Toothed Wheel puzzle (see Figure 7) was not tested in the general testing, as the base board had not been laser cut at that time. In testing the original wooden base was used, see Figure 49.

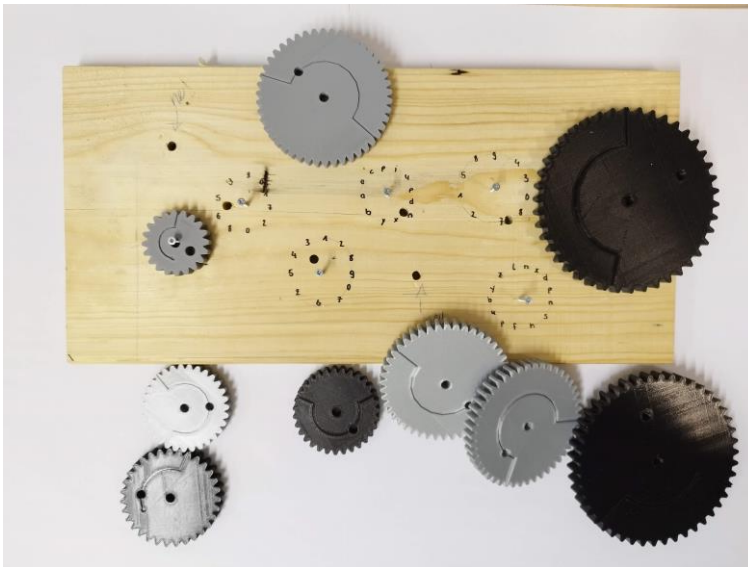


Figure 49 Toothed Wheel Puzzle - Version two

During testing there were no visible problems for the volunteers. Their main source of confusion was, that they did not align the engraved lines on the wheels properly, leading them to the wrong code. The team thereupon updated the descriptive texts and hints to push the players onto the right path.

5.8 Ping Pong

The following puzzle was created, just as the Technical Drawing puzzle, by Anders Skjäl. The team received a base board as well as six Ping Pong balls. The base was originally a glue stick holder he found in Technobothnia. The players have to fit as many balls as possible onto the base plate without touching.

The team liked the idea and continued it by creating a 3D model of the base board for uncomplicated recreation of the puzzle in the future. The base was then remade via additive manufacturing, see Figure 8.

To make the game a little more difficult for players, the team decided to add more Ping Pong balls. In testing it was seen that players were spending more time than expected on this puzzle due to the additional balls. It was the group's call to keep these additional balls, as it also made hiding the code for the robotic arm easier, more under 5.11.

5.9 Cone Puzzle

The last puzzle by Anders Skjäl is the Cone puzzle. Skjäl supplied the team with a model of a cylinder, glued to a cone and a file with possible shapes for the cylinder surface. As the model was broken and in sight of further replication of the game, a 3D model was created, see Figure 50. The team created the real-life model as one 3D model of the cylinder attached to the cone. Two models would have made it more difficult to fit the parts together properly and would have created more work for the project team, as gluing would have had to be done. This would also have made the model less durable.

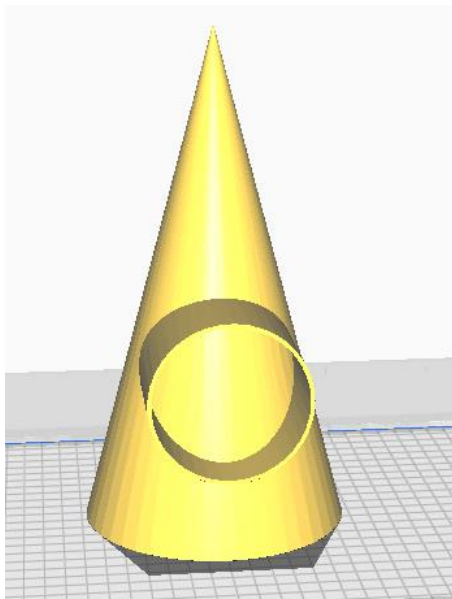


Figure 50 3D-model of Cone

The 3D model was then brought to life via additive manufacturing, see Figure 9. The original plan of using a 3D-printer with a robotic arm to avoid supporting structures had to be discontinued as the team could not get in contact with the responsible person for these types of printers at Technobothnia. Instead, the cone was printed with a regular 3D printer and the leftovers of the supporting structures sanded down.

After the model was recreated, the surface shapes file was adjusted, as it was not possible to get exact measurements off the original model. The file was then reprinted.

During testing, the team found that the players had little to no difficulties finding the correct shape from the papers. The problem they faced was the correct way of typing the code into the app. The cone shapes were numbered with brackets, for example (1). To present players a hint without giving away the code too easily, the team decided to update the numbering to include different symbols, such as #0# or =1=, see Appendix 12.

5.10 Invisible Ink

Another puzzle concerning invisibility is the Invisible Ink puzzle. This puzzle was created in parts by Eija Iivari. The team received all necessary parts such as the Phenolphthalein 1% (Invisible Ink) or the Sodium carbonate (Solution) from Iivari. For the puzzle, the group tested the functionality of the supplies and the chemical components, as well as starting testing rounds to ensure longevity of the invisible ink. The ink was tested after one week, 2 weeks, 1 month, 1,5 months and 2 months and kept on being visible.

In the box, several papers are added, as well as the book 'MAOL-taulukot'. The team's supervisor Stolpe got the team a copy to include in the box. To the book, notes were added that can help players figure out the amounts needed for the solution they must mix. The simpler way for the players to figure out the correct mixtures is by looking at the included spoon and flask. On there the correct measurements are marked. In testing, the team found that some teams were rather nervous of mixing the substances, others were the complete opposite, mixing without measurements. This was also partly due to the papers added in the box.

The added papers include a code in the three languages Finnish, Swedish, and English as well as possible keys for the code. Further, many additional papers that are not necessary for the game were added, such as translations for chemistry-related words. During testing, users exclaimed that these papers were considerably confusing, leading groups to not do the puzzle as planned, described above. The team decided then to scale down the number of papers provided with the game. All added papers can be found in Appendix 13.

Next to the papers, players get the mentioned ingredients for the mixture. The difficulty here is, that the powder is trapped in a maze box that players must open first. Also, the water needed is not included directly with the game but is added to the backpack. In testing, players were able to quickly conduct that they must need the water, so no additional hints were necessary.

In the beginning, it was planned to have several maze boxes included in the game. This idea was discontinued, as it would not have added more value or learning effect to the game and would have rather discouraged players. The team decided to include two maze boxes, one for the Sodium carbonate and one for the robotic arm clue, more under 5.11.

The spray bottle in Figure 10 was labeled with a code that helps calculate the volumes for the solution mixture. Further, an attention label was added. The same was added to the bottle in the maze box. On this bottle, a note to not digest the contents was added after testing. Testing also revealed that players need a utensil to stir the mixture. Therefore, a pipette was added to the puzzle.

5.11 Robotic Arm

In the beginning, the group experienced communication problems with the creator of this puzzle, Mika Billing, a lecturer from VAMK. This led to receiving the needed 3D model of the robotic arm late in the project and made the team decide to push back the puzzle to mid-November. After receiving the models, they had to be adjusted for the escape room purposes. This meant adding the symbols for the hidden codes, more on that later. Originally, the team wanted to provide the users with the separate parts so that they have to build the arm themselves. This would have meant to also change the length of one of the arms to make the correct assembly unmistakable. Not only to save the players some time, but also to not have to change the models, the team decided to provide the players with the ready-built robotic arm. To add another layer to the design of the arm, the name Technobothnia was added to one of the arms.

Players will get the arm from a safe box, see Figure 51. The code for the box, they will get provided from the app, when they have progressed in the app far enough.



Figure 51 Safe Box for Robotic Arm

The added symbols are as follows:

On the base of the arm the numbers 101100 are engraved. These lead the player to console game. In this game, a second paper is included. The paper, see Figure 50, is a game cheat code and, if performed in the game, will display a screen with the code. The code, as with all codes for the robotic arm puzzle, is the value for the scales on the arm. In testing, it was visible that some of the wording of the paper confused the players, so it was changed slightly.

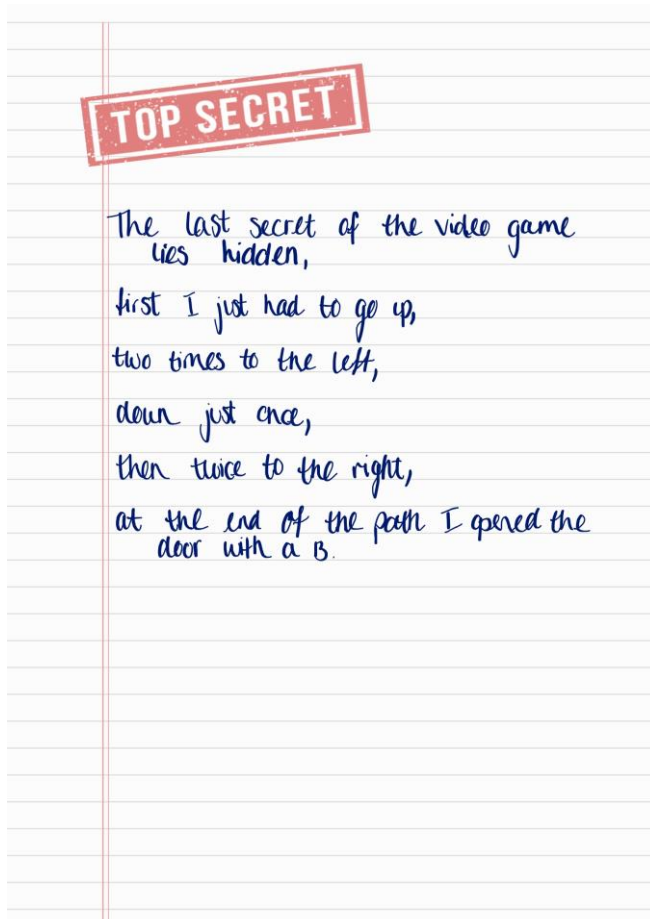


Figure 52 Cheat Code Paper from Console Puzzle

The next part of the robotic arm leads players to the Ping Pong puzzle, where they find the scale value on one of the balls.



Figure 53 Hidden Code in Ping Pong Puzzle

On the first long arm part, one can find a lightning bolt. The same symbol can be seen in the lid of the UV-circuit puzzle, see Figure 36.

The second long arm is connected to the toothed wheel puzzle and the code is visible on the underside of the baseboard.



Figure 54 Hidden Code on Toothed Wheel Puzzle Base

The last hidden code is in the invisible ink puzzle in the little maze box. When players spray the mixed solution on the little paper from the box, the code will appear.



Figure 55 Hidden Code in Invisible Ink Puzzle

As this code is more difficult to find, compared to the others, it was added to the scale that does not necessarily have to be adjusted to find the answer.

The arms then were created via additive manufacturing. The arms were printed in metallic silver, the base in black and the pen holder in gold. The players must find the printed golden pen in the pencil case and screw it into the pen holder.



Figure 56 Finished Robotic Arm and Pen

To find the last code, the users must adjust the arms according to the codes they found in the other puzzles and fit the arm correctly onto a base board. It was thought to create the base out of wood but to make the puzzle look cleaner and more finished, the base was laser cut into an acrylic plastic sheet. To allow players a hint on how to fit the arm onto the base board, a moon symbol was added to the base plate, see Figure 57, and to the base part of the arm.

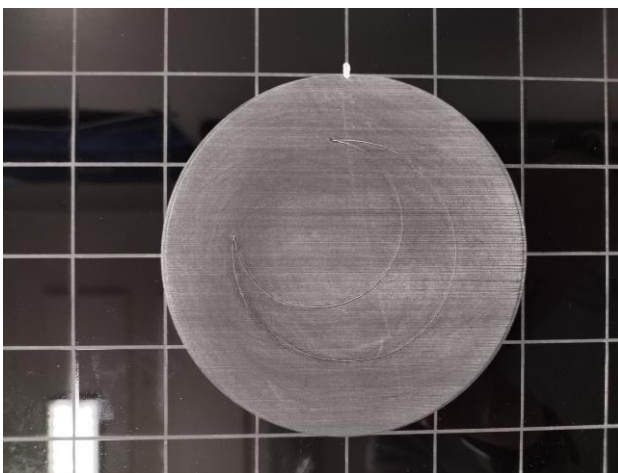


Figure 57 Moon Symbol on Base Plate

6 Conclusion

This paper focused on the execution of the Technobothnia Escape Room Box while integrating feedback from testing rounds. Reflecting upon that, the team is confident to have delivered solid results. The box was finished, with all parts of the box completed, and testing rounds started.

Possible ways of continuation for the project are to go more in depth with testing and focus more on possibilities to reduce the playing time. Further, different versions of the escape room could be produced, that focus on varying user groups and ages. There could be a version for engineering students, different school children age groups, and a shorter version for business collaborators of Technobothnia. Also, the puzzles, for example the secret codes for the Invisible Ink puzzle, and the app must be translated into Finnish and Swedish to open up the range of users to the broader mass.

The puzzles themselves could also be continued. The console game, for example, could have a better visual finish. A future team could stop using public access sprites, and instead work with personal sprites that give the puzzle more cohesion with the rest of the game and relation to Technobothnia. Another game that could be updated and rethought is the robotic arm. Although its base board is functional, it presented some problems with the placement of the arm not being accurate. To combat this, grooves could be added to the board so that the base fits perfectly and the moon could be laser cut out of the board to make looking through possible, and therefore more exact placement on the board.

Finally, some aspects of the webapp could also be upgraded. Apart from the implementation of a dedicated server already mentioned above, sounds and animations could be implemented in the application to improve the immersion and experience of its players.

