OHANDA

A serious game for engaging young girls from a
low-resource setting of Kenya in STEM education

Emma de Cocker
Masters Thesis • Design for Interaction

APPENDICES

Appendix A - Project Brief

TUDelft

DESIGN FOR our future

IDE Master Graduation
Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME
Save this form according to the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name	de Cocker
initials	EMS given name Emma
student number	5160308
street & no.	
zipcode & city	
country	Netherlads
phone	
email	

Your master programme (only select the options that apply to you):
IDE master(s): ( ) IPD   (★) DfI   ( ) SPD
2nd non-IDE master:
individual programme: _____ (give date of approval)
honours programme: (Honours Programme Master)
specialisation / annotation: (Medisign)
(Tech. in Sustainable Design)
(Entrepeneurship)

SUPERVISORY TEAM **
Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair	Jan-Carel Diehl	dept. / section:	Sustainability
** mentor	Mathieu Gielen	dept. / section:	Children's play
2nd mentor			
	organisation:		
	city:		country:

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

TUDelft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Jan-Carel Diehl   date 12 - 10 - 2022   signature

Jan-Carel Diehl
Digitally signed by Jan-Carel Diehl
Date: 2022.10.12 22:26:28 +02'00'

CHECK STUDY PROGRESS
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _21_ EC

Of which, taking the conditional requirements into account, can be part of the exam programme _21_ EC

(x) YES   all 1st year master courses passed
( ) NO   missing 1st year master courses are:

List of electives obtained before the third semester without approval of the BoE

name K. Veldman   date 13 - 10 - 2022   signature

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: (V) APPROVED   ( ) NOT APPROVED

Procedure: (V) APPROVED   ( ) NOT APPROVED

comments

name Monique von Morgen   date 17/10/2022   signature MvM

Initials & Name	EMS de Cocker
Title of Project	Design of a serious game to engage Lamu girls in STEM education

Student number 5160308

Design of a serious game to engage Lamu girls in STEM education

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date   26 - 09 - 2022   16 - 03 - 2023   end date

The project involves the Kenya Red Cross Society (KRCS) and the IOMe005 fabrication lab, a Red Cross initiative, which aims at providing Science Technology Engineering and Mathematics (STEM) education to children in Lamu county. It is a coastal region located in the Southeast of Kenya and comprises an archipelago with Lamu as the main island. In Lamu, locals live off fishery, agriculture and tourism activities. Boat carpentry is also an old traditional activity from which some people live off. The traditional architecture still dominates (no high buildings), there is little access to Internet and no manufacturing plants or commercial businesses. As a result, locals, including children, are barely exposed to technology.
The IOMe005 Innovation Hub facilitates workshops during which children are taught about STEM and invited to tinker with materials and tools. The team wants to provide equality of chance to access this more modern education by targeting the children of Lamu island. The future vision is to introduce similar initiatives in multiple coastal and rural places in Kenya.

Within the main stakeholders, the lab facilitators value education and promote equality of chance for its access and quality. They currently facilitate workshops and programs at the IOMe005 lab. They want to target the Lamu children who value their time at school and what they learn there. They go to school until a certain age for some, often not after secondary school. The parents of these children play an indirect role. Their priority of feeding their family often comes before sending their children to school. The teachers value education but have limited resources. They already educate children but on more general topics as they have no resources and know-how to teach about STEM. In Lamu county, we find the KRCS volunteers who operate for the good of their community. They take action in several programs, sometimes in emergencies. The leaders have more responsibilities. KRCS also implemented a new initiative called the Red Cross clubs which are led by teachers and students together. They organise events that are facilitated by the IOMe005 lab. Finally, the TU Delft values collaboration with international and local organisations to share knowledge and practices. The Faculty of Industrial Design Engineering has already worked with the IOMe005 team.

This project belongs to a larger initiative from KRCS to bring STEM education to coastal and rural places of East Kenya. KRCS, therefore, provides the opportunity to make use of its network of volunteers from local communities and the resources from the IOMe005 Innovation Hub. However, the organisation has a limited budget for funding the workshops they organise and other side activities. In general, the lifestyle in Lamu County does not offer access to technology and infrastructure is basic; locals live off manual labour, and commute using donkeys and hand-made boats. Nonetheless, the traditional expertise of boat carpentry can be an opportunity to get inspired and learn from. Locals speak Swahili, with English being the teaching language at school. Even if mentalities are gradually changing, low value is put on education and children tend to stop school in secondary school, a trend which is seen more with girls, than with boys. Finally, the island context brings by its remoteness a physical accessibility challenge. Having to transport materials by donkey and boat can limit the spectrum of resources to be used and brought to the schools.

space available for images / figures on next page

IDE TU Delft - E&SA Department /// Graduation project brief & study overview /// 2018-01 v30   Page 3 of 7
Initials & Name   EMS   de Cocker   Student number 5160308
Title of Project   Design of a serious game to engage Lamu girls in STEM education

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introduction (continued): space for images

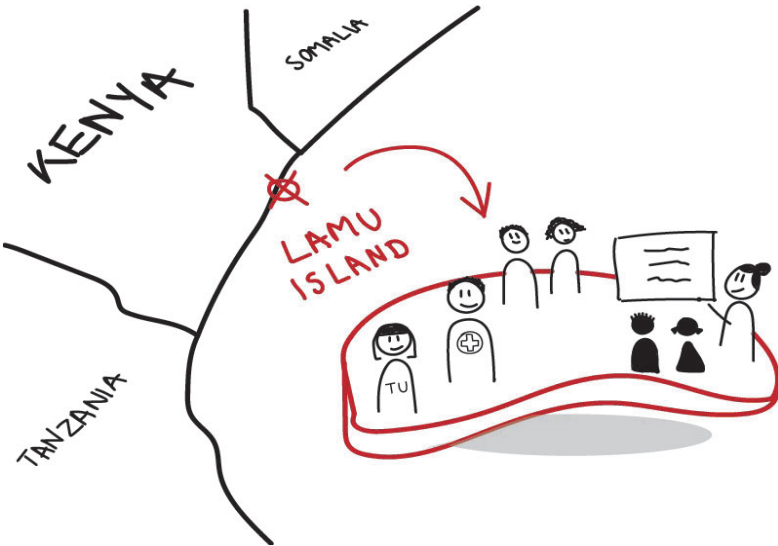image / figure 1:   Donkey race along the port of Lamu during the Cultural Festival

image / figure 2:   Visualised context and its stakeholders

IDE TU Delft - E&SA Department /// Graduation project brief & study overview /// 2018-01 v30   Page 4 of 7
Initials & Name   EMS   de Cocker   Student number 5160308
Title of Project   Design of a serious game to engage Lamu girls in STEM education

4

PROBLEM DEFINITION **
Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Lamu children grow up in a low-resource environment where STEM plays little or no role, and therefore takes barely no part in the education curriculum. However, this trend is different in other, more connected, parts of Kenya which have access to better know-how and resources. The relevance of STEM is such that, in order to tackle the increasingly complex challenges of the 21st century, the future workforce is required to be equipped with a certain set of skills found in these fields [1]. We therefore observe inequalities whereby Lamu children do not have the same chances as other kids to receive relevant education and take control of their own future.
Furthermore, there are also gender inequalities associated with this widely male-dominated topic. In general, strong societal biases and stereotypes convey the idea that STEM is not for girls and that they lack the right abilities for such topics [2]. These ideas tend to push girls away from this type of education leading to their under representation in STEM. This phenomenon also occurs in Lamu. Besides, girls tend to have different interests than boys which are not always accounted for when educating children, especially in gender-mixed classes.
Therefore, considering the context of Lamu, I want to challenge the current stigmas around women in STEM and spark the Lamu girls' interests in these fields. I want to engage them in a relevant way and empower them to build their own future. Ultimately, I aim at providing equal opportunities for the Lamu girls and create female community resilience.

[1] Karanja, F., N. (2021). Unlocking the Potential of Girls in STEM in Kenya: An Assessment Report on the Impact of the UNESCO/GoK STEM Mentorship Programme. United Nations Educational, Scientific and Cultural Organisation.
[2] Hill, C., Corbett, C. & ST. Rose, A. (2010). Why so few? Women in Science, Technology, Engineering and Mathematics. AAUW.

ASSIGNMENT **
State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

I will design a solution that will enable the KRCS to engage the girls of Lamu in STEM education and show them how the associated knowledge and skills can support their future. I expect to deliver a board game (serious game) that challenges current stigmas associated with girls in technology and gets them interested and aware of the purpose and benefits of STEM education.

To ensure the girls' needs and desires are met, I will follow a co-creation process during which I will involve the girls, their teachers as well as the staff and volunteers of the fab lab (and possibly anyone relevant from the community). I will design the product to be contextually relevant and feasible using the educational, financial, technological and organisational resources available locally. The game should be mobile (to be transported by boat and donkey) and preferably portable by the target user. Finally, my design intervention should be easily transferable to the IOMe005 staff to ensure the long-term viability of the initiative.

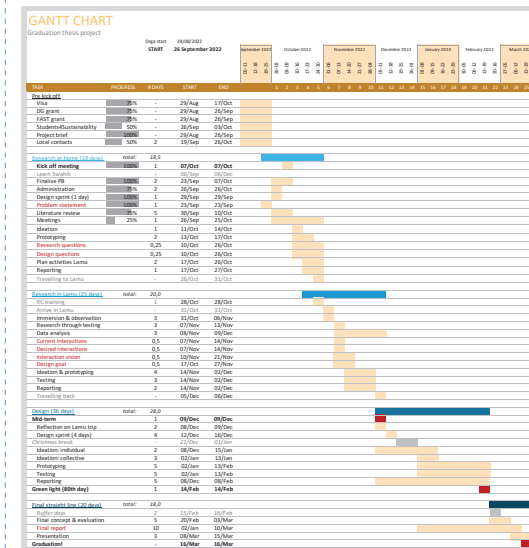These are my research and design questions guiding the exploration of the project:
- What is the current value of STEM education in the world? In Lamu (get different perspectives)?
- What is the position of the girl/woman in Lamu? To what extent can they empower themselves?
- Are there specific topics girls prefer/value/find most important in STEM in Lamu?
- Is a serious game a relevant design form for the context of the project?
- How can I co-create the game with the stakeholders (adapting existing frameworks and methods)?
- To what extent can I involve the IOMe005 staff and volunteers to design and make the product?
- What are the short- and long-term impacts of my design intervention?

PLANNING AND APPROACH **
Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 26 - 9 - 2022   16 - 3 - 2023   end date

During the research and design phase in Delft, I will conduct a literature review including benchmarking and meetings with experts and produce low-fidelity prototypes. I will bring them to Lamu to do research through design. These prototypes aim to be conversation starters and forms of generative materials for co-creating the game with the girls, as well as with the fab lab staff, KRCS volunteers and possibly the teachers. Besides, I will also do some design sprints, develop higher-fidelity prototypes, conduct user tests and concept evaluations.

When I started looking for a graduation project, I was aiming to find one which would involve designing for/with the Global South, ideally for/with children to have an environmental and/or social impact. I am very happy I found the Lamu project which brings all the desired elements! So far in the Masters, I have mainly been designing for students (researching and testing with TU students) or European people aged between 20 and 40 years old. I set up this project for the opportunity it offers to design for a completely new target group in a completely new context. I look forward to immersing myself in an African environment and learn about the culture and traditions of Lamu.

I want to use what I learnt from the mandatory course of the DfI program Exploring Interactions, as well as from the electives Research and Co-design with Children, Material Driven Design and Creative Facilitation. From Exploring Interactions, I learnt how to work individually on a large design project that comprises both a research and design phase. I plan to roughly follow the same process which starts by exploring the current context and the interactions occurring between the target group and other stakeholders as well as their surrounding environment. I found that formulating a design goal and (interaction) vision turned out helpful throughout the project. After envisioning desired interactions, I plan to start the ideation phase and evaluate initial ideas through fast/low-fidelity prototyping and quick user tests. Finally, I found EI challenging at the end when I had to put everything I found together in a final concept. However, I was brought to that challenge again in Material Driven Design for which I successfully designed a final concept which gathered well all elements acquired through the process. Besides, the elective Research and Co-design with Children gave me a first opportunity to research and design with kids. I now understand the challenges and opportunities designing for younger users bring to the table. I enjoyed the combination of freedom and structure the course allowed, and I would like to make use of a good balance of both again. Finally, I grew my creative confidence during the block course Creative Facilitation where I put in practice methods and skills to facilitate sessions in a creative way. I plan to transfer these abilities to co-create concepts with the stakeholders.

