Transformation Opportunity Bloom: Gamified Data Collection on Microalgae

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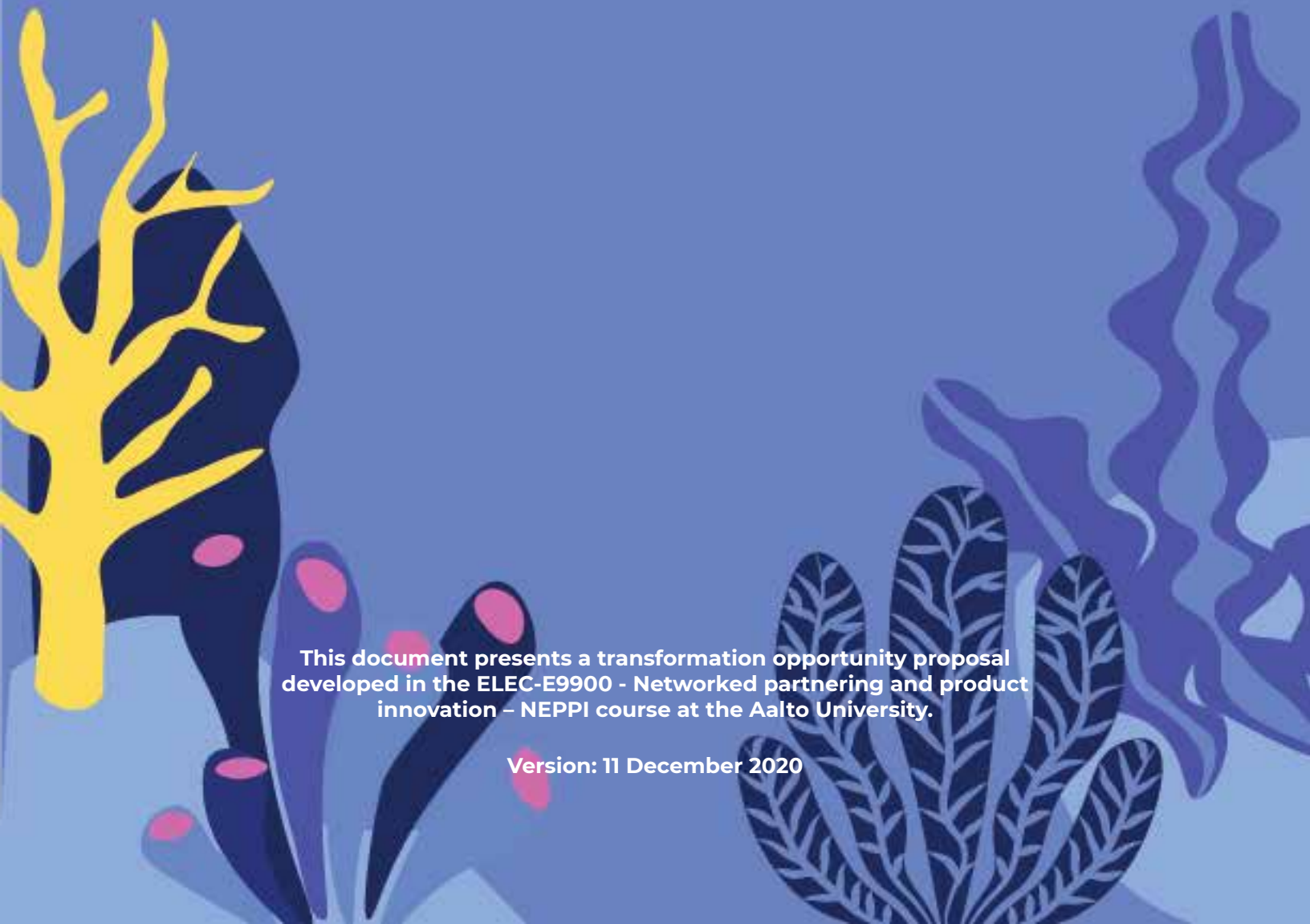

This document presents a transformation opportunity proposal developed in the ELEC-E9900 - Networked partnering and product innovation – NEPPI course at the Aalto University.