7 Resources

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Appendix

Appendix 1 Protocol Layout

Protocol

Protocol for the Technobothnia Escape Room Box

Date:

Present:

- Kiki
- Albert
- Leah
- Josephine

Recorder: Leah Ebert

Mentor: Josephine Stolpe

Talking Points:

Contents

1. Escape Room Story.....	1
2. Programming Video Game	1
3. Robotic Arm.....	1
4. Console	2
5. UV switchboard	2
6. Invisible Ink.....	2
7. PingPong.....	2
8. Geometry.....	2
9. Technical Drawing.....	2
10. Toothed Wheel	2
11. Working Hours.....	2
12. Extras	2

1. Escape Room Story	To Do	

2. Programming Video Game	To Do	Responsibility

3. Robotic Arm	To Do	Responsibility

4. Console	To Do	Responsibility
5. UV switchboard	To Do	Responsibility
6. Invisible Ink	To Do	Responsibility
7. PingPong	To Do	Responsibility
8. Geometry	To Do	Responsibility
9. Technical Drawing	To Do	Responsibility
10. Toothed Wheel	To Do	Responsibility
11. Working Hours	To Do	Responsibility
12. Extras	To Do	Responsibility

Next Meeting:

Appendix 2 Page 2 Budget

amazon.de
03.10.2022

Rechnung

NOVIA UNIVERSITY OF APPLIED SCIENCES, HANS LINDEN WOLFFSTRASSE 33 VAASA, 65200 FI		Bezahlte Zahlungsreferenznummer 26162Kmk622V247591E Verkauf von abgrenzungslos abgrenzungslos abgrenzungslos USt-IDNr. DE33065132 Rechnungsdatum: 05. Oktober 2022 Rechnungsnummer: INV-DE-1294565475-2022-18 Zahlungsbetrag: 73,94 €			
Um unseren Kundenservice zu kontaktieren, besuchen Sie www.amazon.de/contact-us					
Kundenadresse Nova University of Applied Sciences Wulffstrasse 33 Vaasa, 65200 FI USt-IDNr. FI20599102	Lieferadresse Nova University of Applied Sciences, Hans Linden Wulffstrasse 33 Vaasa, 65200 FI	Verkauf von abgrenzungslos abgrenzungslos abgrenzungslos Shen Zhen Shi Luo Hu Qu Yong Xin Jie Ba Da Sheng Chang Fu 1-87, 1-81 Hao Shenzhen, Guangdong, 518001 CN USt-IDNr. DE33065132			
Bestellinformationen Bestelldatum: 03. Oktober 2022 Bestellnummer: 202.4198508-2511552 Auftraggeber: Hans Linden					
Rechnungsdetails					
Bezeichnung	Menge	Stückpreis (ohne USt.)	USt. %	Stückpreis (inkl. USt.)	Zwischensumme (inkl. USt.)
RETROFLAG GP Case für Raspberry Pi Zero / Zero W und Raspberry Pi Zero 2 W mit Raspberry Pi-KB-Körper, SD-Kartenleser, 32 GB SD-Karte Retro Gaming Handsystem ASIN: B08N6G55K4	1	73,94 €	0% (1)	73,94 €	73,94 €
Versandkosten		4,75 €		4,75 €	4,75 €
Aktionsrabatt		-4,75 €		-4,75 €	-4,75 €
Gesamtpreis					73,94 €

Rechnung

Rechnungsnummer INV-DE-1294565475-2022-18

USt. %	Zwischensumme (ohne USt.)	USt.
0%	73,94 €	0,00 €
USt. Gesamt	73,94 €	0,00 €

(1) Steuerfrei - Intragemeinschaftliche Lieferung - Artikel 138 Richtlinie 2006/112/EC

RobotShop
07.10.2022



Order #1300047879

Order Date: October 7, 2022

Shipping Address

Hans Linden
Nova University of Applied Sciences
Wulffstrasse 33
Vaasa, Pajumies, 65200
Finland
T: +358305954266
VAT: FI20599102

Billing Address

Hans Linden
Nova University of Applied Sciences
Wulffstrasse 33
Vaasa, Pajumies, 65200
Finland
T: +358305954266
VAT: FI20599102

Shipping Method

- Standard

Payment Method

Credit Card

Credit Card #: 4270
Card Type: Mastercard

Items Ordered

Product Name	SKU	Status	Price	Qty	Subtotal
--------------	-----	--------	-------	-----	----------

Subtotal					€108.97
Shipping cost					€17.61
Grand Total (Excl.Tax)					€126.58
Grand Total (incl.Tax)					€126.58

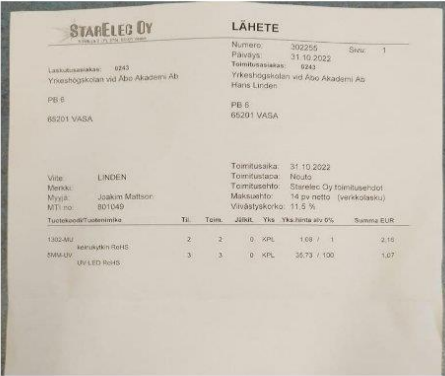
Product Name	SKU	Status	Price	Qty	Subtotal
Retro Arcade for Education	RB-EP-373	out of stock	Excl. Tax: €66.22	Ordered: 1	Excl. Tax: €66.22
			Incl. Tax: €66.22		Incl. Tax (0%): €66.22
GameGo Handheld Console	RB-See-869	out of stock	Excl. Tax: €42.75	Ordered: 1	Excl. Tax: €42.75
			Incl. Tax: €42.75		Incl. Tax (0%): €42.75
Subtotal					€108.97
Shipping cost					€17.61
Grand Total (Excl.Tax)					€126.58
Grand Total (incl.Tax)					€126.58

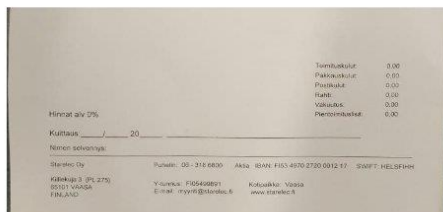
Minimani
19.10.2022

08.11.2022



Starelec
31.10.2022





kivenalla.fi/
09.11.2022

Kiven alla Oy
Patotie 2
01600 Vantaa
Puhelin: 0503225520
info@kivenalla.fi






2151496-7
ALV:tunnus: FI-21514967

Laskutusosoite
 Novia University of Applied Sciences
 Hans Linden
 Wolffintie 33
 65200 Vaasa

Lisätiedot
Puhelin: 0505954366
Sähköpostiosoite: hans.linden@novia.fi

Vahvistus	
Tilausnumerosi on: 14144	Asiakasnumero: 9353
	Tilauspäivä: 9.11.2022

Maara	Nimi		Hinta	Alennus	Vht.
1 kpl	Edding 8280 UV -tuusti  Tuotenro: 1770		5,90 €		5,90 €
1 kpl	 Artline Supreme UV -huopapöytä Tuotenro: 3261-0001 (Var: Sininen)		1,90 €		1,90 €
1 kpl	 Artline Supreme UV -huopapöytä Tuotenro: 3261-0002 (Var: Pääkö)		1,90 €		1,90 €
1 kpl	 Artline Supreme UV -huopapöytä Tuotenro: 3261-0003 (Var: Vihreä)		1,90 €		1,90 €
Valiösumma					11,60 €
Toimitustapa		Posti Pakkupaketti			4,99 €
		Ilmainen toimitus vähintään 150 € tilauksiin.			
Maksutapa		Paytrail - Verkkopankit, luottokortti			
Veroluue		EU maa			
Yhteensä (ilman ALV:ä):					13,38 €
ALV 24 %:					3,21 €
Yhteensä					16,59 €

Ystävällisin terveisin
Kiven alla Oy

Amazon.de
23.11.2022

amazon.de

Details for Order #302-3281005-1053142
Print this page for your records.

Order Placed: 23 November 2022
order number: 302-3281005-1053142
Order Total: EUR 149,24

Not Yet Dispatched

Items Ordered	Price
1 of: GeekPi GPIO Screw Terminal Hat, Raspberry Pi GPIO Extension Board for Raspberry Pi 4B/3B+/3B/2B/B+/Zero (Zero W) Sold by: GeekPi-DE (seller profile) Business Price	EUR 20,91
Condition: New	
1 of: Expansion Breakout Board for Raspberry Pi - GPIO Terminal Adapter Expansion Card Module, Micro Connector for Raspberry Pi 4B/3B+/3B/2B Sold by: Cyhx2020 (seller profile)	EUR 15,87
Condition: New	
10 of: WINGONEER® RPi GPIO Breakout Expansion Board + Ribbon Cable for Raspberry Pi 3 2 Sold by: DollaTek (seller profile) Business Price	EUR 5,87
Condition: New	
4 of: DARENYI 30 x 30 cm Acrylic Panes Black Acrylic Glass 3 mm Acrylic Panels Plexiglass Plexi Sheets Plastic Panel for Crafts Painting etc Sold by: DARENYI (seller profile) Business Price	EUR 13,44
Condition: New	

Shipping Address:

Nova University of Applied Sciences, Hans Linden
Wolffintie 33
Vaasa, 65200
Finland

Shipping Speed:

Standard Shipping

Payment information

Payment Method:	Item(s) Subtotal: EUR 149,24
MasterCard/EuroCard Last digits: 4270	Postage & Packing: EUR 12,02
Invoice Address:	
Nova University of Applied Sciences, Hans Linden	Total Before VAT: EUR 161,26
Wolffintie 33	VAT: EUR 0,00
Vaasa, 65200	
Finland	Total: EUR 161,26
	Promotion Applied: -EUR 12,02
	Grand Total: EUR 149,24

To view the status of your order, return to [Order Summary](#).

Please note: this is not a VAT invoice.

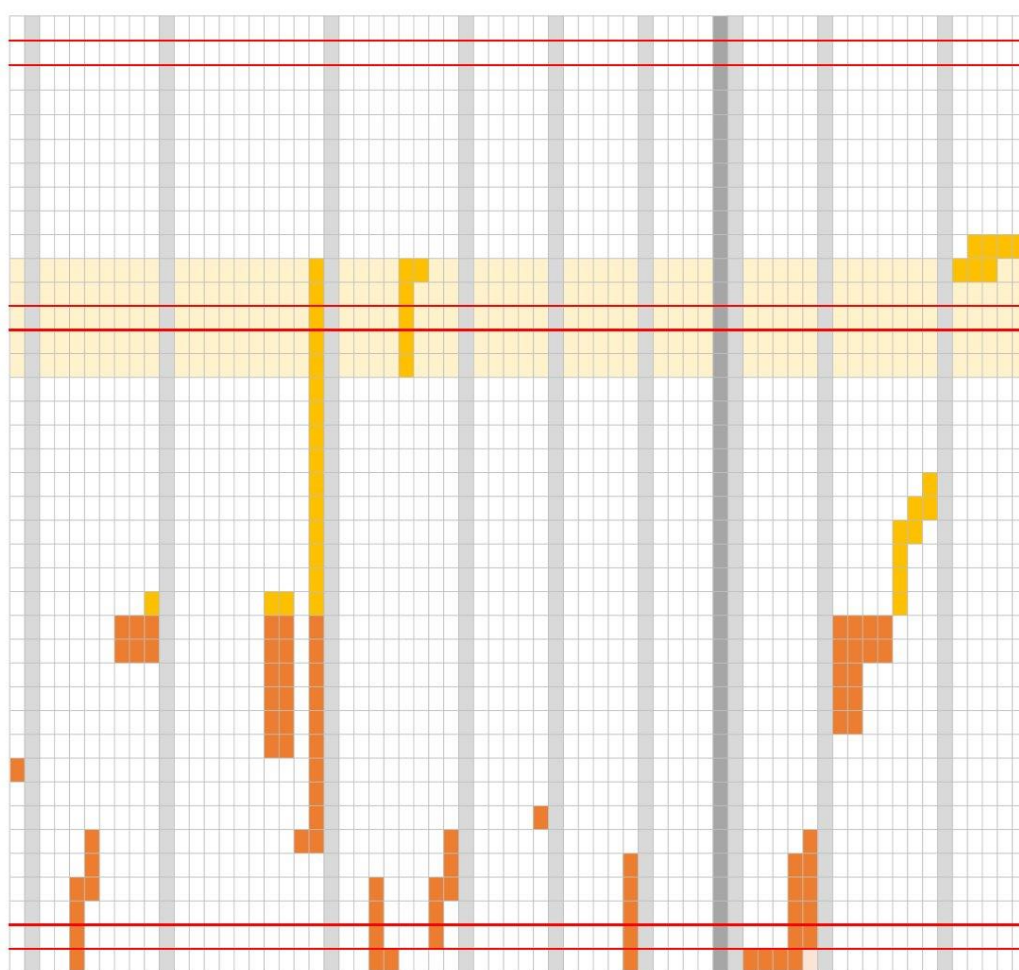
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K-citymarket
12.12.2022