Appendix B - Pictures of research materials

Ice breaker exercise

Self-assessment on school subjects

Mapping the home situation and school subject preferences
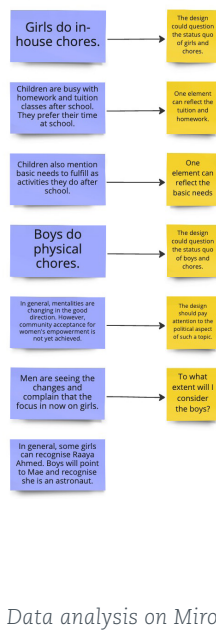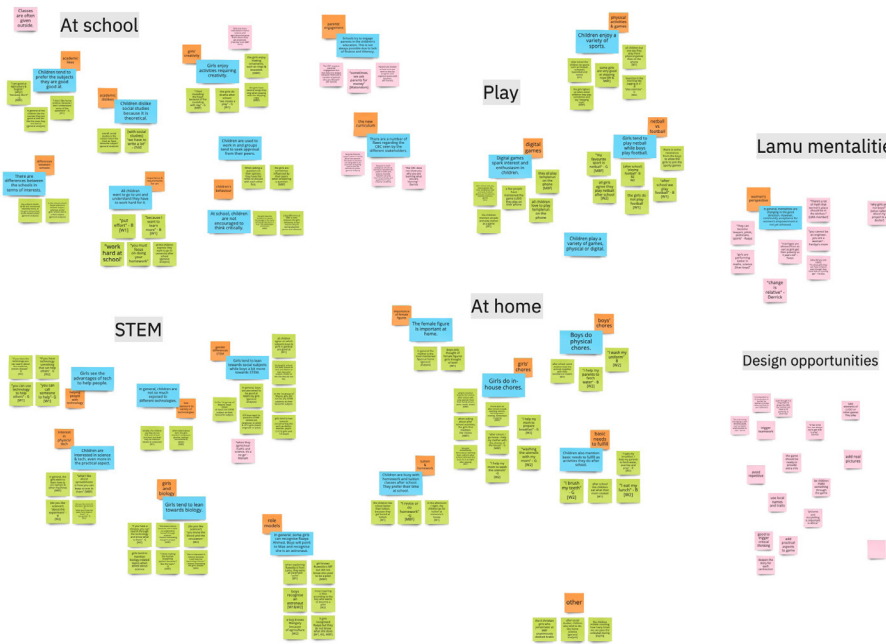
Data analysis on Miro

Appendix C - Types of board games relevant for the canvas

Type of board game	How it is played	Why it is relevant
deck-builder	starting from an identical set of cards, players change it to only keep the best ones (ex: Dominion)	working towards the goal of getting better by trial-and-error
dexterity	players play using physical abilities (ex: Twister)	the whole game can involve practical activities
role-playing	players use their imagination and storytelling to take on characters (ex: Dungeons and dragons)	characters can be inspirational figures, "storytelling is strong in Africa" (-member of the Lamu Women Alliance)
engine-builder	players win by increasing and enlarging their resources (ex: Splendor)	resources can be knowledge and skills
role-and-move	players roll a die and move accordingly on a board which triggers some actions (ex: Monopoly, Game of Life)	actions can gradually build knowledge and skills

Appendix D - Game design toolkit for the IOMe

INSTRUCTIONS - HOW CAN I USE THIS CANVAS?

Print this page so you keep the explanation about the canvas with you when using it.

HOW AND WHERE TO START?

This is the first page of the instructions to using this canvas, and the first page you should read. These instructions belong to a toolkit which you should download and print. If you have not done it yet, go ahead and print everything! But what is everything?

Everything is:

1 5 instruction pages *(reading flow is indicated)*

2 4 pages to be combined for the generator tool

3 8 seperate block pages

4 4 pages to be combined for the evaluation tool

Now read page 2/5 (next page) ⟶

INSTRUCTIONS - HOW CAN I USE THIS CANVAS?

Print this page so you keep the explanation about the canvas with you when using it.

WHAT IS THIS CANVAS FOR?

This canvas is a tool elaborated for the innovators of the IOMe005 Innovation Hub to brainstorm ideas for making games. The tool guides part of the design process whereby the assignment is to design a game as a solution to a given problem. The game is designed to be played by a specific group of users (see example below).

The game in question is not only fun but also has a purpose. This purpose can be:
• purely educational by teaching skills or knowledge to players
• stimulating players to problem-solving and critical thinking approaches
• triggering reflection and discussions on serious issues.

> **EXAMPLE OF AN ASSIGNMENT**
>
> The problem of plastic pollution is getting more and more serious in Lamu. There are a few initiatives like Flip Flopi which makes people from the community curious and sensitised to this issue. However, this mindset and action taking hardly reaches the elderly of the community. The Kenya Red Cross Society is calling for the expertise of the IOMe to develop a serious game to sensitise the elderly to plastic pollution.
> *So let's list the 3 things to know about this assignment:*
>
> Problem as given by the client: THE ELDERLY ARE NOT SENSITISED TO PLASTIC POLLUTION
> Users of the game (players): THE ELDERLY OF THE COMMUNITY
> Context (where the users are): LAMU ISLAND

STEP 1 IS WHERE YOUR CREATIVITY SHOULD GO WILD

The design process for developing such games typically looks like:

1. Generate as many ideas, also called "concepts" as possible, don't think too much about it! You can aim to have 10 for one assignment.

2. Select the design requirements you think are important to consider for the given assignment. You can aim to choose between 5 and 9 requirements.

3. From the 10 initial concepts you generated, select the 3 concepts that best meet the design requirements you selected during Step 2.

4. Make a prototype for these 3 concepts and test them with users! You will be able to see which concept fits best the users' needs and select the winning one.

5. Develop further the selected concept to make it even better. You should think of the rules the game should have, whether there are points, etc. **Always keep in mind your purpose.**

This tool is designed to guide the first two steps (greyed out) of this design process. It allows the innovators to first **generate innovative concepts** and **as many as possible** given one project brief, and secondly **evaluate the selected concepts** throughout the design process. For these two aspects, the canvas is divided in two tools: a concept generator tool and a concept evaluation tool.

Getting familiar with the whole canvas will take approximately 1 hour. You will then be able to start brainstorming.

Now read page 3/5 (next page) ⟶

INSTRUCTIONS - HOW CAN I USE THIS CANVAS?

Print this page so you keep the explanation about the canvas with you when using it.

Have the GENERATOR TOOL pages close to you so you can better understand how to use it.

HOW CAN I USE THE GENERATOR TOOL TEMPLATE

The generator tool consists of blocks corresponding to the key "pillars" which are important for creating a concept/idea for a game. These blocks have to be filled in by choosing "ingredients". For each block, there is a page explaining what the block means and how it should be filled in. There is also a list of possible ingredients that you can choose which are written on cards that should be cut. You can also create your own ingredients.

Example of a block

On the block page indicated in the right corner by BLOCK PAGE , you will find the following information:

TOPIC — the name of the block

LIKE ON THE GENERATOR TOOL TEMPLATE

TOPIC

the question you should ask yourself when filling in the block

what this block means and when it should be filled in

how many ingredient cards to pick for this block

STEM — ingredient cards that you can choose when filling in the template

empty cards on which you can write your own ingredients

The goal of this tool is for you to imagine an idea for a game to serve the purpose and solve the problem of the users. You start by defining what this purpose is in terms of transfer effect(s) and of the topic(s) you want to talk about. You imagine a game world to better guide the players in the game, and for them to have fun. You also think of the physical look of the game and what kind of interactions the players have.
More explanation is given for each block on the corresponding block pages.

NB: the canvas does not include decisions on the facilitation but games should be facilitated by a game master to ensure that the purpose of the game is achieved and that the rules are respected.

INSTRUCTIONS - HOW CAN I USE THIS CANVAS?

Print this page so you keep the explanation about the canvas with you when using it.

GOLDEN RULES BEFORE STARTING!

Order for using the tools
It is best to generate concepts without thinking too much about the constraints. This allows to let your imagination and creativity be free, and potentially come up with great, innovative and out-of-the-box ideas.

➡ After reading this page, you will start by using the generator tool and follow the *"How to use me?"* guidelines written on the template. Only after you used it, you will look at the the evaluation tool (by following the *"How to use me?"* guidelines).

Using the generator tool
The generator tool is a low-key, quick-to-use tool. The main goal is to generate as many concepts as possible within a short time.

➡ Follow the golden rules for using the generator tool:
   1. **allow yourself to combine elements that you think are hardly combinable**
   2. **do not think at how you will actually make the game and if it's even possible**
   3. **postpone judgement** (if you are working in a team)

Offline setting
This toolkit is best used as paper format instead of digitally. It allows to have a dynamic brainstorm.

➡ If you have not done so yet, download and print the canvas templates as well as the ingredient cards. Cut the cards and tape together the 2 template sheets.

Teamwork vs individual
The intention of using this canvas is to have a fast brainstorm session. This is best done when working individually or in small teams to avoid long discussions that should not happen when using the generator tool.

➡ If working in teams, limit yourself to maximum 3 people. In that case, you can even assign roles where one facilitates (does not take part in the decisions) and the other two make decisions.
➡ Don't worry, you will have plenty of time to be critical and think of how you can actually design and make the ideas you come up with. This happens later on, from Step 3 of the design process (page 1).

Timing
Timing is key to have a successful session.

➡ Take your time to get familiar with the canvas first.
➡ Once you are familiar, put a timer for 5 minutes to create one game idea (with the generator tool).
➡ If you are stuck on a block, just move on to another block. It is ok to leave blocks empty, it is even recommended!

BUT MOST IMPORTANTLY, HAVE FUN!

INSTRUCTIONS - HOW CAN I USE THIS CANVAS?

Print this page so you keep the explanation about the canvas with you when using it.

Have the EVALUATION TOOL pages close to you so you can better understand how to use it.

HOW CAN I USE THE EVALUATION TOOL TEMPLATE?

This second tool guides the innovators to decide which are the relevant design requirements, so the important things the game should have or be in order to be suitable for the users and their context. These requirements are categorised under 3 general evaluation criteria:
• feasibility - *is the game easy to make?*
• desirability - *do the users want to play? does the client approve the game?*
• viability - *is the game played on the long-term? does it give long-term effects on users?*

The evaluation tool is used after the generator tool to avoid having all the design constraints in mind when being creative in the ideation phase (Step 1 of the design process). So these requirements stay the same for any of the concepts you previously generated. They will help you choose the best 3 out of the many you created.

Example

Take the example of the project given to the IOMe to design a serious game for the elderly (page 1 of the instructions). The requirements for such a game could be:

FEASIBILITY	DESIRABILITY	VIABILITY
THE GAME SHOULD BE MADE AT THE IOME, THEREFORE USING THE LOCAL EXPERTISE AND AVAILABLE MATERIALS.	THE DESIGN OF THE GAME SHOULD INCLUDE TYPICAL THINGS OLD PEOPLE FROM LAMU DO IN THEIR EVERYDAY LIFE	THE GAME SHOULD MAKE THE ELDERLY UNDERSTAND THE PROBLEM OF PLASTIC IN THE OCEAN SO THAT THEY CHANGE THEIR BEHAVIOUR

The goal of this tool is for you to decide the important things the game should have or be, to prepare for Step 3 of the design process. In each of the columns, you pick requirements and address the four guiding questions:

1. Phrase requirement as a question - *this helps to put in words what the game should achieve*
2. Where does it come from? - *this allows you to keep track of the decisions you make*
3. Who/what does it concern? - *this makes you think who is affected by this requirement (target users? client? the game itself?)*
4. How to evaluate the requirement? - *this allows you to already think of the evaluation procedure and imagine the desired outcome*

Once these questions have been addressed, you can tick the box of the requirement. You are also free to formulate your own requirement to be more specific to the assignment you work on.

NB: it is important to allow yourself to change or even remove the initial requirements later on in the design process. Some might appear not that relevant anymore as you further develop one concept (Step 5 of the design process).

GENERATOR TOOL - LET'S CREATE GAME IDEAS!

What is the problem to be solved? _

Who are the users of the game? Who will play? _

Where would the game be played? _

FROM COMPONENTS

START HERE

YOU CAN GO HERE

TOPIC

and talks about .....

EMOTIONS

in a ..... and fun way

STORYLINE

and immerses the players in a story about...

TRANSFER EFFECT

The game aims to .....

OR HERE

ARE YOU DONE? THEN READ THE SENTENCE OUT LOUD BY FILLING THE GAPS WITH THE CHOSEN CARDS

OTHERWISE GO TO TYPE OF GAMES

OTHERWISE GO TO TOPIC

TYPE OF GAME

and is built as a .....

INTERACTIONS

where players play in ..... and with .....

COMPONENTS

and the game consists of .....

FROM STORYLINE

TRANSFER EFFECT

Print this page so you keep the explanation about this block with you when you use the template.

WHAT IS THIS BLOCK ABOUT?

Next to having fun, what is the intention behind playing this game?

This block is the most important one. It helps you define the purpose you want to give to the game.

You should select 3 transfer effects maximum for one concept.

WHAT ARE THE POSSIBLE INGREDIENTS?

Cut the following cards and use them to fill in the template sheet (generator tool).

ACQUIRE KNOWLEDGE	ACQUIRE SKILLS	SPARK INTEREST
GET INSPIRED	CHANGE MENTALITIES	CHANGE BEHAVIOURS
BOOST SELF-CONFIDENCE		

EMPTY CARDS THAT YOU CAN FILL IN

TOPIC

Print this page so you keep the explanation about this block with you when you use the template.

WHAT IS THIS BLOCK ABOUT?

What is the game about? Which topic(s) are important to talk about?

This block helps you define what the purpose of the game should be about. It gives the content to the *transfer effect*. It can be addressed after the *transfer effect* or the *components*.

You can select up to 3 topic cards for one concept.

WHAT ARE THE POSSIBLE INGREDIENTS?

Cut the following cards and use them to fill in the template sheet (generator tool).

STEM	DRUG CONSUMPTION	VIOLENCE & CRIME
HEALTH	ENVIRONMENT CONSERVATION	POLLUTION & WASTE
IOMe MAKER SPACE	CARPENTRY	
BOAT DESIGN	ANIMALS	

EMPTY CARDS THAT YOU CAN FILL IN

EMOTIONS

Print this page so you keep the explanation about this block with you when you use the template.

WHAT IS THIS BLOCK ABOUT?

How can I make the game fun? Which emotions and feelings should the players have?

This block guides you in choosing what kind of emotions you want the players to feel and how the fun should take place. It complements the purpose so it should be addressed after the *topic*.

You can select 3 emotion cards maximum for one concept.

WHAT ARE THE POSSIBLE INGREDIENTS?

Fellowship: the players feel emotions for the other players as the game and the fun is all about encouragement, solidarity and help

Narrative: the players get immersed in a game which has a strong narrated story (to choose after this block) which triggers related emotions

Discovery: the players have fun by exploring a new world presented by the game which can trigger emotions like suspense and excitement

Challenge: the players feel emotions like excitement and stress because they have to complete challenges and master some skills and knowledge

Expression: the players have fun by expressing their personality, creativity, imagination, etc which can trigger emotions towards themselves

Cut the following cards and use them to fill in the template sheet (generator tool).

FELLOWSHIP	NARRATIVE	CHALLENGE
DISCOVERY	EXPRESSION	

STORYLINE

Print this page so you keep the explanation about this block with you when you use the template.

WHAT IS THIS BLOCK ABOUT?

How does the game world look like? What is the story of the game?

This block helps you imagine the game world in which players are immersed. The relevance of the storyline directly affects how good the *transfer effect(s)* are achieved. The story can be more or less strong based on the chosen *emotions* (narrative will have a strong story compared to fellowship).

Several ingredients can be combined to create one story.

WHAT ARE THE POSSIBLE INGREDIENTS?

Cut the following cards and use them to fill in the template sheet (generator tool).

AFRICA	LAMU	CHINA
CULTURAL FESTIVAL	OCEAN	BEACH
DONKEYS	DHOWS	HENNA
FARM	RELIGIOUS INSTITUTION	
FOOTBALL	SCHOOL	

EMPTY CARDS THAT YOU CAN FILL IN

TYPE OF GAME

Print this page so you keep the explanation about this block with you when you use the template.

WHAT IS THIS BLOCK ABOUT?

What kind of game fits for achieving the purpose?

With this block you select the type of game that helps you achieve the *transfer effect(s)* you picked. It can be addressed after *transfer effect* or *storyline*.

Select only 1 type of game.

WHAT ARE THE POSSIBLE INGREDIENTS?

Deck-builder: players start the game with an identical set of cards and change their own card set to keep the best ones only (which ones are the best cards is for you to decide but later in the process!)

Dexterity: players make use of their physical abilities (with that type of game you can make players practice manual skills for instance. Google Twister if you are not sure what "dexterity" means)

Role-playing: players use their imagination and storytelling to role-play a certain character (maybe this character has certain powers which are skills or knowledge the players can acquire?)

Engine-builder: players win by increasing and enlarging their resources (maybe these resources represent knowledge and skills for the players to acquire in order to win?)

Role-and-move: often played on a board, the players roll a die and move accordingly. This triggers actions players have to do in order to continue playing. (Ludo is a simplified version of role-and-move. You can also look at the UDADISI board game designed for girls!)

Cut the following cards and use them to fill in the template sheet (generator tool).

DECK-BUILDER	DEXTERITY	ROLE-PLAYING
ENGINE-BUILDER	ROLE-AND-MOVE	

INTERACTIONS

Print this page so you keep the explanation about this block with you when you use the template.

WHAT IS THIS BLOCK ABOUT?

Who are the players playing with? Is there competition?
Are the players playing in teams?

This block helps you define the interactions with the players. You choose whether the users are in teams, if there is competition and with whom are the users playing? It comes after *type of game*.

One of the two cards about teams and competition should be selected.
From the other cards, you can select a maximum number of 3.

WHAT ARE THE POSSIBLE INGREDIENTS?

Cut the following cards and use them to fill in the template sheet (generator tool).

teams?	*teams?*	
PLAYED INDIVIDUALLY	PLAYED IN TEAMS	WITH OTHER TARGET USERS
competition? WITH COMPETITION	*competition?* WITHOUT COMPETITION	WITH PLAYERS WHO ARE NOT TARGET USERS
WITH KRCS VOLUNTEERS	WITH IOMe INNOVATORS	
WITH FAMILY	WITH GAME MASTER	

EMPTY CARDS THAT YOU CAN FILL IN

COMPONENTS

Print this page so you keep the explanation about this block with you when you use the template.

WHAT IS THIS BLOCK ABOUT?

What components other than the main one (chosen with format) should the game have? Are the look and feel important?

By filling in this block, you embody the game. You can choose game components and add a characteristic (indicated with a ●) but this is **optional**. This block should be addressed once the *type of game* and *interactions* are defined.

An infinite number of components can be combined. Be careful that the more you choose, the more complex your concept will be.

WHAT ARE THE POSSIBLE INGREDIENTS?

Cut the following cards and use them to fill in the template sheet (generator tool).

CARDS	DICE	BOARD
PAWNS	COINS	BEADS
BELL	PUZZLE PIECES	TOTEM
HOURGLASS (or other type of timing system)	ROPE	BALL

MONEY (or other type of trading system)	SIGNS OR BODY LANGUAGE	
● IMAGE	● TEXT	● SYMBOLS
● NUMBERS	● PLASTIC	● WOOD
TEXTILE	● ANY SURROUNDING MATERIAL	● SQUARE
● CIRCLE	● TRIANGLE	● ODD SHAPE
●	●	●
●	●	●

EMPTY CARDS THAT YOU CAN FILL IN

EVALUATION TOOL – LET'S EVELUATE AND SELECT THE BEST IDEAS!

HOW TO USE ME?

1. Print the template sheets on A4 and tape them together (it should make an A2). Place the template sheet flat on a table.
2. If you have not done so yet, read page 5 of the instructions.
3. Remind yourself what the problem is, who the users/players are and what the context is (block on the left).
4. Read first the suggested requirements and see whether these suit your assignment.
5. Pick the ones that are relevant and fill in the empty text boxes:
6. Once filled in, tick the box: ●
7. You can write your own requirements in the empty boxes below each column:
8. Aim to choose 5 to 9 requirements in total.

What is the problem to be solved?

Who are the users of the game? Who will play?

Where would the game be played?

FEASIBILITY

Manufactured using locally available resources
- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

Manufactured using locally available expertise
- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

Easily transportable
- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

DESIRABILITY

Is fun to play
- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

Fits the client's vision
- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

Fits the players' context
- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

VIABILITY

Achieves the transfer effects
- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

Game is still played after 3 years
- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

Players eventually become facilitators
- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

- *Phrase the requirement as a question:*
- *Where does the requirement come from? Why is it important?*
- *Who/what does it concern?*
- *How will we evaluate whether the requirement is met?*

APPENDIX E - CANVAS DESIGN ITERATIONS

This appendix complements the information regarding the development of the canvas. The different versions prior to the final design were tested, either with users or by the researcher herself, and consequent improvements were implemented to make the next prototype.

Concept A - the "star" canvas

The development of this canvas

This is the first canvas which was developed during the first ideation phase during research in Delft. The goal for setting up this template was to get as many ideas for game concepts as possible to be able to prototype some ideas and test them during field research in Lamu. As the canvas was being used, it was found that this tool also helped the user in coming up with concepts which are creative and out-of-the-box.

It started with writing on post-its all the elements that came to mind which could feature in a game. These elements were components but also types of games or transfer effects. The post-its were eventually clustered and the groups were named, inspired from the findings of the literature and own experience with playing board games.

The use of this canvas

These clusters make the nine key words present on the star canvas: effect, medium, form, interactions, content, storyline, aesthetics, elements and guideline. At this point, the guidance was considered to be an extra group that would not have an impact on the other ones. Therefore, it was put aside, on the bottom left corner.

The way to use this canvas is the same as for the final version. Ingredients are picked for each of the pillar which eventually make a game concept. The canvas was designed in a shape of a star to be read clockwise. The effect would be picked first as being the most important pillar, followed by the medium, the form, etc, until the element(s).

However, after generating four different concepts, it was difficult to come up with varied ones. It was realised that some ingredients had not been picked. A new generation process started whereby four new concepts were produced by starting at another pillar than the effect. Furthermore, when it was difficult to pick ingredients from pillar after one another, some pillars would be skipped and gone back to later. This helped with keeping a creative process.

Finally, a short statement was written for each of the concepts to explain the idea behind it.

The meaning and source of the pillars

The star canvas consist of nine pillars which were derived from the literature and/or own experience.

Effect corresponds to the purpose or transfer effect that should be realised when players play the game. Examples are to acquire knowledge or skills, inspire, change mentalities, etc. This pillar was taken from the Persuasive Game Design method (Visch et al., 2013) and the corresponding ingredients were inspired from the relevant literature and the experience in Lamu.

Medium corresponds to the physical foundation of the game. For instance, the game can be a board game but also an escape game. This pillar and the possible ingredients were derived from my own experience.

Form complements the medium by adding a cognitive dimension to the game concept like constructive or free-end setting. This pillar and ingredients come from the Persuasive Game Design method (Visch et al., 2013).

Interactions define in what social setting the players are and with whom they interact. There can be competition, players can be in teams. Players can be the end users and play amongst each other but they can also play with other stakeholders of the project. This was derived from the conceptual framework for educational games (van Staalduinen, 2012).

Content is the topic the game addresses, which supports the definition of the effect(s). The content cards were listed from the project context such as plastic pollution, boat design, etc. This pillar was derived from the conceptual framework for educational games (van Staalduinen, 2012).

Storyline represents the game world. The cards were listed from the project context such as Kenya, the archipelago, religious institutions, etc but other cards can be written for other contexts. The need for a storyline was derived from the Persuasive Game Design method (Visch et al., 2013).

Aesthetics constitute the mean by which players have fun and feel certain emotions. This can happen in narrative or challenging way for instance. This pillar was taken from the Mechanics, Dynamics and Asthetics approach (Hunicke, et al., 2004).

Elements are the physical components the game can consist of such as cards, rope, totem, etc. These were taken from experience with playing board games.

Guidance is the way the players are guided throughout playing the game. There can be a facilitator or only instructions, or both, etc. Guidance was taken from experience in playing serious games.

Left diagram (template)

content

interactions   storyline

form — aesthetics

medium   elements

effect

guidance

Right diagram (ingredients)

interactions (pink)
l'un contre l'autre (→ competition)
collectif (→no competition)
in teams (→competition)
individuel (→competition)
other girls   teachers   KRCS
boys   parents   siblings

guidance (blue)
instructions   no instructions
facilitator

storyline (pink/red)
Africa   Kenya   Cultural festival   tourists
school   archipelago   ocean   beach
class room   fauna flora   dhows   nature elements (air, wind, water,etc)
climate change   garden   home   religious institution   China

effect (teal)
show role models   get knowledge   practice knowledge
acquire skill   practice skill
tackle bias   lower standards (for self assessment)   complete a challenge
tackle stereotypes   shift to growth mindset   cultivate interests

medium (green)
deck of cards   escape game
board game (any shape)   dice
physical

form (green)
time pressure   constructive (progress)
practical   free-end
living game   role play

aesthetics (yellow)
challenge
narrative
fellowship
expression
discovery

elements (orange)
any surrounding material   non-conventional cards   progress   reward   conventional cards   totem
pions   autres figurines (maison, nourriture...)   conventional dice   bell   rope   money   points
board   puzzle pieces   sablier   non conventional dice   ball   signs

content (purple)
boat making   properties of matter and materials (CBC)   role models   fixing things   laser cutting
STEM   composition of air (CBC)   tinkering   forces (CBC)   Work machines (CBC)

(yellow, elements cont.)
rectangle   text   drawing   symbol   image (realistic)   colour   Spiral   make yourself
images (non-realistic)   progress (ex: move forward)   odd size   any shape   circle   triangle   odd shape   number

Figure XX. Template and ingredients of Concept A

Concept B - the "block" canvas

Concept A was used in the first ideation phase of the project to generate eight concepts. After that, design requirements for the project were defined which led to selecting two concepts and discard the other six as they were not meeting the requirements. Two prototypes were made for these two ideas. Later in the project, a third concept was generated, prototyped and tested.

Towards Concept B - changes in the pillars
It was decided to iterate on this canvas which was found promising by the client as a tool that the IOMe innovators could use themselves.

Therefore, a reflection was done on the experience with Concept A to review and edit the tool. The findings of the literature review were used to revisit the meaning and source of each pillar. This led to changing "medium" to "format" and only consider the three main game components (die, board and cards) as possible formats (see ingredient lists). Similarly, "form" changed to "types of games" because of the scope to specifically focus on board games. The "effect" pillar was also better defined as "transfer effect" from the Persuasive Game Design method (Visch et al., 2013). The pillar "elements" was renamed as "components" to be more specific. Besides, "guidance" became "facilitation" which was considered as a set of questions rather than a pillar. Similarly, "dimensions" was introduced. These sets of questions encourage the users to ask themselves questions rather than picking ingredients, and start imagining how the game can be embodied and facilitated.

A number of ingredients were removed, because they were not relevant anymore with the newly defined pillar, either from the whole canvas or just moved to another pillar. Some ingredients were rephrased to better match their group.

Towards Concept B - structural changes
In parallel of reviewing each pillar, the structure of the tool was revised too. It was designed as multiple blocks, each corresponding to a pillar, to be filled in with ingredient post-its. This new structure allowed to create different user flows while strengthening the organisation of these flows.