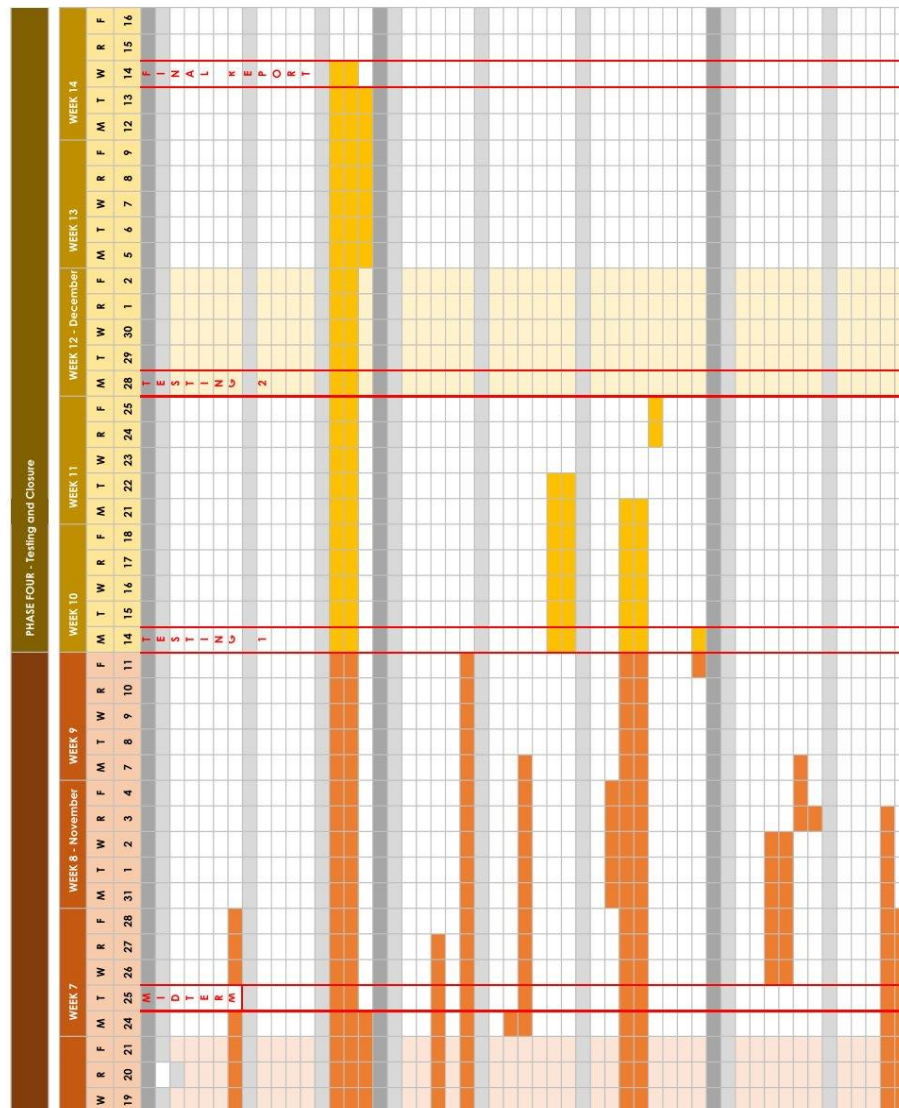


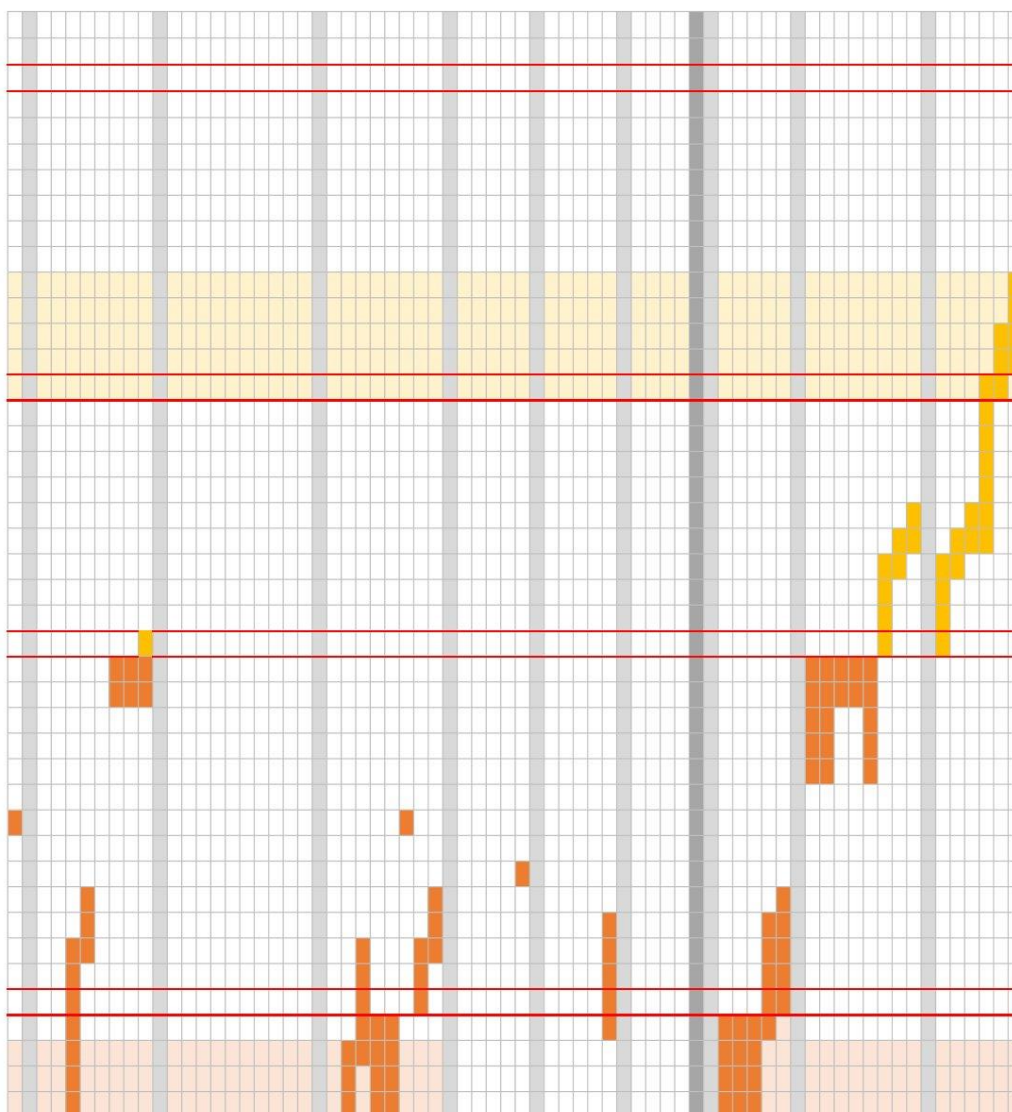


Appendix 3 Gantt-Chart new



Appendix 4 Gantt-Chart old






Appendix 5 Testing Notes

Testing Group 1

1: 20 W 2: 22 A	Ed. Majas, Abo	3: 22 C 4:	Start 10:05
General	1 what to destroy what not ! black mode stops time turn off screen savers		
	2		
	3		
	4		
Game 1 TD	go to book & first aid → calculate formula confuses a lot → "no calculator" → doesn't make sense to use formula used hint 1 after 8 min see backside & tried to see through → "b or b" 3 → print clearer "maybe it's just b?" 3		
2nd hint used	13 min: started comparing heights 3: b:1 (14:33) confused by bottom left "u2" → started calculating random stuff 18 min		
	hint by me ignore bottom left 20 min "1 mag nimmer" 3 21 min → 22 min		

10:28 hr

Game 2	used all cables randomly circuit confused but worked with it started off new (4 min)
1st hint	2 looked in book \rightarrow rope (maybe 15s) "what do the parts of drawing mean?" "why is it not whole line?" "what does it mean" 3 close but wrong direction \rightarrow inst. 6
7 min	: opened box but still looked at drawing instead of connections
18-9 min	used 37  & PD 0622 from battery 37 in book / burned herself 11 min \rightarrow disclaimer in box
hint 1	: it's a VV lamp + close circuit
"gV"	\rightarrow "g- 37" (16 min) 2 "for engine?" 3
19 min	: that 1 used looked at backside

	<p>up send hint 2/1 min</p>
	<p>redraw print : sides switched</p>
10:52hr	<p>connected & started cranking (40s)</p>
console	<p>started playing + add you can use papers</p>
	<p>started with cheat code</p>
	<p>3 min : used int etc</p>
	<p>but they kept running it → solved</p>
10:30min	<p>but they understood what to do</p>
	<p>played 2/3 times ✓</p>
11:02hr	
TLW	<p>started assembling quick</p>
	<p>2: 'you can see numbers' (1min)</p>
	<p>1: 30 min had the wheels in</p>
	<p>3 min had it basically done</p>
	<p>3:30 started reading code → mislead</p>
	<p>6 min : wheels in wrong order</p>
	<p>97e54 at 8:47min</p>
	<p>↳ they had it earlier</p>

they want to turn it

11 min
needed

10 min

59 7 e 50 make correct code

m: 15hr

Ping Pong

found a number on ball but on no other ball "0-22" tried code 1min

2 tried fitting them on

1:50: "it's 6 that's it" 2

"0-22 and then +6" 3 min: "6" 1

m: 18hr

one

you can use papers

change text : yellow

1 min 30 : "5"

"with brackets" 2 (2min)

change (6) to (5)

11:23

11:23

started opening boxes

"that's so cool" 2 about box

started decoding bottle + text

2 min : ^{team work} open grey box

4:30 disappointed about small box

6 min 2 m r l / l tried us code from bottle

sort papers & put code paper on top

H 319 looked for in papers

used no papers in EN as hint

"sell das so?"

10 min found spoon

change r to o on bottle

"30 is argmax" 12

4 b lpl fand

g/ mol bringt nix

is das net backpulver

→ don't eat ingredients

13 einfach mischen

rest zum verkurven

haven't used the book

16 min : started mixing it
→ something to stir

check code because
lines were mixed up

mixing 10 min

Now will they get into state?

didn't mix properly (22:30)

23 min : got another paper for

little box

sprayed in area - 45

24 min

27 min : tried to spray on cable

M: Silver paper

found everything quickly

5 min : started console

moon on moon

6 min : play again ? → no

labyrinth confuses them

→ change

"10/100 could be word"

put in wrong pencil, found screwdriver

11 min : looked in pencil case

but didn't find pencil

want to use hint 10:11:00 on paper

Hint 16 min : you need to
use code paper 10:11:00 in console
don't focus on labyrinth

20 min .. found code

use different pen

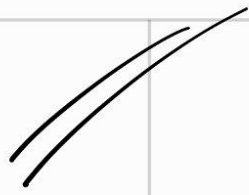
I did not put base on correctly

NS13 → X/Y

base should sit in base board
→ too hard

12:18

26 min found



1st puzzle incredibly
hard

to get into the thinking

in beginning every thing is
important

length or height or scale

too ^{bulbs} confuse them

loved puzzle ideas

abwechslungsreich

have almost never played
1756. Rooms

9/10th grade can work

2: console loved

something for everyone → strengths

combination was good

1: console @

change TD puzzle

12:45

General

3 : 70 adult teacher, package
 2 23 spread needs
 1 22 education

12:53

Game 1

Search for height → instructions not
 read properly
 2min using formula

3min : using book

started measuring bottle

try many codes from beginning on

F: 30 = i it's like 6min so 6:1³

11min : 2nd Hint

13 min wrote formulae as code

distance

change so they can go back to the mints without waiting

"distance on paper : distance in real life" as rate

10 min = "30L"

stem hopeless

→ hopeless : just staring at papers

20:30 → used solution

x : y on scale paper

0 alt
1 on

13:16hr wildly connecting, did not look at picture on bottom

2:30_{min} tried 37 & code on battery

4 min tried connecting the cables
tried to cd ar - code cables

7:30 we 1st hint (it's w lamp)

10 min : start again : unplug everything

looking through book

12 min you have to close circuit

14 min : 2nd row change "black box" → 1 circle

16:30 restart

"here we have 2" 3

18 on right track

→ keep stacking up the cables

disclaimers for first aid kit

27 min Stressed, downer

make dVLS more clear

26 min : started

27 min found code

//
13:49
found

start off with secret code
as well → 313 found

5:30 start programming

reloaded it → instructions

8 min start playing

tried coding 2 times

14 min tried playing 3 times

100 points hard to read

→ assuming that it can stop/slow down
a little bit it stops

20 min found code

14:11

TW

started off right away
but did not pay attention to connecting
lines

"and then what"? (3min)

align perfectly

5min 5374 4

look for mistakes in model base 3
→ wheels too close

8min

53725v

PERFECTLY

10min

59725v

//

30s:

M:ZL

"code with bc number" 3

Finglong

2:20 code on Dall tried

b: 2:50
by 2

14:25

and

1:30 i'd say this one 3
put in 85

maybe 2 shapes? $\frac{4}{3}$ 2:45

0 & 1 ?

5 min tried random codes
CAD etc

7 min ^{point 1 &} started cutting/ripping

8 min: 5 it is but doesn't
work in app \rightarrow ?

maybe not just number 10 min

11:30 put it in

//
14:37

started looking at papers
no attention to bag 1 min
used book

framework: 1 decodes
the other words with book

& other coils through papers

hint 1: 11:30 min

using unmarked pages in book

13:30 using right page

using page 3 → 60

17 min: using sodium carbonate 101 mass
as solution

Na_2CO_3

18 min: "don't have to do calculus"
wanted to use

20 min } code 2 but had to wait

H3/18 land on bottle

21 min used hint 2

26 min

no clue how code could work out

29 min water to 30

32 min 1 spoon in & mixed it in

33 min 3 spoons

helping: spoons on spoon

40 min with a lot of help
they found it

15:19 "you need pencil case"

why do we need this Can have
2:44 moon sand

8 min looking through the old puzzles

11:30 i wanted to put pen in

16 min start playing cards

20 min done



exhausted
happy it was over

most difficult last one all

puzzles should be more easy²
gradually more difficult?

too much work for nothing

room change

invi in 2: leave out papers

something to hold crank
down

TD feels impossible

groot

drawing confused work

cables more yes₃ → nice

Tw

grey & black

Ping Pong Fun → lucky₃
gives push

one change / 5 / as / 5
() & invisible

Rebo Arun 3: fun

make individual puzzles
shorter

Zusammenhanglose Spiele

how should the code
don't like ping pong game

} already
knew
puzzles

For instruction → check

play symbol oder play button

16:33

take ruler 315 1min

^{bmm} weg → welche Ansicht ist das

16:37

started by opening it

did not see drawing

know LED only has 1 direction

1:50 on → find code

checked why red is there
connected rail as well

→ no use → why these?
 for confusion 3

hp 7 w3

why code 37

not reload → back button

3min

16:43

started by reading papers

① connect at same time

→ overpriced listeners

saw int string bool & 2

handwriting

1 min start coding

4:40min play finished, code found

H420 ?

16:51

strategical → first see that
lines connect, found start

did next start by putting on
base

put down both starting points

sort by how big

what are doors for? 1

try out all wheels after another
to see which ones connect

2:20 done 197e5u ✓

16:55

Bing Beng

1:20 b wird ^{mit} Lösung sein
zu leicht

tricked game → fit 8 3:30min

Start w. corner 1 3:40min

5min - just try it

17:01

cond

b's and 405

ruled out b

"5 not nice enough" 3 1:30

(4) wrong

it's 5 → 2min

"did we read wrong" 1

2:30 brackets add

17:05

start by teamaching

2 open boxes / 1 translates

"name a code" ^{on} sodium c 405

1:50 found both & have water

3 min : let's just mix it somehow
1 AC how

5:20 min found 2 mol/L & translated

schmeiß mich 2 schaukeln down
rdn

6:6 min if there is 6 kpl on
the spoon let's do this

→ but on 1 ml? → NO

found code in box → already

know what happened

"below"

"missing scale → can't calculate"

9:50 → 6 spoons

random amount of
water just because

12 min found code

17:20

start by going back & look for codes

11:40 look for pen

Around 2:30 10 11 00

3 min start playing console

7 min still playing

what if we are on the wrong path? - 2

look for door 8:10 min

"with a B" 9:30

13:45 min giving up on console

15 min sprang the Top Secret with inv-link

Q put the light from UV on
 hand tooth wheel & Invi ink
 what was circle → "one" ^{backside}

check backpack & book 18:30 min

19:30 min "with a B", started reading right

21:30 circle still missing

→ has yo for Ping Pong "22"
 Number on bag "22"

tried pens & pencil 23 min

"is there a sharp pen?" 24:30 min
 sharpen one?

21:50 : "27"

27 min done

17:47

Appendix 6 Working Times

Ebert

Date	Start	Finish	Time	Things Done
12.09.2022	09:30	17:45	08:15	Meeting with Josefin @9:30, create "GENERAL INFO", translate meeting notes, create Meeting Questions
13.09.2022	09:30	14:00	04:30	Create Team Calendar, Write Mails to contact persons, get overlook on projects, things we already have etc.
14.09.2022	12:15	17:15	05:00	Prepare for meetings, Meeting Hans, Team Meeting, Create Layout and Team Workspace on Teams
15.09.2022	10:00	11:30	01:30	Research Gameboy
	12:15	17:30	05:15	Research Gameboy, Create List of Materials for Console Puzzle
16.09.2022	13:30	17:30	04:00	Meeting Jyni for Program, Looking into 3D tools, research Gameboy
17.09.2022	10:30	14:15	03:45	Research Gameboy
18.09.2022	18:30	19:30	01:00	Research Gameboy, how to connect hand crank
19.09.2022	09:30	11:00	01:30	Meeting with Josefin
	12:00	15:30	03:30	Create Protocol, Timeline for Project, update Jobs for team on Teams
20.09.2022	15:30	19:00	03:30	get 3D program, start on model, research UV Pen and Lamp
21.09.2022	12:30	15:00	02:30	create timeline, meet Sami and Elja
22.09.2022	09:30	11:30	02:00	Code Ideas for puzzles, Shopping List
	12:00	15:30	03:30	Ideas for switchboard, case etc.
23.09.2022	09:00	11:30	02:30	Write Protocol,
	12:30	16:00	03:30	Project Management Class
24.09.2022			00:00	
25.09.2022	14:00	20:30	06:30	Group Meeting, Create Time Planner
26.09.2022	10:00	11:30	01:30	Meeting Josefin, Talk with group about plan and work for the week
27.09.2022	10:00	11:30	01:30	Start Gant Chart
	12:00	16:30	04:30	Gant Chart, WBS, start 3D print for PingPong game with Kik
28.09.2022	12:30	16:30	04:00	Gantt Chart and WBS
29.09.2022	10:00	16:00	06:00	Project Management Class, Swedish Class
30.09.2022			00:00	
01.10.2022	19:00	19:15	00:15	Finish Protocol and send off
02.10.2022			00:00	
03.10.2022			00:00	
04.10.2022	10:00	14:00	04:00	English Class, Meeting Josefin
05.10.2022	09:00	14:00	05:00	Project Management Class, Guest Lecture
	19:45	21:00	01:15	Write Mails, Organize
06.10.2022			00:00	
07.10.2022	13:00	17:30	04:30	Prisma for Tablet, English Homework, Swedish Class
08.10.2022	08:30	11:30	03:00	Update Protocol, Email Hanna, Swedish Homework, 3D cone work, PM outline report
	12:30	18:00	05:30	Update Protocol, Email Hanna, Swedish Homework, 3D cone work, PM outline report
09.10.2022	09:00	14:00	05:00	und 15 -17
10.10.2022	09:30	11:45	02:15	12:30- 15:30., schwedish 4-5:30
11.10.2022	08:30	11:30	03:00	Write PM Report, write Shopping list, create Swedish soundbite
	12:30	17:00	04:30	Write PM Report,
12.10.2022	09:00	17:00	08:00	Write and Proofread PM Report
	18:30	22:30	04:00	Proofread PM report
13.10.2022	10:00	17:30	07:30	finish PM report, Swedish class
14.10.2022	10:00	15:00	05:00	finish PM report, write E-mails
15.10.2022	15:00	17:00	02:00	study swedish, swedish test
16.10.2022	09:30	12:30	03:00	Create Budget, Evaluation Sheets
17.10.2022	11:30	19:00	07:30	Swedish Exam, Midterm Layout and Table of Contents, Swedish Class, Team Meeting
18.10.2022	09:00	11:00	02:00	Writing Midterm
19.10.2022	09:00	18:00	09:00	Meeting Hanna, go to Minimani, meeting Josefin, writing Midterm
20.10.2022	10:00	18:00	08:00	Swedish Exam, Midterm writing
21.10.2022	09:00	22:00	13:00	Write Protocol, Write Midterm Report, Proofread Midterm
22.10.2022			00:00	
23.10.2022	10:00	12:30	02:30	Outline and Presentation Midterm,
	15:00	16:00	01:00	Team Meeting
24.10.2022	11:30	15:00	03:30	Preparing Presentation, Organisational Work
	15:00	20:00	05:00	Filming video + team meetings
	20:30	22:00	01:30	Preparing for Presentation
25.10.2022	08:00	13:30	05:30	Presentations
26.10.2022	10:00	12:00	02:00	Invisible Ink Test
27.10.2022	09:00	11:30	02:30	Start 3D print and Meeting Anu (FindOut)
	12:30	18:15	05:45	Baseboard Toothed Wheel; Overview Robotic Arm, Review Meeting, new idea UV
28.10.2022	09:00	14:30	05:30	New Idea UV as Model, start on finishing cone, protocol
29.10.2022			00:00	
30.10.2022	10:00	12:00	02:00	research Starelec needed,
31.10.2022	09:00	17:00	08:00	go to Starelec, get supplies for UV board, start remodeling puzzles, team meeting
01.11.2022	09:00	11:30	02:30	English Class, Start 3D print Puzzle Box
	12:30	17:00	04:30	Finish Model UV, code invisible Ink translation and paper sorting, team building game
02.11.2022	10:00	11:30	01:30	English
	12:30	17:00	04:30	update protocol, update budget, divide rest of tasks, testing rounds
03.11.2022	09:00	11:30	02:30	adjust 3d model and reprint puzzle box, research Inv. Ink pen, update shopping list
	12:30	17:00	04:30	Meeting team, create 3D models Toothed wheels
04.11.2022	08:00	10:00	02:00	cheat code paper, robotic Arm Hidden codes writing overview
05.11.2022			00:00	
06.11.2022			00:00	
07.11.2022	09:30	11:30	02:00	overview hidden codes, sort puzzles, update shopping list (email Hans about ink pen and MAOL), protocol
	12:30	17:30	05:00	check papers for cone, update Technical Drawing, create task priority list, console instructions
08.11.2022	09:00	11:30	02:30	English Class, 3D modeling of Toothed Wheels, contact to Mika
	12:00	17:00	05:00	Meeting Josefin, To Do list creating, shopping Minimani
09.11.2022	09:00	11:30	02:30	finish 3D drawings of TW, start on base
	12:30	17:00	04:30	Work on base TW, toothed wheels themselves, finalise idea Technical Drawing
10.11.2022	09:30	11:30	02:00	Start 3D print of Toothed Wheels, update Budget
	12:30	16:30	04:00	Protocol, think about UV puzzle, start Reproduction Instructions, emails and scheduling
11.11.2022	09:30	11:30	02:00	Start building UV puzzle in Box, final Update of Toothed wheels before printing
	12:15	16:30	04:15	Testing Console Game, Guideline Update for Players and Replication, Sand cone
12.11.2022	10:00	15:30	05:30	Start on Final Report, Think of ideas for Hints and Solutions in App and Texts for App
13.11.2022	09:00	16:00	07:00	Start on Final Report, Instructions for Players and Hints and Solutions Texts
14.11.2022	08:30	11:30	03:00	English Class, write texts
	12:30	17:00	04:30	Print TW, write texts, UV circuit drawing
15.11.2022	08:30	11:30	03:00	English Class, 3D modeling of Toothed Wheels, contact to Mika

16.11.2022	12:30	18:00	05:30 Build UV puzzle, Test pen, Meeting Josefin
	08:30	11:30	03:00 print TW, mark MAOL
	12:30	18:00	05:30 Base for Toothed Wheels modeling, update budget, write emails
17.11.2022	08:30	11:30	03:00 Base for Toothed Wheels, English Class
18.11.2022	08:00	11:30	03:30 meet Mika, 3D drawin robotic arm
	12:00	17:30	05:30 3D drawing robotic arm, finish UV puzzle
19.11.2022			00:00
20.11.2022			00:00
21.11.2022	07:30	12:00	04:30 English Exam
	12:30	16:30	04:00 Print TW base, Final Report
22.11.2022	07:30	11:30	04:00 start 3D print robotic arm, talk to osku, write Final Report
	12:00	16:00	04:00 Final Report, emails etc, Protocol
23.11.2022	07:30	11:30	04:00 Shopping List update, Budget update
	12:00	17:00	05:00 Emails, research things to buy, learn new program for laser cutting
24.11.2022	08:30	13:00	04:30 Emails, research things to buy
25.11.2022	08:30	11:30	03:00 Protocol, emails, replication instructions
	12:30	17:00	04:30 get things in order for testing, plan testing, replication instructions
26.11.2022	10:00	14:00	04:00 English, emails
27.11.2022	16:00	18:00	02:00 Sand Robo arm
28.11.2022	08:30	11:30	03:00 English, Sand robo arm
	12:30	16:30	04:00 Start replication for testing, start hiding codes, Final Exam
29.11.2022	08:30	11:00	02:30 Meeting Osku, draw base TW and robot on program, update tobo arm
	11:30	17:00	05:30 draw base TW and robot on program, create functioning prototype for testing, English
30.11.2022	09:00	11:30	02:30 finish base drawing, gather all papers for testing
	12:30	17:00	04:30 prepare testing, Final Paper writing, prepare Instructions for Testing
01.12.2022	09:30	12:00	02:30 Work on Final Exam, To Do list for Exam and Finalisation of Project
	12:30	16:00	03:30 Prepare for Testing, get games ready, work on Final Exam
02.12.2022	08:30	18:30	10:00 Prepare for testing, testing, change mistakes in games
03.12.2022			00:00
04.12.2022	10:00	14:00	04:00 Final Report
05.12.2022	09:00	12:00	03:00 Final Report
	12:45	16:00	03:15 Final Report
06.12.2022	18:00	19:00	01:00 Final Report
07.12.2022	19:00	21:00	02:00 Final Report
08.12.2022			00:00
09.12.2022	20:00	23:00	03:00 Final Report
10.12.2022			00:00 Final Report
11.12.2022	10:00	00:00	14:00 Final Report
12.12.2022	08:00	15:00	07:00 Final Report

07:06

Date	Start	Finish	Time	Things Done
12.09.2022		09:30	12:00	02:30 meeting with Josephine
13.09.2022				00:00
14.09.2022		03:00	03:30	00:30 team meeting
15.09.2022		13:30	15:00	01:30 research on the gaming console, how to program, where to buy? durable, can we make it more durable?
16.09.2022		15:00	18:00	03:00 research on the gaming console, how to program, where to buy? durable, can we make it more durable?
		13:30	17:30	04:00 Meeting Jyri for his code
17.09.2022		13:00	14:30	01:30 relearn how blender works, make a 3d model of the pingpong ball game
18.09.2022				00:00
19.09.2022		09:30	12:00	02:30 Meeting with Josephine + group meeting about what to do this week
20.09.2022		09:00	12:00	03:00 3D print course
21.09.2022		11:00	17:42	06:42 design of the webapp (design Josephine already done), making wireframes and deciding on colors, fonts, etc.
22.09.2022				00:00
23.09.2022				00:00
24.09.2022				00:00
25.09.2022		14:00	16:00	02:00 team meeting and making photo's
		15:30	18:00	02:30 Starting on storyboard
		18:00	18:20	00:20 Getting the pingpong 3D model ready to be printed/ slice it
26.09.2022		10:00	11:00	01:00 team meeting with Josephine
27.09.2022		15:00	17:00	02:00 talking to hans about the parts and 3D printing the pingpong ball game
		21:45	22:45	01:00 Watching some video's on how to make the adhesion for the box so we don't have to glue it together
28.09.2022		21:30	22:30	01:00 watching tutorials for blender
29.09.2022				00:00
30.09.2022				00:00
01.10.2022				00:00
02.10.2022				00:00
03.10.2022		20:00	21:30	01:30 working on the storyline
04.10.2022		13:00	14:00	01:00 team meeting
		16:00	18:00	02:00 working on the midterm report -> risk matrix
05.10.2022		19:15	19:30	00:15 contact Osku and Miguel
06.10.2022				00:00
07.10.2022		16:00	18:00	02:00 putting together the storyboard
		19:30	20:30	01:00 adjusting the risk matrix, starting on own part in the report
08.10.2022		16:00	17:00	01:00 team meeting about the midterm report
09.10.2022		14:00	14:10	00:10 making an overlay picture of the belbin tests
		19:00	22:00	03:00 Making a poster and finalizing the risk matrix
10.10.2022		09:30	11:00	01:30 team meeting with Josefin
		13:45	14:30	00:45 working on the midterm report -> putting in my opinions
11.10.2022		15:00	17:00	02:00 working on the report
12.10.2022		20:00	21:00	01:00 writing the lost piece about the risk identification and risk register
13.10.2022		12:00	12:30	00:30 reading through the report
		17:00	20:00	03:00 citing the references
14.10.2022		11:30	12:00	00:30 alphabetically sorting the references
15.10.2022		13:00	15:30	02:30 doing research about User testing and finding some templates that we can use for the testing
16.10.2022				00:00
17.10.2022		13:30	14:20	00:50 Putting the text in the storyboard for the video
		18:00	19:00	01:00 Group meeting
		19:30	22:00	02:30 Working on the report
18.10.2022		10:00	13:30	03:30 Meeting with miguel, picking up the tablet from Hans, setting up the tablet, working on the report
				00:00
19.10.2022		09:00	10:30	01:30 meeting with hanna
		12:00	14:00	02:00 Team meeting with Josefin
		14:00	14:30	00:30 going to Clas Ohlson to look for a suitcase
		21:00	22:30	01:30 working on the report
20.10.2022		19:00	20:30	01:30 working on the report
21.10.2022		11:00	13:00	02:00 working on the presentation + looking at the general report and correcting
22.10.2022				00:00
23.10.2022		18:00	22:00	04:00 updating the storyboard + presentation
24.10.2022		10:00	11:00	01:00 updating the storyboard
		16:00	19:00	03:00 Filming the video + team meeting
25.10.2022		08:00	14:30	06:30 midterm presentations
26.10.2022				00:00
27.10.2022				00:00
28.10.2022				00:00
29.10.2022				00:00
30.10.2022				00:00
31.10.2022				00:00
01.11.2022		11:00	14:00	03:00 playing the teambuilding game
02.11.2022		12:00	13:30	01:30 testing a couple of games
03.11.2022				00:00
04.11.2022		12:00	15:00	03:00 selecting videos
05.11.2022		15:00	17:00	02:00 editing videos
06.11.2022				00:00
07.11.2022				00:00
08.11.2022		12:00	15:00	03:00 team meeting and meeting with josefin
09.11.2022		14:00	16:00	02:00 editing videos
10.11.2022				00:00
11.11.2022		14:00	17:00	03:00 editing videos
12.11.2022				00:00
13.11.2022				00:00
14.11.2022		15:00	16:00	01:00 editing videos
		17:00	19:00	02:00 rendering videos
15.11.2022		12:00	14:00	02:00 meeting with josefin
16.11.2022		12:00	17:00	05:00 writing the text for the game
17.11.2022				00:00
18.11.2022				00:00

19.11.2022			00:00
20.11.2022			00:00
21.11.2022			00:00
22.11.2022			00:00
23.11.2022			00:00
24.11.2022	12:00	13:00	01:00 reading josefins feedback on the text and making notes
25.11.2022			00:00
26.11.2022			00:00
27.11.2022			00:00
28.11.2022	13:30	15:00	01:30 meeting with josefin
29.11.2022			00:00
30.11.2022			00:00
01.12.2022			00:00
02.12.2022	15:00	18:00	03:00 rewriting the text
03.12.2022			00:00
04.12.2022	14:10	17:00	02:50 rewriting the text
	17:00	18:00	01:00 writing notes for Leah to put into the report
05.12.2022	10:00	18:00	08:00 taking pictures to put in video and to use as still pictures and editing videos
06.12.2022			00:00
07.12.2022	18:00	19:30	01:30 making png's of the photo's to put into the video
08.12.2022			00:00
09.12.2022			00:00
10.12.2022			00:00
11.12.2022	13:00	15:30	02:30 editing videos and rendering them again for Albert
12.12.2022			00:00

02:10

Date	Start	Finish	Time	Things Done
12.09.2022		09:30	12:00	02:30 Meeting with the team and Josephine
13.09.2022				00:00
14.09.2022		14:00	15:00	01:00 Meeting with Leah and Hans
		15:00	15:30	00:30 Meeting with the team
15.09.2022				00:00
16.09.2022		13:30	14:15	00:45 Meeting Jyri for Program
17.09.2022		11:00	12:30	01:30 Thinking and sketching gear puzzles
18.09.2022		12:00	13:00	01:00 Thinking and sketching gear puzzles
		16:30	17:00	00:30 Research on the RaspBerry PI
		21:00	23:00	02:00 Research on the RaspBerry PI
19.09.2022		09:30	11:00	01:30 Meeting with the team and Josephine
20.09.2022		09:00	11:45	02:45 3D Printer Lecture
		12:15	13:00	00:45 Buy Gear Puzzle prototype materials + Check Tablet options
21.09.2022		13:00	13:30	00:30 Check Tablet options
		16:00	16:30	00:30 Check Tablet options
22.09.2022		13:00	13:45	00:45 Get new Raspberry Pi 4
23.09.2022		11:30	12:00	00:30 Thinking videogames for the Game Console
		16:15	16:45	00:30 Check Tablet capacities
24.09.2022		16:45	19:45	03:00 Raspberry Pi 4 Research and testing
25.09.2022		14:00	15:00	01:00 Meeting with the team
26.09.2022		10:00	11:30	01:30 Meeting with the team and Josephine
		13:00	14:30	01:30 UV Research, Puzzle Thinking
27.09.2022		10:00	13:00	03:00 Game drafting
		16:00	19:30	03:30 Game programming
28.09.2022		16:30	20:45	04:15 Game programming
29.09.2022		13:30	15:30	02:00 Game programming
30.09.2022		10:00	14:00	04:00 Raspberry Pi 4 Research and testing
01.10.2022				00:00
02.10.2022		10:15	13:45	03:30 Web App applying design
		16:00	20:20	04:20 Web App applying design
03.10.2022		11:30	14:00	02:30 Raspberry Pi 4 Research and testing
04.10.2022		13:00	15:00	02:00 Meeting with the team and Josephine
		16:30	20:15	03:45 Web's Pop-up redesign
05.10.2022		19:00	19:30	00:30 Web's Pop-up redesign
		19:45	20:10	00:25 Videogame level design
06.10.2022				00:00
07.10.2022		11:00	13:45	02:45 Raspberry Pi 4 Research and testing
		18:00	19:40	01:40 Game programming - adding sounds
08.10.2022		11:00	14:00	03:00 Videogame level design
		16:00	16:45	00:45 Group meeting
		17:00	18:00	01:00 Work on the report
		18:30	20:00	01:30 Videogame level design
		20:45	21:45	01:00 Videogame level design
09.10.2022		11:00	13:30	02:30 Videogame menu design
		16:00	17:45	01:45 Videogame menu design
		20:00	21:00	01:00 Videogame details
10.10.2022		09:30	11:00	01:30 Meeting with the team and Josephine
11.10.2022		16:00	18:30	02:30 Work on the PM report - Write
12.10.2022		11:00	12:30	01:30 Work on the PM report - Write
13.10.2022		11:00	12:30	01:30 Work on the PM report - Details
		19:00	20:30	01:30 Work on the PM report - References
14.10.2022		11:00	12:15	01:15 Hints Timer Implementation
		13:00	13:15	00:15 Jyri Server E-mail
		13:30	14:10	00:40 Videogame adjustments
		16:00	17:00	01:00 GPi Case Research
15.10.2022				00:00
16.10.2022		11:00	13:45	02:45 Videogame Sprites Update
17.10.2022		18:00	19:45	01:45 Team meeting
		20:00	23:15	03:15 Work on the midterm report - Write
18.10.2022		20:00	23:00	03:00 Work on the midterm report - Write
19.10.2022		16:00	20:00	04:00 Swedish Study