Towards Concept B - addition of a tool
The need to guide the selection of design requirements and to then evaluate the genrated concepts led to designing a new tool. The overall canvas was therefore split in two tools: the generator tool (the first tool that was developed) and the evaluation tool 9the new tool).

Figure FIXME shows the initial ideas for the structure of Concept B, including the evaluation tool (bottom picture).

Concept B in a nutshell
Eight blocks with two sets of questions now compose this new version of the canvas tool for concept generation: transfer effect, type of game, interactions, format, components, dimensions, content, aesthetics, storyline, and facilitation. The way to use this canvas is the same as for the final version. Ingredients are picked for each of the pillar which eventually makes a game concept. The source of each pillar is also the same, or as explained above. Different user flows are possible but users should start by filling in the transfer effect(s).

Regarding the evaluation tool, users can pick from already defined design requirements or add their own. Four questions guide the selection of each requirement.

This canvas was developed as a digital version to be tested with end users. It is shown in Figure FIXME (next page).
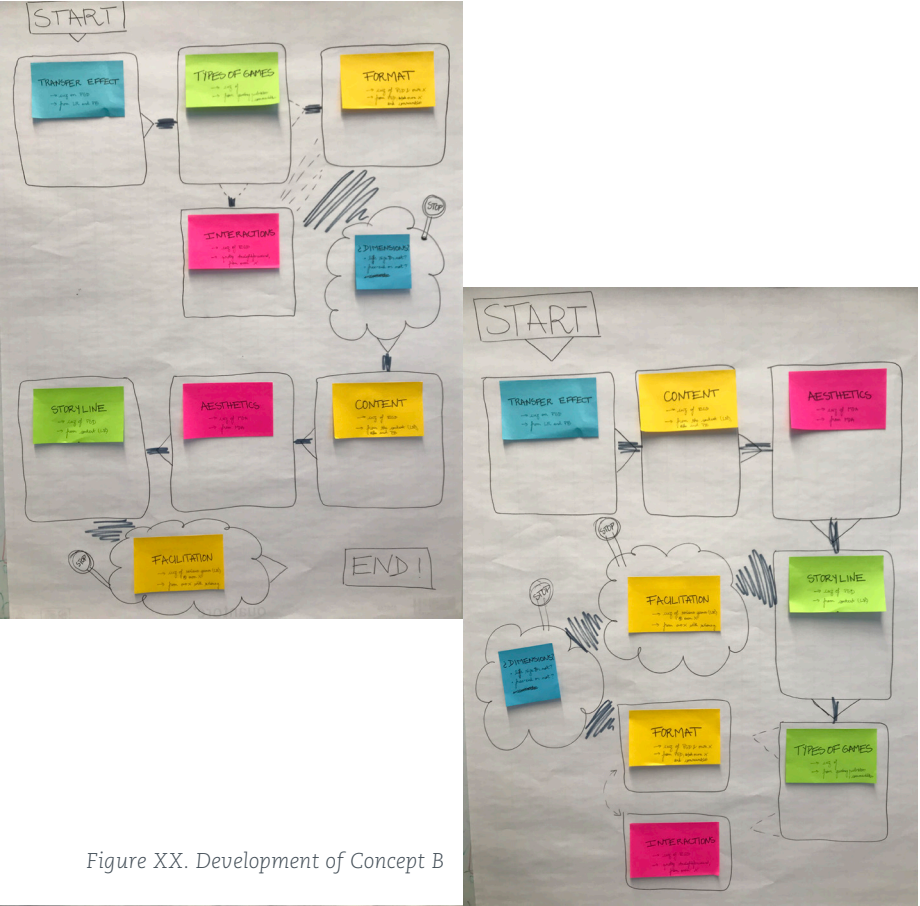
Figure XX. Development of Concept B
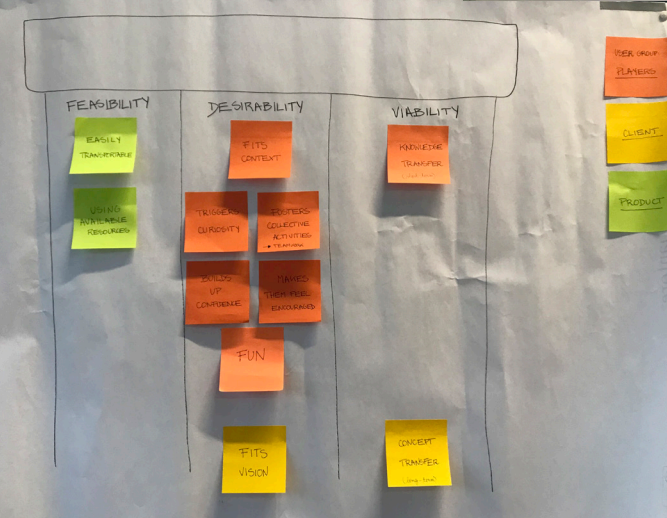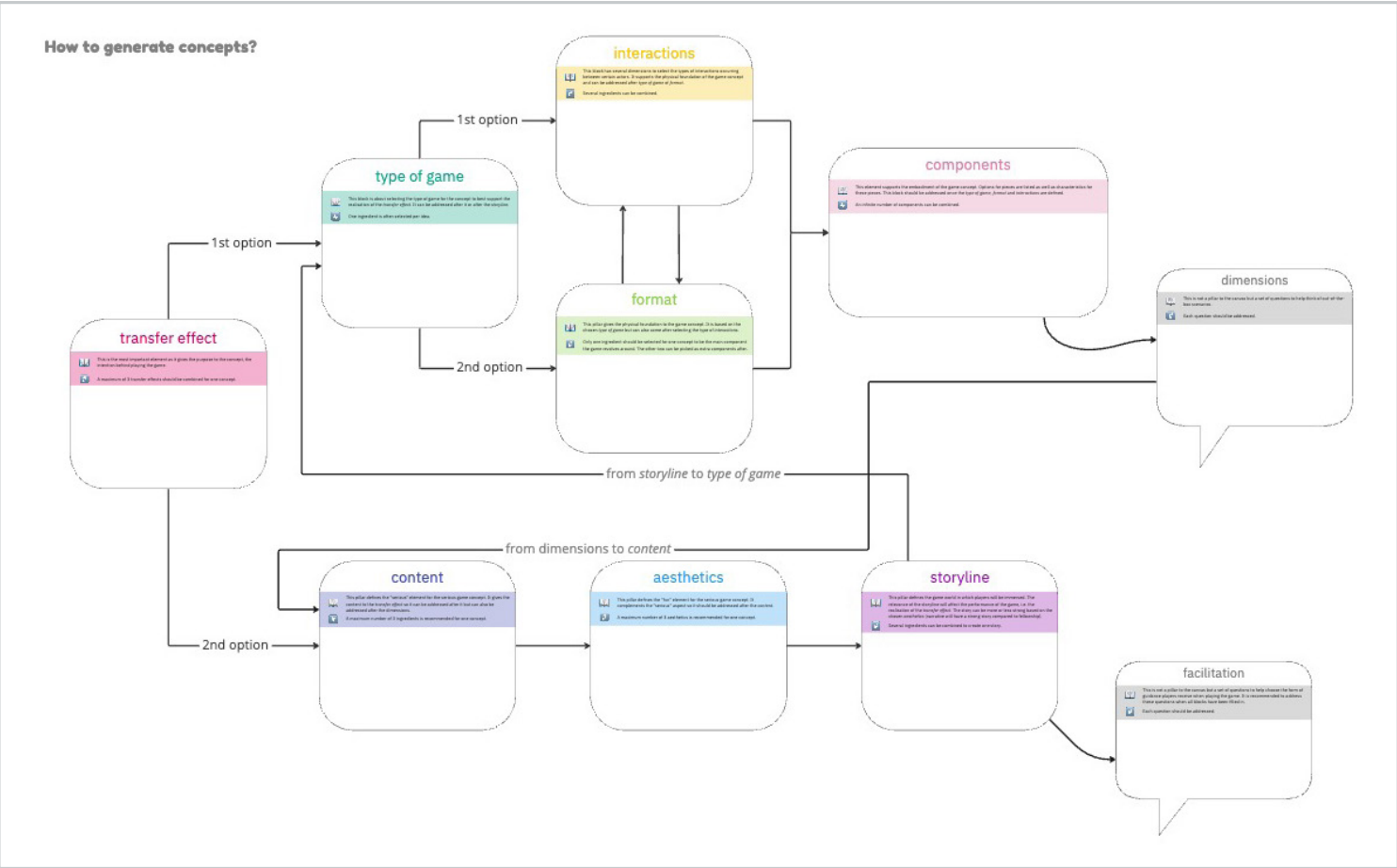
Figure XX. Concept B
Top: generator tool
Bottom: ingredient post-its
Right: evaluation tool

Testing Concept B

As mentioned above, this concept was developed digitally on the platform Miro to be able to test it with end users. This user test was organised as an online workshop supported by a Miro board, as shown in Figure FIXME. The researcher of this project facilitated the session with two facilitators and one innovator of the IOMe as participants. It lasted for almost two hours.

The user test started with an energiser, playing Tic Tac Toe (step 1). The aim of playing this game was to set a relaxed and fun mood, as well as get the participants familiar with the action of dragging items of Miro as it would be used throughout the workshop. A fake but realistic project brief was invented (step 2 of Miro board beside) from which, the assignment to generate concepts for a game to solve the given problem was given to the participants. The persona as on page 29 was presented and both canvas tools were explained. The team was then given some time to generate concepts. At the end, a moment of reflection was conducted to get feedback from the users.

Improving Concept B

The main insights and the solutions given to solve the issues found during the workshop are explained in Chapter 3. The complete set of insights is presented on the next page, followed by the first version of the toolkit. As explained in Chapter 3, it was decided to make a digital toolkit which can be printed for in-person brainstorming sessions with minimum preparation time. The first version of this toolkit as improvement from the Concept B tested through the online workshop is displayed after presenting the insights. The usability of this first version was tested with a fellow design student as demonstrated in Chapter 3. A final version of the toolkit was then made by taking into account all feedback. This version is presented in the next Appendix.
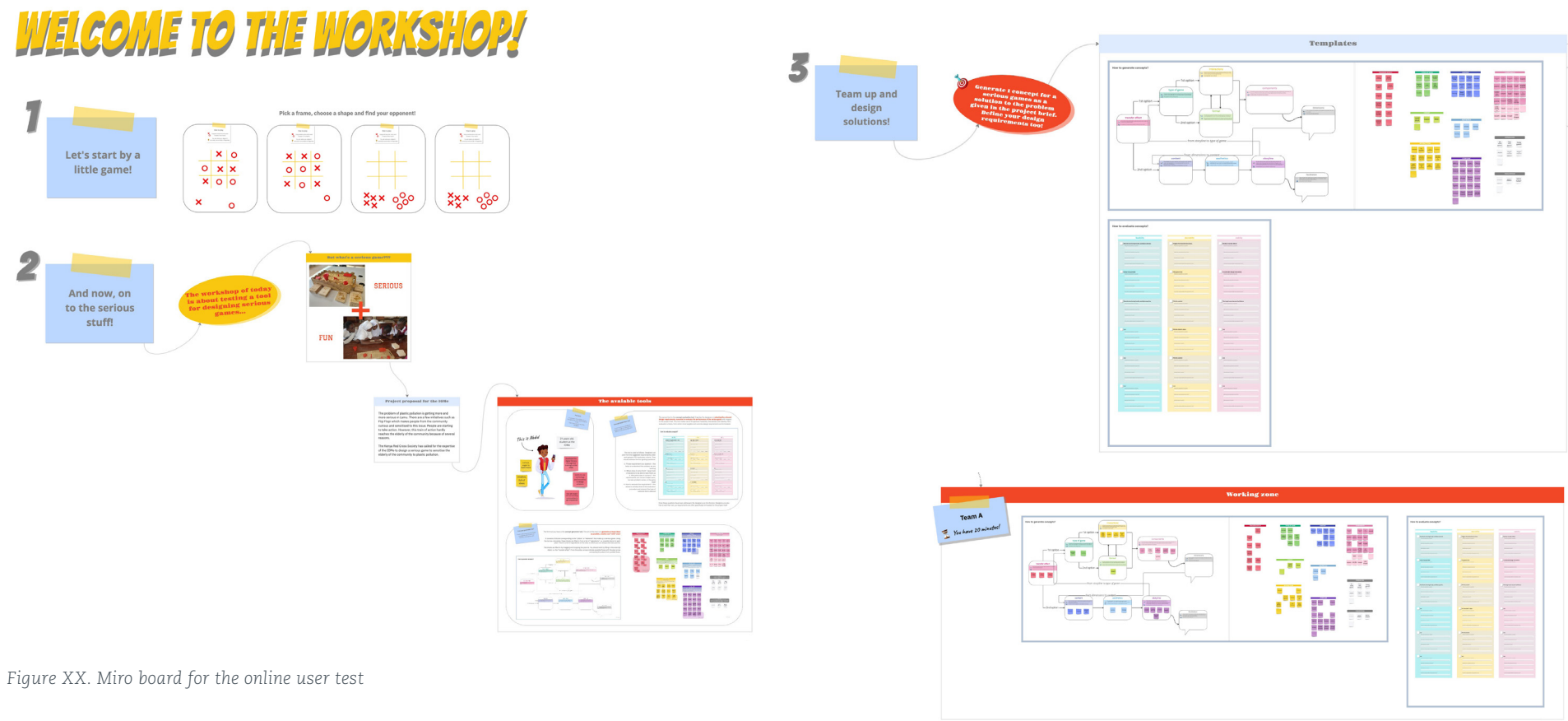
Figure XX. Miro board for the online user test
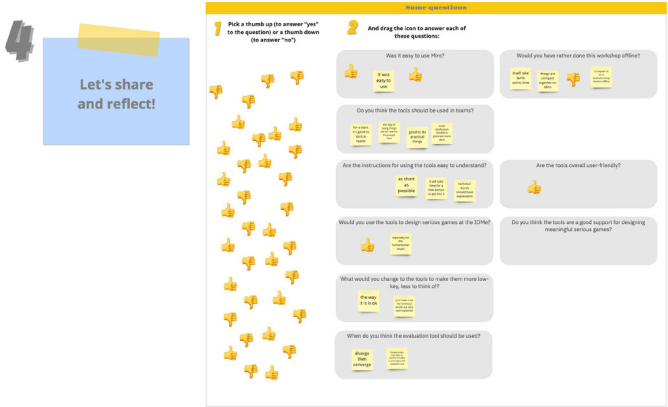
Main insights from the online workshop

Insights on the execution of the user test, as well as the on the use of the canvas were collected during the user test. These are reported (what happened?) and an explanation is given for why it happened as such (why did it happen?). They are then translated into actions (things to change, remove or improve about the game) and insights which are more like general conclusions (what can be concluded?).