20.10.2022	16:00	20:00	04:00 Swedish Study
	20:00	21:00	01:00 Work on the midterm report - Retouching
21.10.2022	13:00	14:15	01:15 Jyri Server Meeting
	20:00	23:00	03:00 Work on the midterm report - Final details
22.10.2022	16:00	17:30	01:30 Swedish Exam
23.10.2022			00:00
24.10.2022	15:00	16:00	01:00 Meeting with the team
	16:00	17:00	01:00 Meeting with the team and Josephine
	17:00	20:00	03:00 Filming Video
	20:30	21:30	01:00 Presentation preparation
25.10.2022	08:00	13:30	05:30 Presentations
26.10.2022	16:00	20:00	04:00 Swedish Study
27.10.2022	11:15	11:30	00:15 Swedish Oral Exam
28.10.2022			00:00
29.10.2022	17:00	20:00	03:00 Robotic Arm Base Design
30.10.2022	17:00	18:30	01:30 Webapp cookies investigation and testing
31.10.2022	10:00	13:00	03:00 Team meeting
01.11.2022	17:00	17:45	00:45 BD Testing + Jyri Email
02.11.2022	17:00	19:00	02:00 Videogame Texts + Retouching + Brain Storming
03.11.2022	13:00	14:00	01:00 Meeting with the team and Josephine
	17:00	18:30	01:30 Meeting with the team
04.11.2022	10:00	13:30	03:30 Robotic Arm Base Design + Tooth Wheel Design
05.11.2022			00:00
06.11.2022	17:00	21:00	04:00 GPI Case Setting
07.11.2022	17:00	01:00	08:00 Videogame Console Coding / Setting / Research
08.11.2022	13:00	14:00	01:00 Meeting with the team and Josephine
	15:00	16:00	01:00 Optimizing Videogame
09.11.2022			00:00
10.11.2022	15:00	17:30	02:30 Last Test GPI
	18:00	19:00	01:00 Final Videogame
11.11.2022	12:30	15:00	02:30 Testing Videogame + Upgrades
12.11.2022			00:00
13.11.2022	16:00	19:00	03:00 Start Videogame Report
14.11.2022	16:00	19:00	03:00 Videogame Report
15.11.2022	16:00	18:00	02:00 Start Code Report
16.11.2022	13:00	14:00	01:00 Team meeting
	16:00	19:00	03:00 Code Report
17.11.2022			00:00
18.11.2022			00:00
19.11.2022			00:00
20.11.2022	17:00	21:30	04:30 Testing Tablet
21.11.2022			00:00
22.11.2022	11:30	16:00	04:30 Crank Test + Testing Tablet
	17:30	22:00	04:30 Testing Tablet
23.11.2022	15:00	16:00	01:00 Team meeting with Josefine
24.11.2022			00:00
25.11.2022			00:00
26.11.2022	12:00	20:00	08:00 Leader board implementation
27.11.2022	12:00	20:00	08:00 BD Manager implementation
28.11.2022	13:30	14:30	01:00 Team meeting with Josefine
29.11.2022	15:00	20:00	05:00 English work
30.11.2022	15:00	20:00	05:00 English work
01.12.2022	11:00	14:00	03:00 Preparing app for testing
	15:00	23:00	08:00 Preparing app for testing
02.12.2022	09:30	16:00	06:30 Teasting Complete Escape Room
03.12.2022			00:00
04.12.2022			00:00
05.12.2022			00:00
06.12.2022			00:00
07.12.2022			00:00
08.12.2022			00:00
09.12.2022			00:00

10.12.2022	00:00
11.12.2022	00:00
12.12.2022	00:00
<hr/>	
	03:40

Tablet Quality: Was the Tablet (quality/screen etc.) sufficient?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
Not sufficient – Sufficient

Why?

Did the Tablet battery hold up sufficiently during the game?.....No Yes

Text size: Was the text on the App, puzzles or instructions too small or just right?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
too small just right too big

****If you did not use the Tablet, continue here:****

Instructions:

Are the instructions for the game easy enough to understand?.....No Yes

Would you have preferred a paper version of the instructions to look back on during the game?.....No Yes

Puzzle Questions

Game Idea (Concept) or Theme: How did you like the Theme/Story of the game?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
Boring or weak OK Terrific

Did the puzzle fit into the Theme? Why?

Interest (How much did you like this puzzle in general?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
Hated it It was OK Loved it

Why?

Complexity: How complex was the puzzle to you, especially your age group?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 very simple average very complex

Why?

Game Instructions/Rules: Were the instructions for the puzzle sufficient?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 very simple average very complex

Why?

Interaction (How much did the puzzle cause you to interact with other players?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Never All the time

Uniqueness / Game Mechanics (How different was this from other Escape Room games?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Not much different – Very different

I have never played an Escape Room game:

Code: How was the code hidden?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 very simple average very hard

Why?

Hints: If used, were the hints sufficient? Did they help?No Yes

Comments:

Are the time penalties for hints or the solution too long/short/right?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Too short Just right Too long

Why?

Materials: How much did you like the materials and/or game pieces given?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Did not like Average Loved

Why?

Graphics: How much did you like the graphics/illustrations of the puzzle?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Did not like – Loved

Why or why not?

User Testing – General

Player's name:
Team members' names:
Date & Time:

What age range do you think this game is suitable for (circle one):

3 – 6 6 – 9 9 – 12 12 – 18 adult

How many minutes did it take you to finish the game?

Under 30 30-40 41-50 51-60 61-90 Over 90 mins

Rate these on a continuum; circle one number in each area:

Tip: Game refers to the whole Escape Room game, puzzle is the part you played 😊

App/Tablet Questions:

Appearance (How much did you like the graphics/illustrations of the tablet app?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
Did not like – Loved

Why?

Interaction with App: Was the User interface easy to understand and to work with?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
Easy It was OK Difficult

If Difficult, why?

Tablet Quality: Was the Tablet (quality/screen etc.) sufficient?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Not sufficient – Sufficient

Why?

Did the Tablet battery hold up sufficiently during the game?.....No Yes

Text size: Was the text on the App, puzzles or instructions too small or just right?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 too small just right too big

Instructions:

Are the instructions for the game easy enough to understand?.....No Yes

Would you have preferred a paper version of the instructions to look back on during the game?.....No Yes

Game questions

Game Idea (Concept) or Theme: How did you like the Theme/Story of the game?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Boring or weak OK Terrific

Why?

Interest (How much did you like this game in general?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Hated it It was OK Loved it

Why?

Complexity: How complex was the general game, especially for your age group?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 very simple average very complex

Why?

Game Instructions/Rules: Were the instructions for the puzzle sufficient?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 very simple average very complex

Why?

Game Complexity (Was the game simple, average or very complex, especially for your age group?)

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 very simple average very complex

Why?

Playing time (Was the game too short, too long or just right?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Too short Just right Too long

Was time of 45min long enough?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Too short Just right Too long

Why?

Waiting time with nothing to do (How much waiting where you as individual were not busy?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Very little Normal amount Too much

Interaction (How much did the game play cause you to interact with other players?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Never All the time

Hints:

Are the time penalties for hints or the solution too long/short/right?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Too short Just right Too long
 Why?

Uniqueness / Game Mechanics (How different was this from other Escape Room games?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
 Not much different – Very different

I have never played an Escape Room game:

Puzzle questions

Hints: How were the codes hidden?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
very simple average very hard

Why?

If used, were the hints sufficient? Did they help?No Yes

Comments:

Do you have comments about one game in particular? Did you experience extreme problems in one/several of the games?

Order: Was the mix of 'hard' and 'easy' games good?No Yes

Why?

Materials: How much did you like the materials and/or game pieces

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
Did not like Average Loved

Which ones did you like best and why? / Which ones did you not like at all and why?

Graphics: How much did you like the graphics/illustrations of the puzzles?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
Did not like – Loved

Which ones did you like best and why? / Which ones did you not like at all and why?

TECHNOBOTHNIA

ESCAPE ROOMGAME

SUOMI

SVENSKA

ENGLISH

WELCOME TO
THE TECHNOBOTHNIA ESCAPE ROOM GAME!

PLEASE ENTER THE NAME OF YOUR GROUP HERE

CONTINUE

RULES**1/3**

2 TO 4 PLAYERS (3 RECOMMENDED)

NO PUZZLE REQUIRES STRENGTH TO BE SOLVED. BE CAREFUL WHEN DEALING WITH THE COMPONENTS OF THE GAME

FOR A BETTER EXPERIENCE THE USE OF MOBILE PHONES IS PROHIBITED

CONTINUE**RULES****2/3**

USING HINTS ADDS TIME TO YOUR TIMER. THINK CAREFULLY ABOUT WHEN TO USE THEM

WHAT YOU WILL NEED FOR EACH PUZZLE WILL BE INDICATED IN THE APPROPRIATE MOMENT

THE TABLET WILL ONLY GIVE YOU CLUES AND WILL BE USED TO ENTER THE CODES. IT IS NOT RELATED TO ANY PUZZLE

CONTINUE

RULES

3/3

CODES CAN BE COMBINATIONS OF NUMBERS AND LETTERS. THEY CAN EVEN HAVE SYMBOLS!

A CODE HAS ONE USE. IT WILL NO LONGER BE REQUIRED FOR ANY OF THE FOLLOWING PUZZLES

ENTERING A WRONG CODE HAS NO PENALISATION. TRY WITHOUT FEAR!

**CONTINUE**

WELCOME TO TECHNOBOTHNIA!



Hi! Welcome to Technobothnia, nice to meet you. I am the Technobothnia Coordinator Josefin, and I will be giving you a tour around the facilities today.

OH! What happened!?!? The lights went out! What's going on?

Oh, and now the lights turn back on? Pfew, that was weird.

Do you see that too? There is a paper taped to this board. Let's

**CONTINUE**

Hi teachers!

Hope you've had a nice Teacher's Training Day. You're probably eager to get home now, right? But no can do, we've locked you in! The only way you can get out of Technobothnia is to prove to us that your tech skills are as good as they should be for engineering lecturers such as yourselves. So, as you have done for us so many times, we will now put you to the test. Oh, and you only have TWO HOURS to finish all eight of the puzzles, otherwise the door will remain locked, and you are going to have to spend the night here.

Good luck!

//Your students

CONTINUE

LET'S START!



Let's try the doors first! This can't be real. Oh no, the doors are really locked!

We can't get out. Where do we even start solving these puzzles?

START

TECHNICAL DRAWING

00:01:24



Let's start off easy, shall we?

You teach a lot of complicated classes and topics, but do you also know the basics?

Can you think logically and find out the scale of this tank?

You gave this as homework, but we want to test if you can do it yourselves.

Now you can use the papers of the divider 1 of the folder

HINT 1

CODE

CONTINUE

TO THE ELECTRICAL LAB

00:02:17



Great job with finishing the first game!

We have to hurry up so follow me to the next room I think I know where we have to look. Let's go to the Electrical Lab!

There is some kind of circuit board here. The hint earlier said something about making good connections. What could that mean?

Good, you passed the first puzzle. The next one will test your ability to make good connections. So, buzz off!

//Your students

CONTINUE

UV-CIRCUIT

00:03:35



Lecturers rave on and on about how we students need to think interdisciplinary and how everything is connected, so now you have to connect things yourselves.

See if you can figure out the code written in invisible ink. It's the only way to get closer to making it out of Technobothnia.

HINT 1

CODE

CONTINUE

TOWARDS THE IT LAB

00:04:19



So where do you think we should go next?

What about the IT Lab, "language" as in "programming language"?

Okay let's go, quick!

Second test passed, well done!
Language is power. Do you
have what it takes to
power things up?
//Your students

CONTINUE

A WEIRD INVENTION

00:04:52



Look what we found!

It looks like one of those retro gaming consoles and a crank. I have never seen that here before.

What happens if you turn on the console?

CONTINUE

VIDEOGAME CONSOLE

00:05:23



Well, you've arrived earlier than we expected!

That's all right, now it's you who will have to do your homework before you can have fun.

Get the console to turn on and complete the code to be able to play the game and get the next password.

Now you can use the papers of the divider 2 of the folder

HINT 1

CODE

CONTINUE

MECHANICAL LAB

00:07:22



Okay, so could this mean that the next test is at Mechanical Engineering?

Fast, follow me.

Excellent work solving the third puzzle! Seems like the wheels in your thinking cap are starting to turn properly, but perhaps you need to gear up a bit if you want to make it out in time.
//Your students

CONTINUE

PATTERN

00:07:52



We are here, this is the lab...

Let's take a look around. Is there something out of order?

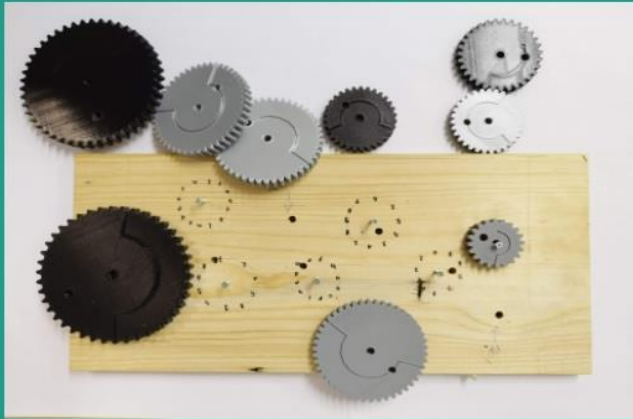
Ah it's here, hurry up! There seems to be a pattern on these toothed wheels...

Maybe if we connect them, we'll know what to do next.

CONTINUE

TOOTH WHEELS

00:08:43



Let your gears turn for this puzzle.

Is your mind a well-oiled machine like this puzzle?

Find the code by fitting the toothed wheels on the base.

HINT 1

CODE

CONTINUE

PHYSICS LAB

00:09:23



"Physical skills"...

I would guess that means the Physics Lab, let's go have a look.

Aha! Those balls are still moving, that must mean we're closing in on the students!

Let's finish this puzzle quickly! First we must fit as many Ping Pong balls as possible on the base.

Great job teachers!
Your mental skills seem to be
up to the test, how about
your physical skills?
//Your students

CONTINUE

PING PONG BALLS

00:10:04



Let's try out your patience, dear lecturers.

Can you sit through this tricky little puzzle and get the right answer?

How many balls can you fit onto the base without the balls touching each other and without destroying them?

HINT 1

CODE

CONTINUE

CONE SHAPE

00:10:38



Today we can use CAD programs for digitalising ideas and creating technical drawings or blueprints.

You teach us how to use these programs, but can you think logically without them?

Take the old-timey cone and find out which of the choices the shape of the cylinder surface is if cut open and rolled flat.

Now you can use the papers of the divider 3 of the folder

HINT 1

CODE

CONTINUE

SNEAKY PRANKSTER

00:11:09



What does that mean?

Hey! WAIT! Did you see that?

A student ran out of the Chem Lab!
Let's go take a look at what they did there...

I hope they didn't make a mess.

Good work, physics is fun, huh? But have you ever heard the joke about the angry flask that completely overreacted?

//Your students

CONTINUE

IN THE SCIENCE LAB

00:11:41



It's another test, where do we start?

We probably have to mix a solution.
But what do we do with it and what does this code mean?

CONTINUE

INVISIBLE INK

00:12:13



Teachers love to say that chemistry is everywhere even if it is not visible, just like this code.

Gather all you know about chemistry and make us see.

Will you succeed?

Start by decoding the code and then make the secret writing visible.

Now you can use the papers of the divider 4 of the folder

HINT 1

CODE

CONTINUE

CHATCH THEM!

00:13:05



"Almost there! If only there was something that could help you with the heavy work and get the final test done on time...
//Your students"

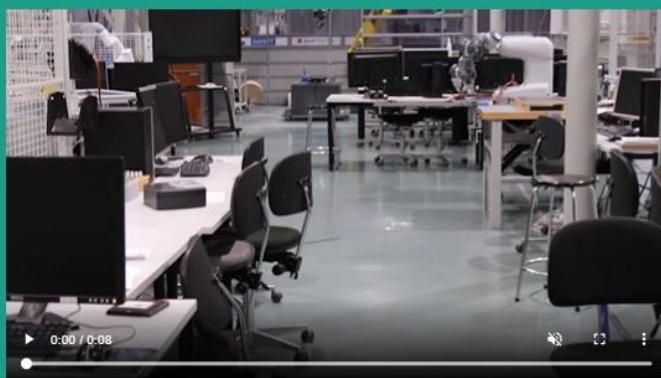
What about we follow the student we saw earlier, she went in the direction of the Robotics Lab I think.

Almost there! If only there was something that could help you with the heavy work and get the final test done on time.
//Your students

CONTINUE

A LOCKER BOX?

00:13:46



Hey there is a locker box here I didn't see that here earlier...

Let's open it and see what's inside!

Good work so far! As a reward, here is the code to the safe

380

//Your students

CONTINUE

ROBOTIC ARM

00:14:16



Wouldn't life be easier if robots could take over our tasks?

Sadly humanity has not yet created the perfect robot.

Help the robotic arm out and adjust it so it can lead you out of Technobothnia.

You may need to consult the previous puzzles for clues.

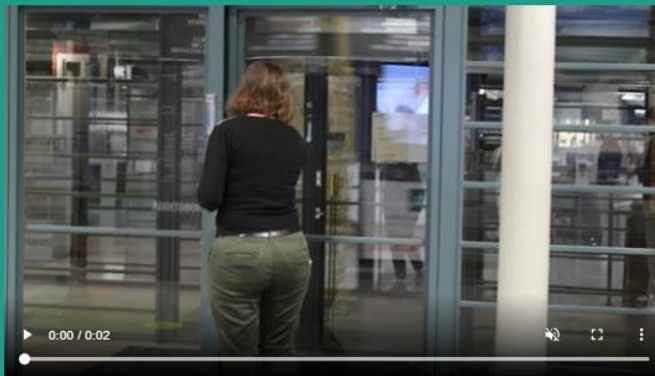
HINT 1

XY

CONTINUE

CONGRATULATIONS!

00:15:23



Yay! We did it, let's use the code and get out of the building.

GREAT JOB!

YOU HAVE SUCCESSFULLY COMPLETED THE ESCAPE ROOM OF TECHNOBOTHNIA!

Congratulations dear teachers, you made it! You finished all your tests, and this final code unlocked the main doors, you are now free to leave. Class dismissed!
//Your dear students :)

FINISH!

THE TECHNOC LEADERBOA

It looks like you don't have internet connection so it won't be possible to upload your final time. Take a screenshot if you want us to upload it in the future.

Group	Hints used	Time	Date
true	0	00:00:11	28.11.2022

BACK TO START

THE TECHNOBOTHNIA ESCAPE ROOM GAME LEADERBOARD

Position	Group	Hints used	Time	Date
1	fast	0	00:00:01	26.11.2022
2	we are top 5	0	00:00:11	28.11.2022
3	Equipo	2	00:00:15	28.11.2022
4	Adios	2	00:00:22	28.11.2022
5	Hola	2	00:00:25	28.11.2022

BACK TO START

THE TECHNOBOTHNIA ESCAPE ROOM GAME LEADERBOARD

Position	Group	Hints used	Time	Date
1	fast	0	00:00:01	26.11.2022
2	Equipo	2	00:00:15	28.11.2022
3	Adios	2	00:00:22	28.11.2022
4	Hola	2	00:00:25	28.11.2022
5	team bla bla	0	00:00:26	26.11.2022
Your position	Group	Hints used	Time	Date
7	DEV	0	00:05:11	28.11.2022

BACK TO START

Appendix 9 Items Escape Room Box

Box

- 1x Suitcase with puzzles in suitcase organisers
- 1x Backpack
- 1x Android Tablet 10"
- 1x Safe Box
- 1x Bottle of water
- 1x Pencil case with pens, ruler, and pen for robotic arm
- 1x Screwdriver
- 1x Folder with notes
- 1x Maol-taulukot

Technical Drawing Puzzle:

- 1x Torn paper

UV-Circuit:

- 1x box with holes, circuit and UV-light
- Several cables

Console:

- 1x Hand crank generator
- 1x Video game console
- 1x Cable
- 2x Papers

Toothed Wheel Puzzle:

- 12x Gears of different sizes
- 1x Base with hooks

Ping Pong Puzzle:

- 12x Ping Pong Balls
- 1x Base plate

Cone Puzzle:

- 1x Paper with figures
- 1x 3D model of the figure

Invisible Ink:

- 2x Maze boxes
- 1x Sodium carbonate
- 1x Spray Bottle
- 1x Spoon

1x Pipette
Several scientific papers

Robotic Arm:

1x Base
1x Built robotic Arm

Appendix 10 Player Instructions

Dear Player!

In the following you can find the instructions to set up, run, and complete this Technobothnia Escape Room Game.

You will find all items you need for this game included in the suitcase. The First Aid Kit only contains spare items should something be missing or damaged, you do not need it for the puzzles.

Before you start playing you should make sure that you have enough time (approx. 2h) on hand as you cannot stop the game once you start playing. You should also be in an uninterrupted space without other teams playing. This could be a classroom or a room at Technobothnia.

To begin the Escape Room, turn on the Tablet and start the Game App. Do not open any of the Suitcase organiser bags. These bags include all necessary materials you will need for the successful execution of the individual puzzles and the overall game. Open up the bags only when the App tells you to do so, and you are at the correct puzzle.

Once the App works, follow the instructions it gives you. You will be able to select the language you prefer (Finnish, English, Swedish). You will then get an introduction into the game story. Afterwards you can start the game. Attention: The timer will start once you press 'Play'. You will not have the chance to stop the game after this.

While playing you will find clues you will have to follow in order to find codes. Put these codes into the App.

If you are stuck, you can use the hints given to you at the bottom of the screen. Should you not succeed even with the hints you can also use the solution and it will show you the final code. Attention: You can only use Hint 2 if you used Hint 1 and only use the Solution if you used Hint 2. Also, you must wait and try to solve the game before getting another hint.

After the game:

After you played the game, please put all items back into the Ziplock bags they belong in (in case you don't remember what goes where look at the labels on the bags).

Fill out the checklist included in the game about what items you put back in the box, which ones were destroyed etc. to help us make the game ready for the next teams.

Thank you for playing,

Your Technobothnia Team

Box Checklist

Items	Included	Not included	Notes/Written on?
GENERAL BOX			
All suitcase organiser bags			
Backpack			
Pencil Case			
All pens in different colours			
Triangle ruler			
Scissors			
Sharpener			
Two Erasers			
Water Bottle			
MAOL-taulukot			
Folder			
INVISIBLE INK			
Puzzle box big with closed sodium carbonate bottle inside, open			
Puzzle Box small with code written on paper inside, open			
Spray bottle			
Code Paper			
Big dot code Paper			
Dots and Lines Code Paper			
Warning Signs paper			
Greek Alphabet Paper			
Periodic Table of Elements Paper			
11 pages of H-, P- and EUH sentences			
Molar mass paper			
Pipette			
Marked measuring cylinder			
Marked spoon			
PING PONG			
Base Plate			
12 Ping Pong Balls, 1 with code			
CONE			
Cone model			
4 Papers with shapes printed on			
TOOTHED WHEELS			
10 toothed wheels in different sizes			

Items	Included	Not included	Notes/Written on?
Base board			
UV-CIRCUIT			
Box with circuit			
5 Cables for connecting			
CONSOLE			
Console			
Crank			
Connecting Wire			
Helping Paper			
Chat Code Paper			
TECHNICAL DRAWING			
Technical drawing paper			
ROBOTIC ARM			
Safe box			
Robotic arm			
Base board			
Special pen in pencil case			

Replication Instructions

Technical Drawing

How to prepare:

Print paper 'Technical Drawing.pdf' on A3 paper

Rip off upper left corner so the left side of the left tank with the height measurements is missing



Box should include:

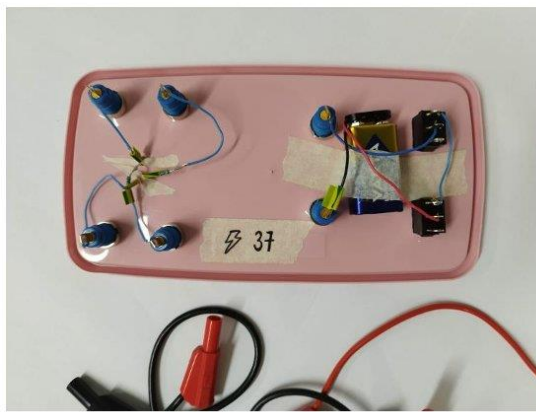
- ☐ One paper with the Technical Drawing

UV-circuit

How to prepare:

Take a lunch box (23x11x6) and add holes according to the following measurements (hand drill is sufficient)

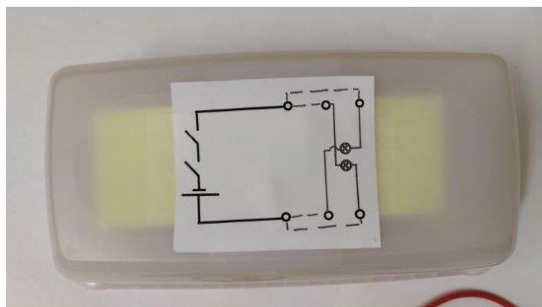
Connect the LED, UV-LED, two light switches and battery according to the following picture:



Check the connections and add the code "hp7w3" with the invisible edding 8280 securitas uv marker directly above the UV lamp (be careful: don't make them too big or the players will not be able to see them properly, also maybe go over the letters twice and let dry properly)

Write code "37" on box with black permanent marker, alternatively on tape and tape it to bottom of lid

Print the paper "sticker" on sticker paper and add to bottom of box



Add the following caution note on box inside



Box should include:

- ☐ Circuit box
- ☐ Two cables
- ☐ Paper with clue taped to bottom
- ☐ Caution note

Toothed Wheel

How to prepare:

3D-print wheels from stl files: Wheels stl (best to print on S3 with 0.15 layers, use different colours, does not matter which wheels is which colour -> colours in names of files do not matter)

Base must be laser cut, best to ask Osku for help: you need 300x300mm acrylic plates in black

Then laser cut the file: base tw.gnh

Watch out: the toothed wheel symbol with the number 75 next to it should be laser cut in the back of the board

The numbers and letter should be

20 power

80 speed

1 times

800 dpi

The holes in the middle

30 power

60 speed

3 times

800 dpi

To cut off the bottom that is too big use:

80 power

5 speed

1 times

800 dpi

Then 3D print the file prongs.stl and superglue them to the holes on the base board

Box should include:

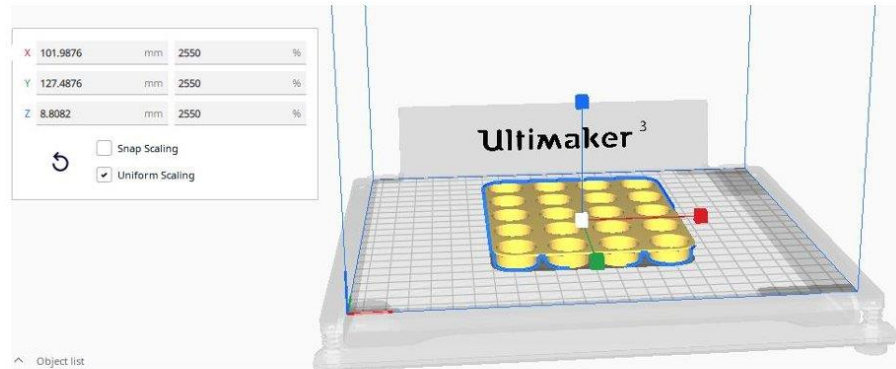
- ☐ Base board
- ☐ 10 toothed wheels
- ☐ Super glue in the first aid pouch just in case

Ping Pong

How to prepare:

Open 'PingPong_base.stl' and change size to 2250% (keep uniform scaling), PLA, (should take around 6h)

! you need support



Take the black pen and write a circle and '– 22' on one of the balls

Box should include:

- ☐ Base
- ☐ 12 Ping Pong Balls
- ☐ 1 of the balls with hidden code

Cone

How to prepare:

3D-Print the file 'cone.stl'

! you need support, print on S5 (AA 0.8, use same printer head for cone and support), PLA, Extra fast 0.3



Write the notes as follows in the MAOL

BETECKNINGAR OCH FORMLER 29

Storheter

Storhet	Symbol	Enhet
molmassa	M	g/mol
molvolym	V_m	dm^3/mol
substansmängd	n	mol
koncentration*	c	mol/dm^3
densitet	ρ	$\text{kg/m}^3 = \text{g/dm}^3$

* som enhet för låga halter används också ppm (= parts per million)

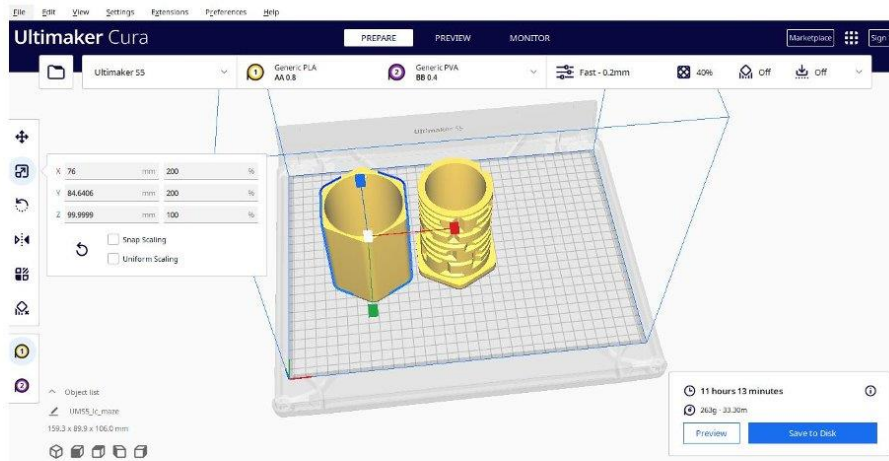
Räkneformler

substansmängd = $\frac{\text{massa}}{\text{molmassa}}$	$n = \frac{m}{M}$
substansmängd för en gas = $\frac{\text{volym}}{\text{molvolym}}$	$n = \frac{V}{V_m}$
substansmängd = $\frac{\text{partikelantal}}{\text{Avogadros konstant}}$	$n = \frac{N}{N_A}$
koncentration = $\frac{\text{substansmängd}}{\text{volym}}$	$c = \frac{n}{V}$
densitet = $\frac{\text{massa}}{\text{volym}}$	$\rho = \frac{m}{V}$
densitet för en gas (NTP) = $\frac{\text{molmassa}}{\text{molvolym}}$	$\rho = \frac{M}{V_m}$
gasernas allmänna tillståndsekvation	$pV = nRT$
eflmängd vid elektrolys	$Q = It = nFz$