The execution of the user test

WHAT HAPPENED?	WHY DID IT HAPPEN?	WHAT CAN BE CONCLUDED?
1. The participants understood well the workshop instructions and the flow of the session was good at the beginning.	They knew how to use Miro which made it easy to start and the instructions were clear. The energiser was effective in getting participants engaged at the start.	Miro board is a good platform to conduct online user test. The number of features to be used by the participants should be kept minimal and the ones to use throughout the session should be "tested" through the energiser.
2. The workshop started 40 minutes late to have more participants. However, only 3 participants showed up to the workshop, instead of the many requested.	The reason is not known.	Flexibility is key when designing with and for another culture with which communication happens differently.
3. They would rather do such a session offline but preparing all post-its would "take quite some time".	They like the readiness of a Miro board but recognise that brainstorming sessions are better offline.	A toolkit which is donwloadable and printable can be made as end product to give to the client.

The use of the canvas

4. The users found the canvas "user-friendly" and stated they would use it, "especially for humanitarian issues".		Overall, the product was accepted by the users and a better version should be made as final design.

WHAT HAPPENED?	WHY DID IT HAPPEN?	WHAT CAN BE CONCLUDED?
5. The use of the generator tool took way longer than planned which led to not testing the evaluation tool.	It takes quite some time for users to get familiar with the tools before efficiently using them. Some aspects lacked explanation.	An indicative time of about 2h to get familiar with the tool should be added. More explanation should be added to technical words. The evaluation tool should be tested.
6. They were confused with the types of games', aesthetics', dimensions' and some of the components' ingredients.	There was no explanation of the technical words such as "dungeon-crawler".	Add a short explanation to technical words and revise these words to see if they can be rephrased or even removed. Add a question under each pillar name to guide the users in understanding well the pillars. Ex: *How do you have fun?* [for aesthetics] Change the way Dimensions and Facilitation are presented to be more guiding, as inspiration for discussion and not blocks they feel like they have to absolutely fill in.
7. They were discussing a lot and questionning each other's ideas which is not the intention with which this tool was developed.	This intention was not clearly stated. This intention also requires users to adopt a design thinking mindset of psotponing judgement and allowing themselves to fail. This behaviour clashes with the cultural norms of the context.	Emphasis should be put in the instructions of the canvas to adopt this behaviour. Blocks and ingredients which trigger too much discussion should be removed. It is better to use this canvas individually or in very small teams of maximum 3 members.
8. The recommendations for the number of ingredients to pick per block felt like an obligation.	It might not have been clear that these were recommendations only.	The instructions to the tool must be revised to be more guiding and provide examples.
9. One of the IOMe facilitator allocated roles whereby the two facilitators would take decisions and the student would do the changes on the Miro.	Assigning roles was not part of the instructions. It might have happened because of their culture tending to be hierarchical.	Allowing users to assign themselves roles should be in the instructions to respect the way of doing.

Appendix F - Initial concepts

Concept 1 - filled in canvas

FROM COMPONENTS

START HERE

YOU CAN GO HERE

TOPIC

and talks about .....

STEM

ROLE MODELS

EMOTIONS

in a ..... and fun way

DISCOVERY

CHALLENGE

STORYLINE

and immerses the players in a story about...

AFRICA

LAMU

OTHERWISE GO TO TYPE OF GAMES

TRANSFER EFFECT

The game aims to .....

GET INSPIRED

ACQUIRE KNOWLEDGE

OR HERE

ARE YOU DONE? THEN READ THE SENTENCE OUT LOUD BY FILLING THE GAPS WITH THE CHOSEN CARDS

OTHERWISE GO TO TOPIC

COMPONENTS

and the game consists of .....

CARDS

TEXT

IMAGE

TYPE OF GAME

and is built as a .....

MEMORY

FROM STORYLINE

INTERACTIONS

where players play in ..... and with .....

PLAYED INDIVIDUALLY

WITH COMPETITION

WITH GAME MASTER

Concept 1 - Strengths, Weaknesses and Opportunities

STRENGTHS

✔ The game can provide general but also new type of knowledge.

✔ Most of the children found it *"very fun"* to play.

✔ It is moderately easy, because *"you cannot remember"*.

✔ The size of the cards is user-friendly.

✔ The concept of the game brings a new perspective on education.

✔ The children reported liking to work in teams.

WEAKNESSES

✘ Overall, it was hard to convey the game vision to the volunteer.

✘ The players had a hard time memorising and did not fully understand the importance of memorising for winning the game. They also did not understand the rule of matching the pairs and how the pairs were matched.

✘ The game master did not organise the card in a matrix way which made it hard to remember the position of the card.

✘ The game can be easily repetitive and the concept does not offer so much room for large development.

✘ Compared to Concept 2.0, it was observed that the children were less engaged and enthusiastic.

OPPORTUNITIES

↗ The cards can be designed to be modular to be played in different ways, through different game mode.

↗ More cards can be designed, especially about lcoal women.

↗ Information about the role models should be available for the interested learners.

↗ The physical dimension of the game could be expanded to introducing 3D printed objects to be paired with the role models.

↗ The stories of the women can be developed more as *"storytelling is important in Africa"* (- Lamu Women Alliance member).

Concept 2 - filled in canvas

FROM COMPONENTS

START HERE 🏃

YOU CAN GO HERE

TOPIC

and talks about .....

BOAT DESIGN

CARPENTRY

EMOTIONS

in a ..... and fun way

CHALLENGE

NARRATIVE

STORYLINE

and immerses the players in a story about...

OCEAN

DHOWS

ARCHIPELAGO

TRANSFER EFFECT

The game aims to .....

ACQUIRE KNOWLEDGE

ACQUIRE SKILLS

OR HERE

OTHERWISE GO TO TYPE OF GAMES

ARE YOU DONE? THEN READ THE SENTENCE OUT LOUD BY FILLING THE GAPS WITH THE CHOSEN CARDS

OTHERWISE GO TO TOPIC

FROM STORYLINE

TYPE OF GAME

and is built as a .....

ROLL-AND-MOVE

INTERACTIONS

where players play in ..... and with .....

PLAYED IN TEAMS

WITHOUT COMPETITION

WITH OTHER TARGET USERS

COMPONENTS

and the game consists of .....

CARDS

TEXT

BOARD

DICE

PAWNS

Concept 2 - Strengths, Weaknesses and Opportunities

STRENGTHS

✓ Girls were more engaged and took the lead more, than with prototype of Concept 1.0.

✓ The reading aspect suits the girls well.

> *It was observed that girls often take a book during their break and tend to prefer literacy subjects such as Arabic and Kiswahili.*

✓ The die is fun to throw and makes them *"happy"*.

✓ All the children found the game *"very fun"* and moderately easy.

✓ The children reported liking to work in teams.

✓ The participants reported having learnt about sailing, about fixing a boat and about reading. They also learnt that they should *"not give up"* in the future.

✓ It includes game mechanics from the widely played game Ludo.

> *The facilitator introduced the rule that teams had to throw a 6 in order to be able to start playing.*

✓ When setting up the game, recognising the shapes serve as an energiser.

WEAKNESSES

✗ The die was too fun so the children were too focused on throwing it and not enough engaged with the content of the cards.

✗ The children mainly remembered the mechanics of the game like "go back 2 steps".

✗ The storyline about dhows and building them is too specific and not enough familiar to the users.

✗ The STEM content is too shallow and does not stimulate the players enough.

✗ The game vision was hardly perceived.

OPPORTUNITIES

↗ The pawns could be designed according to the game world to immerse better the players.

↗ The learning experience can be enhanced by transforming card statements into questions. This can trigger reasoning, problem-solving and critical thinking.

↗ The storyline can be broaden to tackle several familiar topics to the girls, to better mirror their daily life and immerse them in the game world so the transfer effects are better realised.

↗ Practical tasks or activities can be introduced in the game to make the learning even more meaningful.

↗ A throwing pot can be designed for the die.

> *The children used the tupperware containing some extra pieces as a pot to throw the die.*

↗ There is a double lesson conveyed by this concept about struggle in life: through the game narration (challenges and lessons) and through the game dynamics (die and action feedback).

Concept 3 - filled in canvas

FROM COMPONENTS

START HERE 🏃

TOPIC

and talks about .....

STEM

ROLE MODELS

IOMe
MAKER SPACE

YOU CAN GO HERE

EMOTIONS

in a ..... and fun way

NARRATIVE

CHALLENGE

STORYLINE

and immerses the players in a story about...

LAMU

OTHERWISE GO TO
TYPE OF GAMES

ARE YOU DONE? THEN READ THE
SENTENCE OUT LOUD BY FILLING THE
GAPS WITH THE CHOSEN CARDS

OTHERWISE GO TO
TOPIC

TRANSFER EFFECT

The game aims to .....

SPARK
INTEREST

BOOST
SELF-CONFIDENCE

OR HERE

TYPE OF GAME

and is built as a .....

ROLE-AND-MOVE

FROM STORYLINE

INTERACTIONS

where players play in ..... and with .....

| PLAYED IN TEAMS | WITH COMPETITION |
| WITH OTHER TARGET USERS | WITH GAME MASTER |

COMPONENTS

and the game consists of .....

CARDS

BOARD

DIE

THROWING
POT

PAWNS

Concept 3 - Strengths, Weaknesses and Opportunities

STRENGTHS

✓ All the girls found the game *"very fun"* and could answer the questions with ease.

✓ The questions make the game more challenging than Concept 2.0, they trigger problem-solving and critical thinking. They bring the serious element.

✓ Together with the die as the core fun element and the tangible representation of the struggle, the fun is now better balanced with the learning experience.

✓ The game vision is partly perceived, but better understood than for previous concepts.

✓ The time pressure and competition enhances teamwork spirit which contributes to engaging and having a positive effect on the learning goals.

   After the game was over, one girl mentioned the lesson learnt from one of the hardest questions.

✓ Giving points is more tangible than game mechanics afforded to the players.

✓ It includes game mechanics from the widely played game Ludo.

✓ The participants preferred the 3D printed pawns to the clay ones.

WEAKNESSES

✗ Next to the difficulty in reading my handwriting (due to prototying constraints, read above), the language used made the understanding of questions difficult.

✗ Some questions discuss things which are too far from what the girls are exposed to.

✗ It was not clear how many answers the players should give per person, therefore making the scoring system not clear either.

✗ The girls did not like the shapes carved in the corner of the cards.

✗ The girls did not like the donkey pawn.

OPPORTUNITIES

↗ There is much potential to iterate on the questions; make the language clearer and add new ones to make a whole card set.

↗ A manual with instructions, answers and extra information to support the most difficult questions should be designed for the facilitator.

↗ A point system can be designed like on a footbal table.

↗ A time keeping system can be designed to support the facilitator's job and for the players to monitor the time progress.

↗ Paper and pen should be given to players to work out the questions.

↗ New pawns that girls would prefer can be designed and incorporate other iconic elements of Lamu.

↗ The cards should have a full hole with the corresponding shape which will also facilitate transport (a rope can be passed through).

Appendix G - Final user test with CHANUA

Test set-up

Aim and research questions

The aim of the final user test was to assess whether the final prototype met some of the design requirements, concerning desirability and viability. Feasibility is evaluated through the making process.

A few research questions were formulated to guide the preparation of the test:

1. Are the transfer effects, and therefore design goal, realised?
2. Are the interactions taking place as desired?
3. Are the participants engaged and do they have fun playing?
4. Does the game fit the users' world and client's vision?
5. Is the design intervention easily transferable to the game master?

Test procedure

1. Arrive at MBF Girls and gather with the participants
2. Game master welcomes participants and presents session objectives
3. Gives 1st questionnaire
4. Explains rules of game
5. Users start to play, game master facilitates and observer observes
6. Reflects with participants when game is over and gives 2nd questionnaire
7. Wraps session up

Methods

Method for conducting the test

The user test was conducted by a volunteer from the Kenya Red Cross Society and a student from the IOMe, met during field research in Lamu. Only volunteers usually go on the field, but it was decided to also involve one of the students who participated in the iterative design process of the game so that he could have the opportunity to see the implementation of the design intervention.