** z = antal elektroner som per oxiderande eller reducerande jon/atom/molekyl överförs vid elektrolys

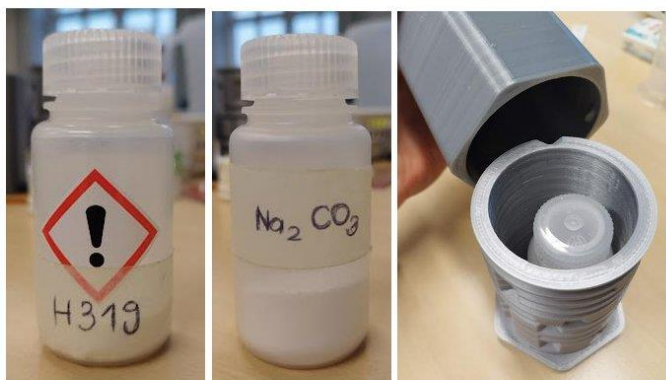
Feel free to add some other markings to the book

3D- print the box under 'big_maze.stl' and 'big_top.stl': unclick 'Uniform Scaling' and sit the box upright, then make X and Y 200%, use PLA -> Ultimaker S5, AA 0.8, Fast-0.2, no support and adhesion needed: should take 11h 13min

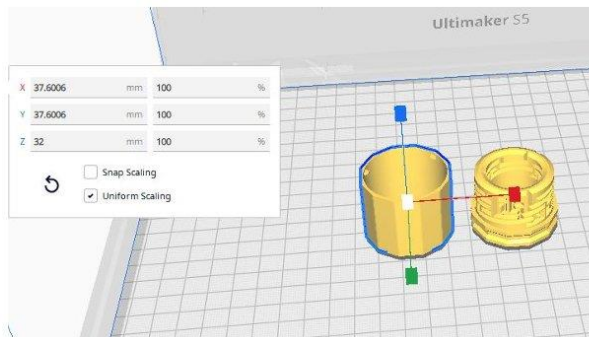


Take bottle and fill with Na_2CO_3 /Sodium carbonate, take tape and write on: " Na_2CO_3 " as well as "H319", take attention sticker and put on bottle -> put this bottle in big puzzle box and close box

Also add note: "DO NOT EAT" to it



3D-print the small box under 'small_maze.stl' and 'small_top.stl', no adjustments necessary, no support and adhesion needed, 0.2 should be good enough



Add the flask symbol and the code "-45" written in the invisible ink on a little paper inside and close

Draw the flask symbol on tape and add it on lid of the small maze box

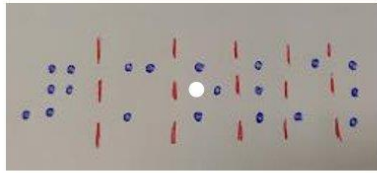


Take marker and mark 30ml on 50ml measuring cylinder

Take 1ml spoon and write on bottom 6 kpl/spoons



Take small spray bottle and add the following blue dots on a sticker (says: 2 mol/l)



(do not write the red lines, they just signify a letter ending and beginning, make sure to leave enough space between letters)

Box should include:

- ☐ Puzzle box big with Sodium carbonate inside, closed
- ☐ Puzzle Box small with code inside, closed
- ☐ Spray Bottle
- ☐ Papers printed and added in a folder
- ☐ Marked measuring cylinder
- ☐ Marked spoon
- ☐ Pipette or similar item for mixing
- ☐ MAOL-taulukot with notes
- ☐ Another version of both papers with the invisible ink in first aid pouch



Robotic Arm

How to prepare:

Buy safe box and make code 380

Reprint all files under "my models stl": base should be black, the arms metallic silver or grey and top part (scale and pen holder + pen) in another colour, maybe neon or gold

Print it on S3 and make wall speed 35 (this ensures the scale numbers to be more visible)

Best to print over night as it takes a long time and use glue for the arm with Technobothnia written on it (results are nicer)

Screw the arms together and add the screwdriver and the printed pen to the pencil case

For base you need an acrylic plate of the measurements 300x300x3 (lxbxh) for the laser cutter

engrave the base file under base_robo.gnh (again ask Osku for help, same values as for Toothed Wheel Puzzle)

cut out the moon from the base (you should try some settings as it did not work with this prototype base)

Box should include:

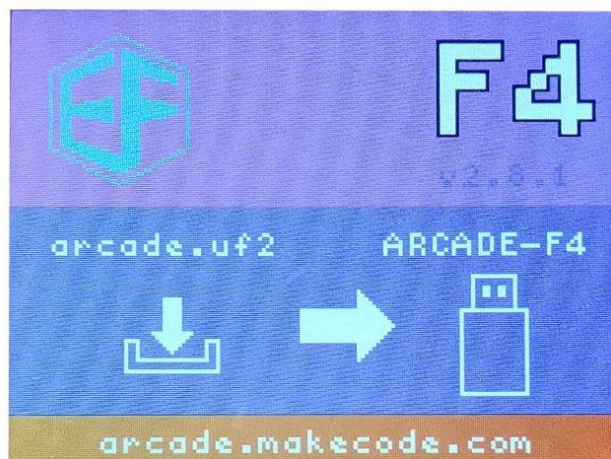
- ☐ Safe box with code 380
- ☐ Fully built robotic arm with black base, 4 silver metallic/grey arms and different coloured scale + pen holder
- ☐ Pen in same colour as pen holder in pencil case
- ☐ Base plate

Console

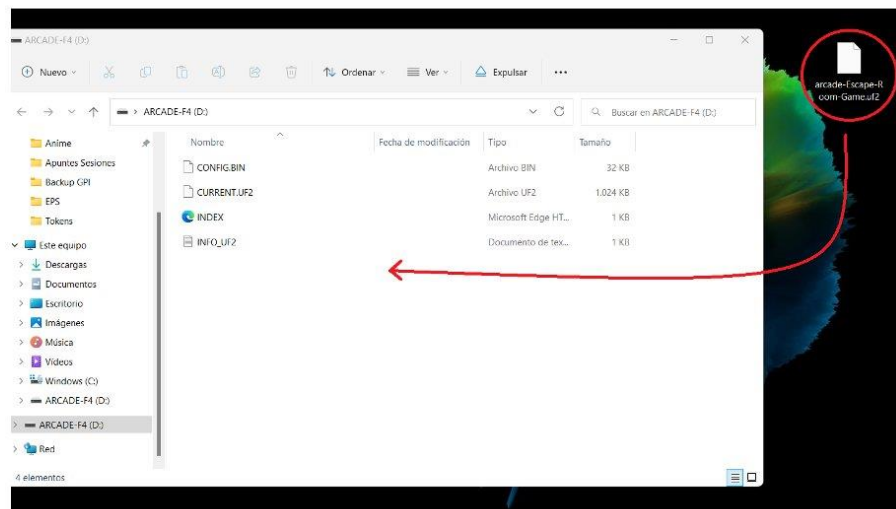
See file “Explanatory guide to the video game code”

How to prepare:

1. Access the file repository and download the file named “arcade-Escape-Room-Game.uf2” in the computer.
2. Connect the Retro Arcade to the computer using the USB cable. The game console should turn on and display the following screen:



3. Once connected, a similar window should open on the computer. Insert the file with the video game into it.



4. After the previous step, the console screen should show the video game running:




5. In the video game select the option "CODE" and then always the first menu option until you return to the main menu. This will ensure that in the future players will have to solve the code correctly before they can play.

6. Disconnect the console from the computer and let the battery drain.

7. Print the file "CrankGeneratorSticker.png", preferably on adhesive paper, and stick it on top of the generator.
8. Print copies of "CheatCode.pdf" and "Console instructions_two lovers united.pdf", one of each.
9. Put everything in the appropriate box.

Trouble Shooting:

Why don't I get the right result after passing the code file to the console?

In case the appropriate result is not achieved during step 4, press  on the console and repeat from step 3. If it still doesn't work, check the code for possible errors.

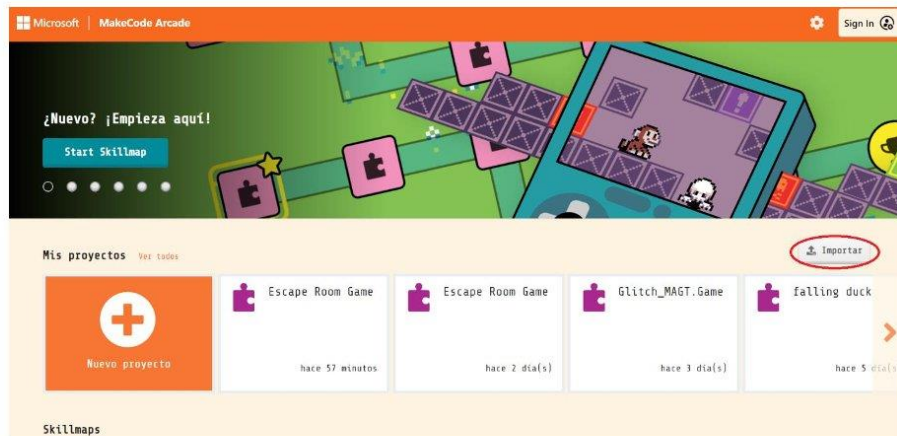
Do I have to configure anything on the crank generator?

No, the console only needs to be connected to one of the USB ports on the generator. If it doesn't work, try replacing one of the components.



Steps to follow for code modification:

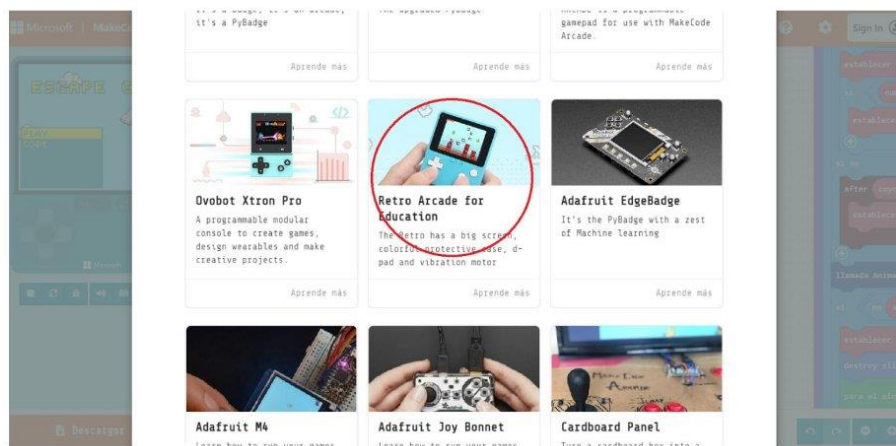
1. Access the file repository and download the file named "arcade-Escape-Room-Game.uf2" in the computer.
2. Access the website <https://arcade.makecode.com/> in the web browser.
3. Click "Import" and select the file downloaded in step 1.



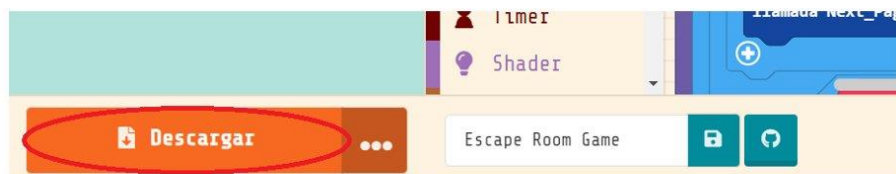
4. Modify the game code as desired. For more details see "Explanatory guide to the video game code".

5. Click on "Choose your hardware" in the bottom left corner and then select Retro Arcade for Education.





6. Click on “Download” to get the new uf2 file.



7. Finally, follow the tutorial "Steps to follow for preparation" with the obtained file.

Steps to take after the end of a game:

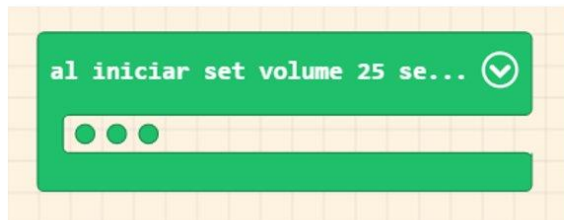
1. In the video game select the option "CODE" and then always the first menu option until you return to the main menu.
2. Let the battery of the video console drain.
3. Check the notes related to the puzzle to make sure they are in good condition and have nothing written or scribbled on them.
4. Put everything in the appropriate box.

Box should include:

- ☐ Retro Arcade for Education
- ☐ USB wire
- ☐ Crank

Explanatory guide to the video game code

On start



Receives: -

Returns: -

This function is executed automatically as soon as the game starts. It modifies some options that will be useful at all times, it also calls the Create_Animations and Load_Main_Menu functions.

On menu option



Receives:

option - string - Text of the selected option of the menu

index - int - Index of the menu to which the selected option belongs

Returns: -

This function is executed each time a menu item is selected from the menu created in the Load_Main_Menu function.

In case the main option selected is "CODE" we call the Next_Page function to change the menu options in chain until it reaches the last set, which call the Last_Page function.

In case the selected option is "PLAY" checks if the options selected during the programming part are correct by calling the Check_Code function and acts accordingly. If it returns false it shows a pop-up with a error text, if it returns true it calls to Start_Game.

On game update



Receives: -

Returns: -

This function is called automatically every frame of the game. So here are checks or modifications that need to be done all the time. For example, on game update checks if the player is touching the ground after a jump to allow him to jump again. It controls the animations of the entities by calling Animate_Player. Or it moves enemies by calling the function Move_FunGuy.

On button press



Receives:

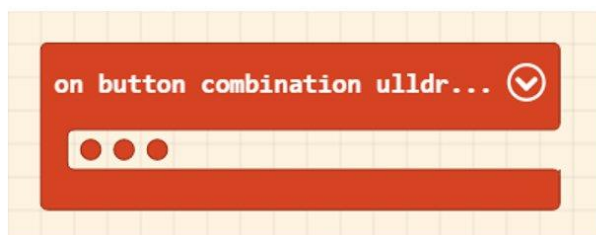
Option to choose which button needs to be tracked

Option to choose the type of interaction of the button which will trigger the function

Returns: -

These functions are automatically executed when the indicated console button is pressed. They have quite varied functionalities. "A" is responsible for jumping and double jumping. "Up" and "Down" produce sounds only if a menu is open. "Left" and "Right" help us to keep track of the direction in which the player is facing, to animate accordingly.

On button combination



Receives:

string – String indicating the combination which will be tracked

Returns: -

Function executed when the button combination indicated by the string is imputed. If this happens, it will show the player a pop-up with the secret code. For more details on how to define that string, right-click on the function and select " Help".

On sprite overlaps sprite



Receives:

sprite - Variable with overlapping participant object

Option - Kind of the overlapping participant object to check

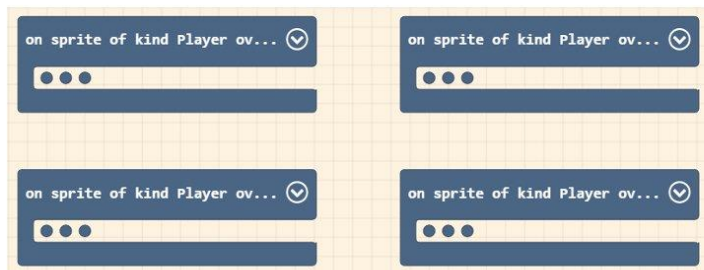
OtherSprite - Variable with the other overlapping participant object

Option - Kind of the other overlapping participant object to check

Returns: -

These functions are automatically executed when two game entities of the indicated types overlap. They can be used to make the player take damage from existing enemies or to score points by getting coins or other things.

On sprite overlaps tile



Receives:

sprite - Variable with overlapping participant object

Option - Kind of the overlapping participant object to check

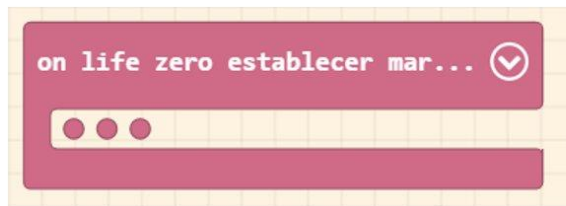
Option to choose which tilemap sprite should be checked for overlap

location - Location of the sprite when the overlap occurs

Returns: -

These functions are automatically executed when a game entity and a tilemap sprite overlap. Although they can be used in similar situations to the previous set of functions, here they are use it for game-ending overlaps. With the different parts of the flag to win that also call the End_Game function or with the lava to lose.

On life zero

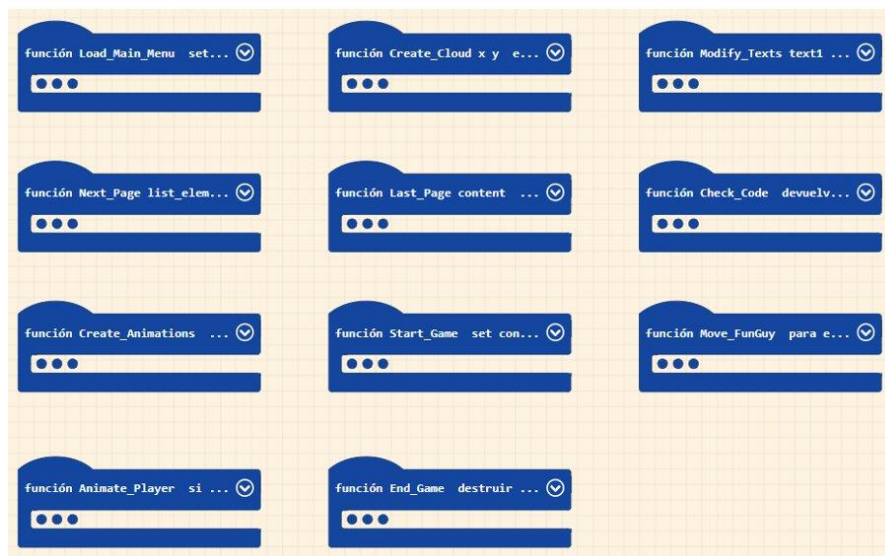


Receives: -

Returns: -

A function that is automatically executed when the player's lives reach zero. A function that is automatically executed when the player's lives reach zero. At that moment, the player is shown a pop-up and the game ends.

Functions



This is the set of defined functions that are used throughout those defined above. An overview of each of them is will be given below.

Load_Main_Menu

Receives: -

Returns: -

Called right at the beginning, it is responsible for creating and preparing the entire main menu. It adds the texts confirming the game title, creates the menu with the main options "PLAY" and "CODE" and calls the Create_Cloud function multiple times.

Create_Cloud

Receives:

x – int – x-position of the new cloud to be created
y – int – y-position of the new cloud to be created

Returns: -

This function creates a sprite of type "Cloud" at the screen position indicated by x and y. It also gives them a base speed to move to the right and sends them to the bottom of the z-axis to be behind the menus. The aim is to decorate the main menu.

Modify_Texts

Receives:

text1 – string – New text for the textSprite1
x1 – int – New x-position for the textSprite1
text2 – string – New text for the textSprite2
x2 – int – New x-position for the textSprite2

Returns: -

This function modifies the variables "textSprite1" and "textSprite2" that make up the title "ESCAPE GAME". This is done to avoid creating more variables than necessary and is used in the Next_Page function to display the code texts to be completed.

Next_Page

Receives:

list_element1 – string – Text of the first option of the next menu page
list_element2 – string – Text of the second option of the next menu page
list_element3 – string – Text of the third option of the next menu page
page_text – string – Text indicating which page is active and how many pages there are in total. Example: "1/4"
index – int – Number indicating the index of the actual menu page
var – string – Text indicating in which setting the select option will be saved

content - string - Text of the option selected from the last menu during the coding game.

Returns: -

This function is called after the "CODE" option from the main menu is selected and in every instance up to the last page.

A new menu with 3 options is created using "list_element1", "list_element2" and "list_element3". It also updates the bottom left text with the content the "page_text", updates the setting "menu_index" with the value of "index". It saves the setting "var" with the value the "content".

It modifies the text of the code the player has to fill in according to the text contained in "page_text".

Finally, it sets the background to black and cleans up the clouds that have been previously created to decorate the main menu as they might disturb the readability of the text.

Last_Page

Receives:

content - string - Text of the option selected from the last menu during the coding game.

Returns: -

This function is called after the final option of the programming part is selected. It saves "content" in the setting "option_4", destroys the variables textSprite1 and textSprite2 used to write the texts because they will be recreated when Load_Main_Menu is called, sets to null "page" and calls Load_Main_Menu.

Check_Code

Receives: -

Returns:

bool - Bool indicating whether the stored values are correct or not

Checks if the value of the options set during Next_Page are appropriate.

Create_Animations

Receives: -

Returns: -

This function creates the animations that are then assigned to the hero with the Animate_Player function. A variable contains the result of creating a new animation, this

variable is attached to the player's sprite and then the corresponding frames it will have are added. This has to be done for each animation, differentiating the direction.

Start_Game

Receives: -

Returns: -

This function is called when "PLAY" is selected and the "CODE" part has been done correctly. It takes care of preparing a lot of different things; it removes some variables that will no longer be useful to free up memory and create new ones, puts the player in place, loads the tilemap to be used, replaces the placeholders used in the tilemap with enemies and coins, among others.

Move_FunGuy

Receives: -

Returns: -

This function is called every frame. It checks if an enemy of the type "Enemy" is colliding with a wall, if that is the case it changes to walk in the opposite direction. For that, it changes to the corresponding animation and gives the appropriate x-speed.

Animate_Player

Receives: -

Returns: -

This function is called every frame. This function is called every frame. By making certain checks it is decided which animation the player should have.

If the velocity at X is 0 and the player is touching the ground, he is still, or the velocity at y is low, the player is in the "Idle" animation.

If the speed at X is other than 0 but the player is touching the ground, the player is in "Walking" animation.

Otherwise the player is in "Jumping" animation.

To decide the direction of the animation it is use the bool variable "lookingLeftHero".

End_Game

Receives: -

Returns: -

Called when the player touches one of the flag sprites at the end of the game. Its main function is to check the player's current score. If it is greater than or equal to 90, it will show the puzzle code, otherwise it will show a pop-up indicating that not enough have been obtained. Whatever the result ends the game in victory.

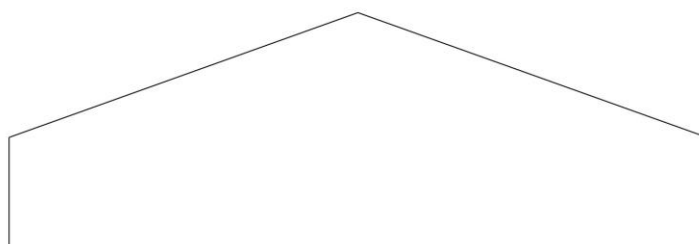
Appendix 12 Cone Surface Area Outlines

Is printed on A3 paper

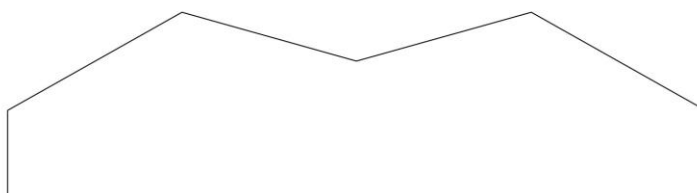
#0#



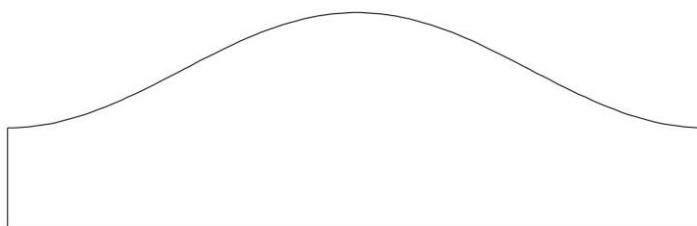
=1=



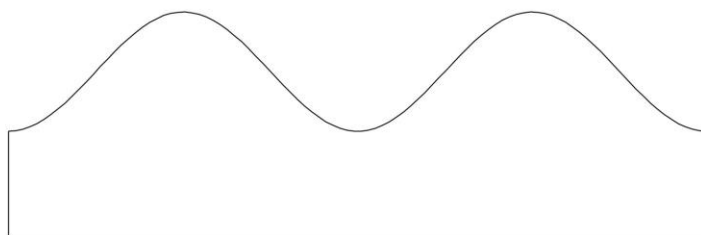
???



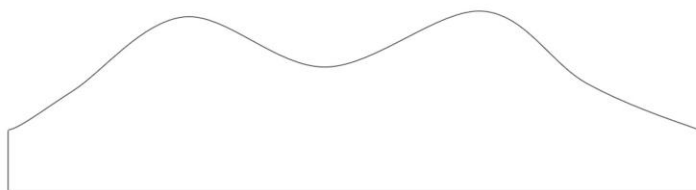
32



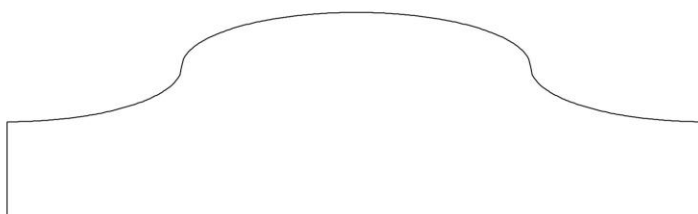
<4>



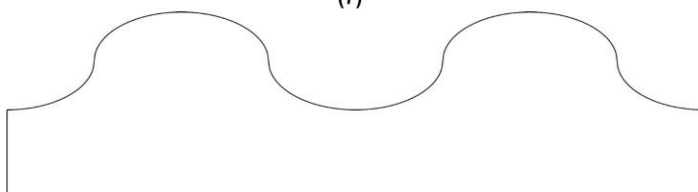
/5/



&6&



(7)



Appendix 13 Papers Invisible Ink

Code English

EN:

--- -- . / ... - - . . / ... - - . - / - - - - . / / - - - - - / - - -

Other papers such as keys and molar masses:

FI

Aineen nimi	Moolimassa (g/mol)
natriumkarbonaatti	105,99
kalsiumkarbonaatti	100,09
natriumkloridi	58,44
kaliumkloridi	74,55
magnesiumfosfaatti	218,28
strontiumsulfaatti	183,68
natriumasetaatti	82,03
magnesiumnitraatti	148,3
kalsiumnitriitti	164,09
strontiumkloridi	158,53
natriumfosfaatti	163,94

SW

Name of the substance	Molar mass (g/mol)
natriumkarbonat	105.99
kalciumpkarbonat	100.09
natriumklorid	58.44
kaliumklorid	74.55
magnesiumfosfat	218.28
strontiumsulfat	183.68
natriumacetat	82.03
magnesiumnitrat	148.3
kalciumpnitrit	164.09
strontiumklorid	158.53
natriumpfosfat	163.94

EN

Name of the substance	Molar mass (g/mol)
sodium carbonate	105.99
calcium carbonate	100.09
sodium chloride	58.44
potassium chloride	74.55
magnesium phosphate	218.28
strontium sulphate	183.68
sodium acetate	82.03
magnesium nitrate	148.3
calcium nitrite	164.09
strontium chloride	158.53
sodium phosphate	163.94

a	b	c	d	e	f	g	h	i	j
•	• •	••	•• •	• •	•• •	•• ••	•• •	• •	•• •
k	l	m	n	o	p	q	r	s	t
• •	• • •	•• •	•• • •	• • •	•• • •	•• •• •	•• •• •	• • •	•• •• •
u	v	x	y	z	å	ä	ü	ö	w
• ••	• • ••	•• ••	•• •• •	• • ••	• •	• • •	•• •• •	• • •	•• •• •
1		2		3		4		5	
• • •		•• •• •		•• •• ••		•• •• ••		•• •• •	
6		7		8		9		0	
•• •• ••		•• •• ••		•• •• ••		•• •• ••		•• •• ••	
,	;	:	!	?	+	=	(*)
•	• •	••	•• •	• •	•• •	•• ••	•• •	• •	•• •
.	-	'	/	\	”	<	>	@	&
•	••	•	• •	•• •	• •	• •	• •	•	•• •• •

A .-	P .--.	0 ----	? ..--..
B -...	Q --.-	1 .----	/ -...-
C -.-.	R .-.	2 ..----	= -....-
D -..	S ...	3--	: ----..
E .	T -	4-	, --...-
F ..-.	U ..-	5-.-.-
G --.	V-	6 -....	
H	W .--	7 --...	
I ..	X -...-	8 ---..	
J .----	Y -.-	9 ----.	
K -.-	Z --..		
L .-..	Å .-.-		
M --	Ä .-.-		
N -.	Ö ---.		
O ---	Ü ..--		

[illegible]

	Akuutisti myrkylliset aineet		Elinmyrkylliset, karsino- geeniset, mutageeniset ja lisääntymismyrkylliset aineet sekä hengitystie- herkistäjät		Paineenalaiset kaasut ja nesteytetty kaasut
	Akuutisti myrkylliset aineet, iho-, silmä- ja hengitystieärsytystä aiheuttavat aineet sekä ihoherkistäjät		Syövyttävät aineet, vakavan silmävaurion vaaraa aiheuttavat aineet		Räjähdysvaaraa aiheut- tavat aineet
	Helposti syttyvät aineet		Hapettavat aineet		Ympäristölle vaaralliset aineet

A	α	Alfa	a
B	β	Beeta	b
Γ	γ	Gamma	g
Δ	δ	Delta	d
E	ϵ	Epsilon	e
Z	ζ	Zeta	z
H	η	Eta	h
Θ	θ	Theta	th
I	ι	Iota	i
K	κ	Kappa	k
Λ	λ	Lambda	l
M	μ	Mu	m
N	ν	Nu	n
Ξ	ξ	Xi	x
O	\omicron	Omicron	o

Π	π	Pi	p
P	ρ	Rho	r
Σ	σ, ζ *	Sigma	s
T	τ	Tau	t
Y	υ	Upsilon	u
Φ	ϕ	Phi	ph
X	χ	Chi	ch
Ψ	ψ	Psi	ps
Ω	ω	Omega	o