The KRCS volunteer had already supported the research activities as facilitator, so she was appointed game master (facilitator). Her role was to facilitate the session and make sure the rules and objectives of the game are respected.
The IOMe student was appointed observer with the responsibility to support the facilitation if needed, take pictures and record some moments of the session.

A test preparation meeting was organised to communicate the aim of doing such a test to the volunteer and student. The essence of the game was recalled and a suggestion for conducting the user test was given, leaving the game master free to change it according to the situation.

Method for collecting data

As the test was conducting at a distance by the researcher of this project, it was important to collect enough and specific data to be able to draw insights and later evaluate the performance of the game. Data was planned to be collected from the observer as pictures and videos, from both the game master and observer as qualitative comments and feelings for how it went, and finally from the users as quantitative data.

An observation form (Figure FIXME) was given to the observer as a list of certain moments to record.
Two questionnaires (Figure FIXME) with statements with Likert scale were also prepared to be given to the players. The players should fill in one before starting to play, and repeat the same questionnaire with additional questions after playing.

Finally, a reflection meeting was organised for the game master and observer to share their experience. The aim was to discuss the execution of the test, the use of the game during that session and the performance of the prototype with regards to the requirements.

Observation form

OBSERVER FORM

Check list for photos and videos to take:

on your way to school

☐ 3 photos of either of you carrying the game under the arm
--> show transportability

before starting to explain the game

☐ photos of girls filling in questionnaire
these are for the test only

when getting ready to play

☐ photos of girls setting up the game
these are to show the process

☐ photos of Asya explaining the rules / girls listening to Asya
these are to show the process

when playing

☐ 3 photos of the girls thinking and working together
--> show collaboration and teamwork, as well as encouragement

☐ 3 photos of the girls looking curious
--> show curiosity

☐ 3 photos of girls smiling or laughing or throwing the dice
--> show the game is fun and engaging

☐ 3 photos of the board with different position of pawns
--> show that eventually the girls build their knowledge as they answer questions correctly

☐ photos of girls winning a card
you can ask the team to look at you and show you the cards they won

☐ photos of Asya keeping time on her phone
these are to show the process

when playing

☐ video of the whole test

OR

☐ video of one round (team throws dice, moves pawn, picks card, reads card, works out question for 2min, gives answer, keeps the card or no)

Questionnaire for the participants

Let's play a game!

Name:
Grade:

Today we are talking about Science, Technology, Engineering and Mathematics.

1. Do you like to learn about *Science and technology* at school?

○ I don't like it at all   ○ I don't like it   ○ I don't have an opinion   ○ I like it   ○ I love it

2. Do you like to learn about *Mathematics* at school?

○ I don't like it at all   ○ I don't like it   ○ I don't have an opinion   ○ I like it   ○ I love it

3. Do you think the subject *Science and technology* is interesting?

○ I think it is not at all   ○ I think it is not interesting   ○ I don't have an opinion   ○ I think it is interesting   ○ I think it is very interesting

4. Do you think the subject *Mathematics* is interesting?

○ I think it is not at all   ○ I think it is not interesting   ○ I don't have an opinion   ○ I think it is interesting   ○ I think it is very interesting

5. Do you think you are good at *Science and technology*?

○ I think I am not good at all   ○ I think I am not good   ○ I don't have an opinion   ○ I think I am good   ○ I think I am very good

5. Do you think you are good at *Mathematics*?

○ I think I am not good at all   ○ I think I am not good   ○ I don't have an opinion   ○ I think I am good   ○ I think I am very good

7. Give an example of what you do which relates to Science, Technology, Engineering and Mathematics is.

....

8. Do you think girls can study Science, Technology, Engineering and Mathematics?

○ No way!   ○ I do not think they can   ○ I don't have an opinion   ○ I think they can   ○ Of course they can!

What is a nice name for the game?

What did you learn today?

How did you feel when playing the game?

happy   bored   curious

confused   excited   ashamed

Were the questions easy?

○ Not easy at all   ○ Not so easy   ○ No opinion   ○ Easy   ○ Very easy

How fun was the game?

○ Not fun at all   ○ Not so fun   ○ No opinion   ○ Fun   ○ Very fun!

1. Do you like to learn about *Science and technology* at school?

○ I don't like it at all   ○ I don't like it   ○ I don't have an opinion   ○ I like it   ○ I love it

2. Do you like to learn about *Mathematics* at school?

○ I don't like it at all   ○ I don't like it   ○ I don't have an opinion   ○ I like it   ○ I love it

3. Do you think the subject *Science and technology* is interesting?

○ I think it is not at all   ○ I think it is not interesting   ○ I don't have an opinion   ○ I think it is interesting   ○ I think it is very interesting

4. Do you think the subject *Mathematics* is interesting?

○ I think it is not at all   ○ I think it is not interesting   ○ I don't have an opinion   ○ I think it is interesting   ○ I think it is very interesting

5. Do you think you are good at *Science and technology*?

○ I think I am not good at all   ○ I think I am not good   ○ I don't have an opinion   ○ I think I am good   ○ I think I am very good

6. Do you think you are good at *Mathematics*?

○ I think I am not good at all   ○ I think I am not good   ○ I don't have an opinion   ○ I think I am good   ○ I think I am very good

7. Give an example of what you do which relates to Science, Technology, Engineering and Mathematics is.

....

8. Do you think girls can study Science, Technology, Engineering and Mathematics?

○ No way!   ○ I do not think they can   ○ I don't have an opinion   ○ I think they can   ○ Of course they can!

Test insights

The insights concluded from the user test are now presented. First, observations and comments about the execution of the test are reported (what happened?) and an explanation is given for why it happened as such (why did it happen?). These are then translated into actions (things to change, remove or improve about the game) and insights which are more like general conclusions (what can be concluded?). The same procedure is repeated for the use of the game.

The execution of the user test

WHAT HAPPENED?	WHY DID IT HAPPEN?	WHAT CAN BE CONCLUDED?
1. Not all the parts were manufactured for the test (not all pawns and the manual) and the 3D prints were done in red instead of the required white.	The IOMe facilitator did not have the time to make the full set and change the filament colour.	Manufacture the full set at least once to have it as an example. Regular communication is essential when two different parties are responsible for the design and manufacturing tasks. The red colour turned out really nice in the end. It also reminds of the Red Cross!
2. There was not enough printed questionnaires for all participants.	The teachers called 10 girls instead of the 8 planned and the volunteers did not print extra papers.	Extra material should always be prepared to account for these unexpected events.
3. The game master was enthusiastic to facilitate. *"it was fun", "it was not hard"* - the game master *"they [suggested answers] were giving guidelines"* - the game master	The game master understood well the objectives and rules of the game.	It is good to organise a preparation meeting before such a test where the objectives and rules of the game should be stated clearly. The facilitation of the game is well designed. The instructions for the game master as well as the suggested answers are useful.
4. The observer took a lot of photos and videos, all very useful to the analysis. *"for me, it was easy to observe"* - the observer	The facilitation was going well so the observer could focus on recording the session. Besides, the observation form helped.	It is good to give an observation form to guide the person in charge, as well as prepare the test beforehand with a preparation meeting.

WHAT HAPPENED?	WHY DID IT HAPPEN?	WHAT CAN BE CONCLUDED?
5. The girls did not bring paper and pen.	Bringing pen and paper feels too much like a class. *"not everyone brought pen and paper because they knew they would play a game"* - the observer	The "serious" aspect of the game should be hidden. Change the instructions to recommend preparing pen and paper to the game master if the players need.
6. They did not finish the game, no team arrived at school and both questionnaires were given to fill in at the end.	Time was lost at the beginning when the volunteers arrived at school and there was not enough planned time. *"She [the game master] did it because of the pressure with all the girls being around. She broke the rules according to the environment and the dynamics."* - the lab facilitator	The timing for such a test should be better planned. Priorities for things to do should be better communicated to avoid skipping essential steps. *"you should plan extra time"* - the observer However, the game is long enough for a round to be played in several moments. The players therefore have time to reflect and construct their knowledge in between.

The use of the game

WHAT HAPPENED?	WHY DID IT HAPPEN?	WHAT CAN BE CONCLUDED?
7. The board was slid out of the box to start setting up the game but children suggested that it is slid back and used on top of the box.	The girls might have liked the box. Eventually it was played without the box, otherwise it might be too high for some children to see when seating.	The game can be played with and without the box, depending on where players are. If they play outside, on the floor, the box can provide a nice support and enhance the playing experience.
8. The girls did not get to keep the card as a point after answering well. Instead, they put the card back in the stack and shuffled it.	The contact teacher kept the scores on a piece of paper.	Make the rule about keeping the card as a point clear. This is a very essential rule that allows players to have a tangible recognition of their effort, which also encourages them to keep on trying.

WHAT HAPPENED?	WHY DID IT HAPPEN?	WHAT CAN BE CONCLUDED?
9. The game master mainly spoke English, with some Kiswahili when necessary.	There were a few difficult words and phrasing and some learners are weaker than others.	It is recommended that the game master speaks the children's mother tongue but in general, the game should stay in English as it is the school language.
10. After the girls would read the questions, the game master would read them again. Besides, it was reported that some questions were hard. *"I had to repeat the questions for some of the learners who did not understand right away"* - the game master	The issue of not understanding the questions came from the vocabulary mainly. For example, "knowledge of physics" is not suitable as pupils are not familiar with the concepts of "physics" but are familiar with "science and technology" as it is a school subject.	The perception of difficulty of the cards is widely spread. This depends on the level each pupil. Some words such as "physics" should be revised but the overall difficulty level of the cards should not be changed not to make the game too dull. It is also worth mentioning that this situation of level difference is common in class. It can therefore make the strong learners encourage the weaker ones and enhance collaboration and teamwork.
11. The players were hesitant to pick the card at the top of a deck. *"they were very conscious to pick the cards"* - the game master	*"they were hoping they would get a certain card from a specific STEM field"* - the game master	Choosing a card anywhere from the pile also contributes to the fun.
12. The game master let the team roll the dice again if they threw a 6 and answered correctly, a rule which was not in the official game rules.	This was a rule the game master decided herself to mirror game rules familiar to the children.	Introduce the rule that if the team throws a 6 and gets the point, they get to throw again. However, if they throw again a 6, they will have to throw lower. The game master made the game hers, she felt the ownership which is essential for the transfer effects to be realised.
13. The game master initiated and facilitated important discussions about the role of girls in STEM. *"we had a great discussion about whether girls can study STEM"* - the game master	The game master understood well the objectives and essence of the game. She was actually part of the early stage of the design process when researching in Lamu. It was also possible to explain the essence of the game to her directly.	The manual of instructions as well as a training from the IOMe facilitator will prepare other volunteers to facilitate the game in the future.

Appendix H - Game rules and suggested answers
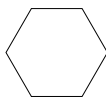
CHANUA
Instructions for the game master

THE GAME

CHANUA is a board game to talk about Science, Engineering, Technology and Mathematics (STEM) on the island of Lamu, in Kenya. It is a fun game mirroring real life situations with the purpose of engaging the young girls of the island in STEM education. The manifestation of STEM in Lamu is becoming more and more important which makes these disciplines relevant for the younger generations.
The game is built on questions encouraging the players to look at their environment with a critical eye and a scientific mindset. The game was specifically designed for young girls of Lamu but can also be played by boys.

The core principles of the game are the following. The players should feel encouraged to participate actively. The players should be curious about the questions and feel confident to give their answers. It is a collective activity where knowledge, curiosity and confidence are built up gradually.

THE STORY *(to read to the players)*

You wake up at home and have to get ready for school. On your way to school, you observe what is going on in Lamu. You see trees, people selling things in shops, donkeys carrying merchandises. You wonder, how much stuff can you actually carry on a donkey? You stop to play with your friends and buy fried potatoes. You wonder, how can we use science to explain the cooking of potatoes?

There is a lot happening and you wonder why these things happen the way they happen. Sometimes you encounter problems and you need to solve them. You want to learn as much as possible but you cannot be late for school!
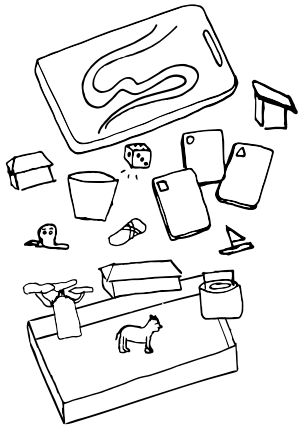
THE GAME ELEMENTS *(needed to play the game)*

The game comes in a box that is closed using the board. The box contains the board features (house, school, baobab, well and shop), cards, a die and throwing pot, some pawns (cat, dhow, sandal and octopus), this manual and a sheet with suggested answers.
The cards are divided in 3 categories: circle, triangle and square. The meaning of these categories is explained under "THE RULES".
The board has features (objects) that must be fit in one of the slots (rectangular or circular) on the board. The players should install these features.

THE GAME MASTER

The game master does not play but will facilitate the game. Your role is to first introduce the game and help setting everything up. You then guide the players through the game and make sure the rules are followed. You also keep track of the time for every question.

Some tips for the game master:

- Before starting to play, ask the players to recognise the shapes on the board and the features.

- Read all the instructions to the players except the ones about "THE GAME MASTER".

- Make sure the core principles of the game are respected (section "THE GAME") so the goals of playing the game are achieved.

- If a team does not understand a question, you can explain it in Kiswahili.

- Avoid giving examples when you explain the question if the question is about giving examples.

  Example: "There are different plants growing around the path to school. Draw five different plants."
  → do not give examples of plants before the players start working out the question

- There is another wooden sheet with suggested answers in the box. They should not be taken as absolute truth, but are a guideline for you.

THE RULES

Start the game

1. If you are playing on a table, remove the board from the box. If you are playing outside, you can keep the board on the box.

2. Find where the house, school, well, shop and baobab should fit on the board and **place them**.

3. Depending on the number of players, **make 2 to 4 teams of about 4 to 6 players**. Each team picks a pawn which they will move on the board every time it is their turn.

4. Toss a coin to know which team starts. The next team to play is to the right of the starting team (move clockwise).

5. The teams must **throw a 6** to be able to put their pawn on the board and start playing. If **after three turns** teams still have not thrown a 6, they can start on the board.

Play the game

6. The first team to throw a 6 or the starting team (from tossing a coin) throws the die and move the pawn accordingly.

7. The team picks a card with the same shape. The players read the question **out loud**.

   ● **CIRCLE CARDS**
   Solve a problem! More or less open-ended question, multiple answers are correct but the team is required to give only one. The game master decides if the answer is one of the possible correct ones.

   ▲ **TRIANGLE CARDS**
   Answer a close-ended question! Often one possible answer and the game master decides if it is correct.

   ■ **SQUARE CARDS**
   Square cards: think wide! Here, the game master should facilitate a discussion. The answer can be one word but also the discussion itself.

8. When the question is understood by all players, they have **2 minutes** to answer the question. The game master keeps track of time **with a phone**. The game master can give paper and pen to work out the questions.

9. Whenever the team thinks they have the answer, they can give it to the game master.

10. If the answer is correct, the team **keeps the card** and that card counts for 1 point. If the team gave an incorrect answer, the other team(s) can try to give their answer. If it's correct, they **get the card**. If it's still not correct, the game master gives the answer.

11. If a team throws a 6 and wins the card, they can throw again, but lower than 6.

12. There are no hexagon cards. When a team lands **on a hexagon**, the team throws the die again. According to the number, a scenario occurs:

    🎲 *it's your lucky day! you move your pawn* **forward once**

    🎲 *too bad! you move your pawn* **backwards twice**

    🎲 *the game master invents a question about the icon you landed on (baobab, well or shop), if you get it correct, you move your pawn* **forward once**

    🎲 *your team can ask any question to another team, if they are correct, they move their pawn* **forward once**

    🎲 *your team asks a question to the game master,* **you choose what happens** *if the game master is correct*

    🎲 *the other team(s) ask your team any question, if you are correct, you move your pawn* **forward once**

End the game

13. The game ends as soon as one team **arrives at school**. This team gets the chance to pick any card from any shape and answer the question. This gives the chance to the team to win one last point.

14. **But careful!** The winning team is not the first one who arrives at school. **The winning team is the one with the most cards!**

15. **HAVE FUN!**

THE REFLECTION *(to do after playing)* ⚠

A reflection at the end of the game helps to summarise the **key learnings** from playing the game. It is a moment where all the players of all the teams share what they learnt, what they liked and what they disliked. These are possible questions the game master can ask during the reflection:

- *What did you learn by playing the game?*
- *Is there an important message you take from the game?*
- *Are there situations you recognise from your own life?*
- *How did it feel to face a problem? How did it feel to be able to solve it?*
- *How was it to play in teams?*
- *What did you like about the game? What did you dislike?*

CHANUA
Suggested answers

FOREWORD

Here are suggested answers to the questions of the game. They should not be seen as absolute truth but rather a guide for the game master to keep the spirit of the game.
Some questions can have different answers. Only one answer is expected to win one point and keep the card.
For the open-ended questions, a few answers are suggested and are separated by a "/".

CIRCLE CARDS

1. measure the area of the room / make a prototype / etc
2. learners should draw a well with a rope and a pulley
3. horsepower is a measure of the speed so the 200 horsepower boat
4. sharp
5. 3 donkeys; the weight can be distributed differently
6. a cylinder and a beam / a stick to hang the bag over your shoulder / etc
7. making Excel spreadsheets; the learners can draw an example
8. using Word document and sending it by email
9. an Excel spreadsheet / writing it somewhere on your phone / etc
10. the peel disintegrates on the ground and becomes compost
11. everyone breathe the same air, mainly composed of nitrogen and oxygen
12. not throwing trash on the floor / participate in waste collection activities / etc
13. can start from the height of people playing skipping rope
14. build boats like Flip Flopi / make art / make coasters / etc
15. make a water filter so filter out the salt / collect water when it evaporates (gas state) and condense it again (the salt remains in solid state) / etc
16. learners are free to draw what they know

TRIANGLE CARDS

1. gravity
2. reflection of light
3. friction
4. photosynthesis
5. tides
6. using the equation for distance, speed and time so the speed is 2m/s
7. balance / weights / comparison with something you know the weight of / etc
8. lemon / orange / some candies / etc
9. the water will freeze and switch to solid state
10. gas state
11. heat transfer
12. using pushing force
13. 180 stones
14. sound waves
15. gases are able to expand
16. 115 beads

SQUARE CARDS

1. pave streets / pave grounds for buildings and houses / etc
2. to fight plastic pollution in the nature / give a second life to plastics / avoid making new plastic when we already have a lot / etc
3. Woman Representative and plane pilot
4. Nobel Peace prize
5. because the machine uses a laser to cut through the wood and the laser is so hot that it burns the wood
6. plywood (thin piece of wood)
7. the surface is rough, not smooth because the machine prints objects layer by layer
8. plastic
9. it is not so easy because plastic is quite rigid and strong
10. hard wood, Mvule from Congo
11. the CNC machine makes things in 3 dimensions (3D)
12, 13, 14, 15, 16. the game master should facilitate a discussion for each of these questions. These questions are for players to be critical of their situation as girls and to be confident when solving a problem (like being late for school or hearing they cannot become an engineer for instance).

Appendix I - Design iterations for the final prototype

Concept 3 was selected because of its strengths, opportunities for further development and better achievements of the design requirements. The design steps undertaken to design the final prototype as presented in Chapter 5 are shown in this Appendix.

How to read the design steps

The several steps that led to the final design of each component come from insights collected during four user tests, two co-creation sessions with girls and teachers and one feedback session with KRCS volunteers:

Test 1
- with prototype of Concept 1 and 2
- conducted at Wiyoni Primary with 4 girls and 3 boys
- as described on pages 70 and 71

Test 2
- with prototype of Concept 3 (prototype 3.0)
- conducted at Wiyoni Primary with 6 girls
- as described on pages 72

Co-design session
- with material and probes
- with 3 girls and 3 boys from Wiyoni
- not yet described

Test 3
- with prototype 3.1
- conducted at Mahmoud Bin Fadhil Girls with 8 girls
- not yet described

Co-creation session
- with prototype 3.2
- with 4 teachers of 2 different schools
- not yet described

Test 4
- with prototype 3.2
- conducted at Mahmoud Bin Fadhil Girls with 10 girls
- as described on page 45

Feedback session
- with prototype 3.2
- with 3 KRCS volunteers
- not yet described

Therefore, for each user test, a prototype was evaluated, insights were collected and decisions were made upon these conclusions. The next pages therefore presents the main changes for the:
- the board, features and box
- the die and throwing pot
- the pawns
- the card
- the manual

These iterations are illustrated by showing the different prototypes, the outcomes of the user test which led to making certain design decisions towards the final design. These are shown as:

prototyping comments

user test outcomes

design decisions
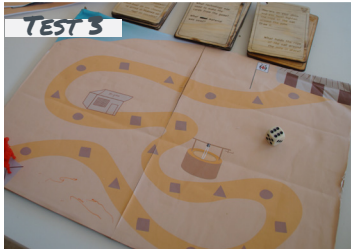
Board, features and box

CO-DESIGN

The features the board should have were co-created with children.


TEST 2

The power was off in Lamu so the board had to be manually drawn.

A game world which mirrors the users' real world was imagined so the transfer effects are more easily realised.

TEST 3

The design of the board is simple and straightforward. The well and shop accentuates the storyline. The path is long enough to have a game which lasts 45 minutes.

The board is CNCed to carve depth.
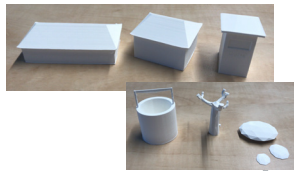
In Delft, 3D models of the board and features were made and prototyped.
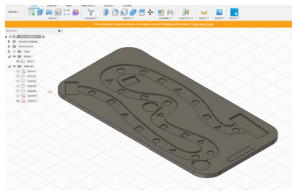
In the meantime, prototypes were also done at the IOMe.

To which a box was added to store and transport all the game components.

And decorated on the edges to mirror Lamu's carpentry expertise and artistic traditions.

TEST 4

Die and throwing pot

TEST 1

During test 1, the children used the tupperware laying around, which was storing the loose elements of the game, to throw the die.

The first test showed that the die brings out the fun in the game. It was also found that it represents the struggle in life (in the randomness), according to the children.

TEST 3

The same container and die were used for Tests 2 and 3 which confirmed the need to design a throwing pot to fit the users' habits.

Making a die at the IOMe is cheaper than buying a conventional one and avoids shipping delays. The die and pot are therefore produced with the 3D printers.

In Delft, 3D models of the die and pot were made and prototyped.

Which were eventually made at the IOMe for the final user test.

TEST 4

Pawns

TEST 1
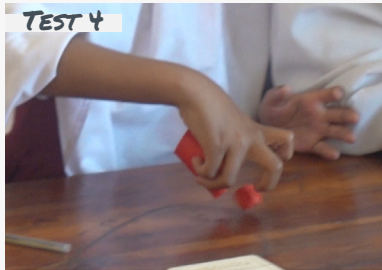
The pawns were initially made from clay in a coin format.

To include all production techniques, it was decided to 3D print the pawns. To reflect the users' world and enhance the storyline, a boat and donkey were picked.

TEST 2
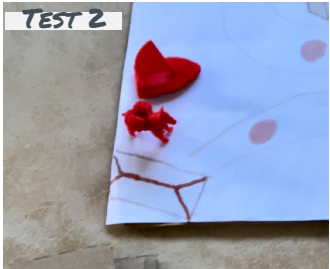
The girls preferred the 3D printed pawns compared to the clay pawns but did not like the donkey.

Donkeys are only used by men which might explain why the girls did not like the design. It was decided not to print a donkey as a pawn.

In Delft, other designs for pawns were prototyped: octopus, cat and sandal (all iconic things from Lamu).

For the final user test, the IOMe facilitator 3D printed what was easiest: the octopus, the cat and the boat.

TEST 4

36
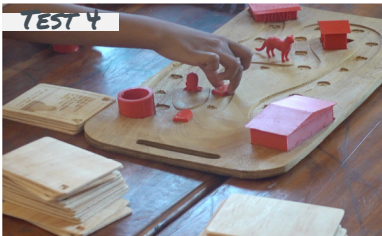
Cards

Test 1 showed that the reading aspect suits well the girls as the boys tended to give the cards to read to the girls and that a lot of girls spend their school break reading in the courtyard.

Cards with questions instead of statements (concept 2) to actively engage players' cognitive processes.

Test 2
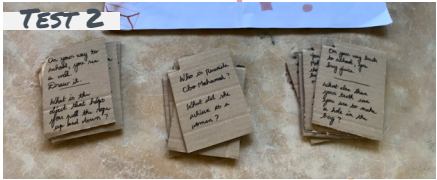
Due to power cut, the cards were hand written which made it hard for the girls to read the questions.

The cards are laser cut to be easily readable and engrave visuals.

A few iterations on the aesthetics and card size were done at the IOMe before picking one format and making 12 cards for Test 3.

Test 3

But it also shed light on some issues regarding the difficulty of some questions, mainly due to the use of difficult words or sentences.

The reading was much better. It was also observed that keeping the cards is the physical representation of getting one point.

The rule for scoring a point is to keep the card. When a situation is described, an image could support that.

Prototype 3.1 was used in the co-creation and feedback sessions.

CO-CREATION

Ideating on card content was part of the co-creation session which led to obtaining a lot of ideas for questions which were almost all taken from the syllabus.

A lot of new questions were made, inspired from the teachers' ideas and adapted to be narrated and not repeating the syllabus.

The teachers were enthusiastic about using the game as a *"fun"* supporting material for their class as it fits in the syllabus and *"breaks the monotony of the class"*.

Feedback

However, the real intention behind the game was not understood at first in both sessions as they thought the questions were not specific to girls.

From these two sessions, some rules were adjusted and mechanics were re-designed to produce better dynamics.

The manual of instructions should also state the objectives of the game.

A last walk in Lamu allowed to get some inspiration to write some more cards.

And the interview with Nooran, a female boat builder, led to allocating a role model card (square category) to her.

Finally, a last revision of the questions was done with a teacher to make the cards for the final prototype.

Test 4

Manual

The first prototype did not have a manual. Instead, the game master was trained just before the test but it was found that he/she could not be independent.

Therefore, it was decided to make a manual for the game master to facilitate confidently, with instructions and answers to the questions to which she can refer.

Test 3

NSWERS

The answers were very useful as often volunteers are not very knowledgable about STEM.

But the sheet should be labelled "suggested answers" to give freedom to the facilitator to adjust what she thinks is correct or not.

Feedback

The feedback session with the volunteers showed that the manual should be more visual. Ideally, a video would be made to explain the goals and intention of playing the game.

Some iterations were done on the manual in Delft.
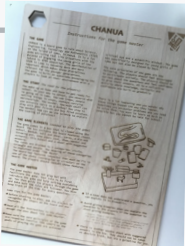
But due to time constraint, the manual could not be laser cut for the final user test in Lamu and a printed version was used.

Appendix J - Learnings from researching and designing with people from Lamu

As part of the reflection process, learnings from researching and designing with people from Lamu were identified as meaningful lessons for not only the project itself but also for personal growth. These are shared from the personal point-of-view of the researcher.

How to best conduct the project overall
Well first and foremost, going on the field is definitely a must which will ensure a minimum of success to your project. Even though it might seem obvious, it is worth mentioning. I, myself, learnt way more than I think I would. It also allowed me to immerse myself in Lamu, live like a local for five weeks and gain empathy not only for my users but for the whole community.

How to ask for preferences
At the end of a prototype testing session, I wanted to ask the girls for their preference in card aesthetics amongst different samples. I did not get any valuable information as one would grab the sample card preventing others from physically picking it which I believe led the girls to choose different ones so they could hold one in the hand. Furthermore, they were still in the teams setting which made them choose a different sample than the opposit team. When asking for a preference, I should have as many samples per card as there are participants or ask them to write down the one they prefer.

How to facilitate sessions
Throughout the several user tests I did in Lamu, I recognise different ways I did it that taught me different things and showed me the way I should do it in the future. I started testing ideas embedded in a low-fidelity prototype that were facilitated by KRCS volunteers. That way, I could see how a local would present my concepts. I facilitated the next prototype testing myself with the support of a volunteer. I learnt that it is better to let the volunteer conduct and facilitate the session. This is because, even though the volunteer does it in English, they talk the same English as the kids do compared to me (with my accent, intonations and formulations). Moreover, it is easy for the volunteers to feel whether the students need extra explanation in Kiswahili.

How to design research sessions
I learnt a lot from the sessions and the materials I made to conduct these. In one session, I gave to each of the participants a scale from 'not good at all' to 'very good' and a tick indicating the middle of the line with written 'good' on top of it. The assignment was to rank three chosen school subjects on the scale. The children thought they had to place the three subjects on either of the three scale labels. This coincidence of having three items to rank with three labels made them think they had to place them strictly at one of the three labels. I learnt that I should avoid having coincidental situations like this one not to direct the child in a certain way of thinking that was not intended. Besides, it taught me that it is better to ask participants for their 2-3 favourite subjects instead of all the ones they like. Otherwise, they make a list containing almost all subjects from which it is not easy to conclude.

I tried to conduct a co-design session with a mixed group (4 girls and 2 boys). I gave them the exercise of looking in their surroundings for a problem that can be solved using science and technology. They then had to present the problem to the other teams and ask them for a solution. Two teams out of three ran towards the computer room. They all came up with a challenge, mostly about broken things and how to fix them. One team provided the solution instead of asking for the solution to the rest of the group. The challenges seemed directly inspired from science classes in the way it was presented and phrased. I also observed that they mainly look at product-oriented problems, occurring from tangible products, not so much in process-oriented issues. One thing I could have done to ensure I get the outcome I want is to break the exercise down to make sure all pupils get to the goal of the activity. This activity was nevertheless useful in understanding how they present and phrase scientific problems.

In general, attention should be paid to the type of activity proposed to participants. There is the risk to push them too far from their comfort zone which might prevent them from actively and willingly participating. I felt the teachers were put off guard when I asked them to play my game during the co-creation session. They asked for me to first demonstrate it because that's "how we do it in class". Eventually, they played it withiut demonstration but I could feel that I had pushed them out of their comfort zone and reassurance was needed to repeat that there is no judgement. This also resonates with the cultural trait of wanting to do things as perfectly as possible not to run the risk to embarass themselves.

Finally, I learnt that I should not ask participants to write their name under something they have to evaluate. They will most likely feel like they are assessing themselves and not the thing in question.

Appendix K - Tips & Tricks for a fun and smooth collaboration with the IOMe

This project marks the beginning of the collaboration between the TU Delft and the IOMe005 Innovation Hub and Kenya Red Cross Society, together with Dorrit Bueters' project. "You guys were a prototype" shows the need to share a reflection on the process which is intended to future designers from the TU Delft (or others!) who want to conduct a research-through-design project in Lamu. To start with, practical tips are given. Secondly, I reflected on the things that surprised me, the ones I enjoyed and the ones I found challenging through the cultural dimensions as defined in The culture map *book from Erin Meyer (Meyer, 2016), and as shown in Figure FIXME. If you want to know more, I highly recommend reading the book. Finally, I list the important tips and tricks to have in mind.*

Praticalities

It is advised to stay in an accommodation as close as possible to the IOMe. However, Hindi is not the most suited for "mzungus" and I stayed on the Lamu island which was very fine. I stayed there for five weeks, a period chosen because of personal repsonsibilities to attend to back in Delft. The IOMe facilitators advised to stay longer to have more time together during the co-creation process.

Regarding activities on the field, always be accompagnied by a local. This person will allow you to get into the community, reach some people who are not as easily reachable and, of course, translate for you which is often necessary. Besides, always bring prototyping materials such as paper and cardboard to account for possible power cuts or more participants than expected or even a donkey stepping on your things! This is to avoid having to cancel a session.

When setting up your project, align your expectations with the client to avoid disappoitments and frustrations. You can even use these cultural dimensions that I will now present. They were used with the IOMe facilitators during the reflection session and deemed very useful to understand each other's culture and find a middle ground for designing together.

Understanding the Kenyan culture

Communicating

The issue I ran into during my project was a very distant communication when I got back to Delft. It was very hard to get hold on anyone at the IOMe even for 5min calls to check on each other. My messages would be left unanswered, even when sharing them on a groupchat I had set up before leaving. Therefore, I recommend to align your expectations with the IOMe's in terms of communication from the start of the project. A channel should be chosen and the preference of contact regularity should be discussed. I would highly suggest to remind the people you work with to ask to react to messages using emojis or just a "noted" or "received" or anything!

But after all, even though there is no replies to messages and calls, it does not mean they are not doing anything. They are probably busy with it! In my project, they were very pro-active and did not disappoint me at any moment. Their way of working is just different. They are more goal-oriented when we tend to be more process-oriented. *"You tell us the goal and we do it in our means"* - Nassor.

In terms of online meetings, they appreciate well-structured meetings with slides. Use images instead of text. They don't always turn on their camera which makes it hard to feel whether they are engaged in the session. Besides, they are often doing other things on the side and you have to repeat the question or even the discussion that just happened.

Disagreeing and evaluating

Even though the Kenyan culture tends to avoid confrontation when it comes to disagreeing, I was surprised that the IOMe facilitators do not exactly fit in that mould. In contrast, they would dare to share with me their honest opinion. In general, they are open to confrontational feedback and comments if a solution also comes with it.

Besides, the IOMe facilitators received higher education which makes them closer to our culture in general, especially due to the fact that they are engineers and were therefore trained to develop their critical thinking and problem-solving. This is why the disagreeing and evaluating dimensions do not exactly fit them as suggested. They do appreciate direct negative feedback if necessary, but again with alternatives or solutions. *"I like critique because it allows me to not make the same mistakes in the next iterations."* - IOMe facilitator.

This honesty in feedback is however not a given in general. This was a challenge during session with locals where I would ask for their opinion or whether they like what I show them. They would always reply with *"it's fine"*. This is partly explained by the fact that I am a "mzungu" and that locals do not always trust mzungus, therefore do not open as easily (see trusting dimension). One solution to this is to always show several options people can choose from instead of showing one and asking their opinion on it. Showing several options will allow the interviewees to comment on why they prefer a certain option.

Deciding and leading

Both the deciding and leading dimensions are very hierarchical. This can typically be observed during a session with the leader and facilitators, and even innovators (students). During the canvas user test, one of the facilitators assigned the role of making decisions for the exercises to him and the other facilitator. He assigned the role to make the respective changes on the Miro (dragging post-its around) to the innovator. I was quite surprised by this initiative (role assigning was not asked from me) as it also felt very natural for them. Besides, if the lead of the IOMe is present, then he will reply first and then the people below the hierarchy will.

I also witnessed this hierarchical dynamic when I would suggest to the innovators to engage in a new activity (for example: going on the field with the KRCS volunteer to observe at the final user test) and they would tell me that they first need to ask the lead of the IOMe what he thought about it.

Trusting

I love the Kenyan people because of their "hakuna matata" culture. In Lamu, saying hello and taking the time to chat to anyone you know passing by in the street is important. I was once busy with my thoughts and did not see one of the teachers I was working with walking past me. The next day he asked me *"why didn't you say hi to me??"* and I had to apologise for not paying attention. Acknowledging people and taking the time to talk with them is the fundamental way to build relationships. This is especially the case in Lamu as it is a small community where everybody knows each other. *"We believe in the long-term perspective trust"*, *"we usually don't cherish business-only relationships"* - IOMe facilitator. Besides, it is also very important to plan with the IOMe to have a focal person who can facilitate meetings with local stakeholders. This person is essential for the locals to feel comfortable and safe to engage with you. The locals will then more easily open to you and consequently, their feedback and comments will be closer to what they really think.

Scheduling

The habits on scheduling were hard to fully understand. I was first surprised to be asked to plan more and better during field research by the IOMe and KRCS contact persons. So this is what I did. I made a thorough planning for all the research and design activities to do. I also made a planning for the things to develop in terms of design and manufacturing with the IOMe facilitators. I was therefore expecting a more linear way of scheduling. However, when iterating on the design when I was back in Delft, I got confronted to interruptions and changes in planning. This was especially the case for online workshops and meetings where people were always late.

Even though you schedule a meeting or session long in advance, it is possible that it will be postponed or will have to be finished in a shorter time than expected because people planned other stuff in the meantime.

The scheduling culture can also affect conversations. As we tend to oversee all necessary to do's to come (let's say in the coming three weeks), we also tend to communicate these. We tend to list these to do's with the people who we work with and share them. However, this clashes with the Kenyan culture of scheduling which is more on the short-term. We only confuse them if we already tell them what we will be doing in three weeks time from now. You should therefore stick to the essential and work step-by-step.
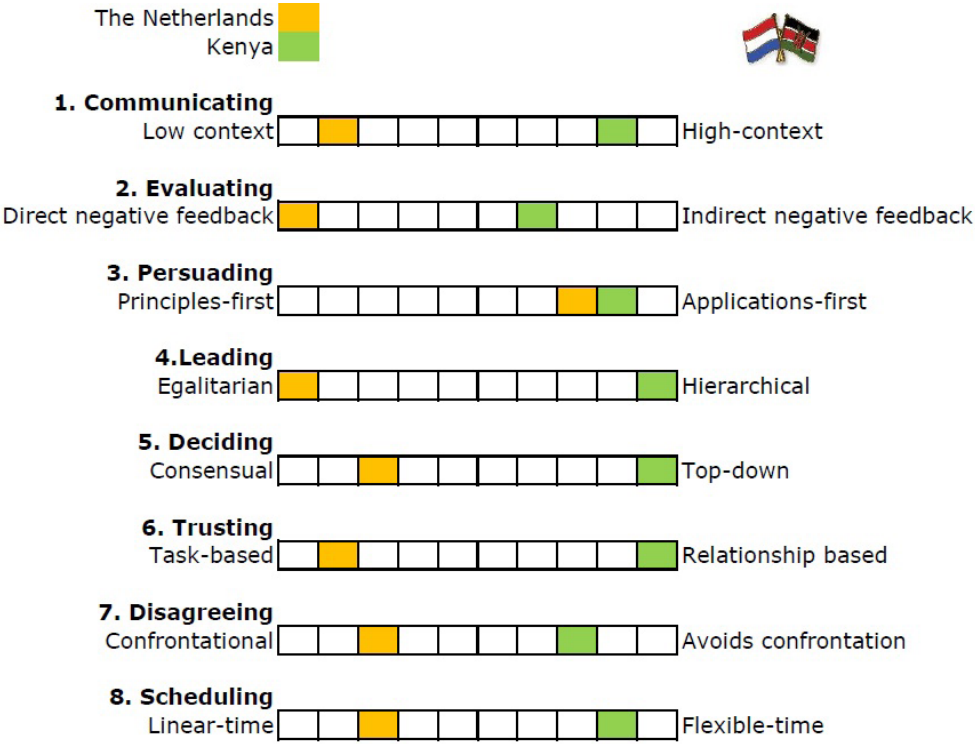

Figure XX. The cultural dimensions between the Netherlands and Kenya

Tips & tricks

- Align expectations from the start
- Give daily updates to the KRCS contact people, typically to the community leader
- Start a groupchat to better share updates but prefer private messages and calls for personal matters
- Organise meetings to share urgent matters (rather than texts)

- Prioritise tasks and avoid sharing extensive planning because it will probably not be grasped
- Be flexible and allow for spontaneity in your planning
- Always prepare session in advance sessions in case timing is moved forward (yes it does happen)
- Be smart when asking for feedback, especially for personal opinions
- Always have a local person accompagnying you