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We should not teach children the sciences but give them a taste for them.

- Jacques Cousteau

The Opportunity

Problem description

We were tasked to create a transformation opportunity concept for a problem our team chooses. We began brainstorming for possible areas that could see change within the next 100 years. Possible areas included societal, financial, legal, technological and nature related problems, just to name some. Our team soon decided on going with the nature theme as it is related to everyone in the team. Nature is also related to many of the United Nations' sustainable development goals such as climate action, life below water and life on land (UN Volunteers, 2020).

However, nature alone isn't enough to focus our problem. Discussions about nature soon turned to water as it also affects everyone and could be paired with civic science that was discussed on the first lecture. We envisioned that humanity would live harmoniously with nature by the year 2100 thanks to scientific advancements. However, these advancements would not come on their own, so our transformation opportunity was linked to children who will become the next scientists that will improve technology before the year 2100. Thus, we decided to inspire children to take part in sciences from a young age so that more people would take on scientific education and to become familiar with the nature around them.

We thought that inspiring children alone wouldn't make for a brilliant project and even more the results of this would only be seen after two decades as the children would complete their education and start working. Inspired by the civic science lecture and projects found online we decided to include civic science in the same opportunity. Valuable data could be collected as children experimented with nature. This had twofold benefits: more data could be gathered for free and children partaking could feel additional pride for contributing into a real project.

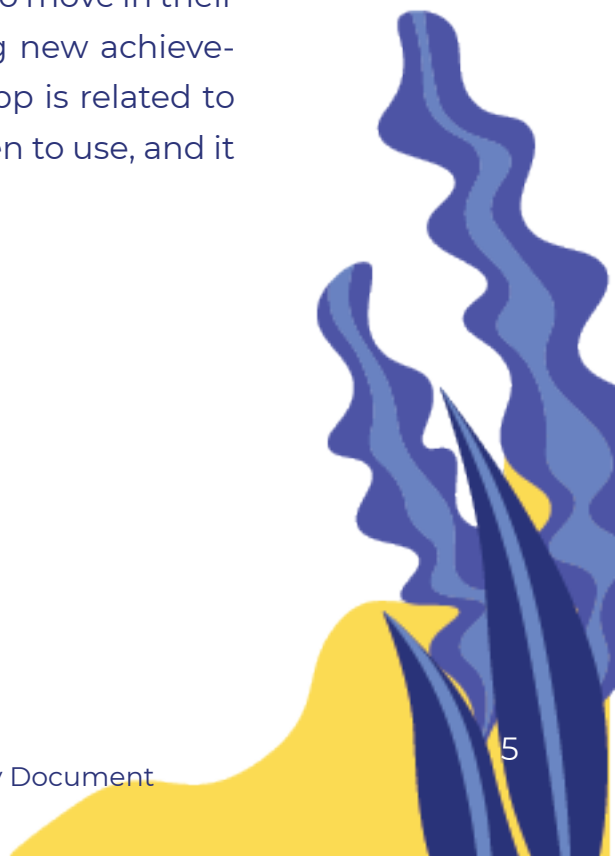
The Opportunity

Requirements for the Solution

Our team started to tackle the problem of how to inspire children to explore nature and scientific activities. We agreed that modern technology has reduced the time spent outdoors and thus also caused a decline in the connection of humans and nature. Children are also quite a difficult target group in some ways. Their attention spans and skill sets are limited. The activity should be fun and relatively quick in order to keep their attention while also being easy to perform. However, the activity should also benefit researchers, so some valuable data should be gathered with methods that are simple and exciting.

Civic science is already performed by hobbyists, volunteers and scientists around the world. Data gained from civic science is very beneficial to different institutions performing research. Civic science reaches places that might otherwise not be under investigation. However, if we were to harness more volunteers from children to both collect data and have fun while doing it the advancements in measurement frequency and variety would be greater.

Geocaching, whilst aimed at slightly older audiences, has inspired citizens to go outside and explore their surroundings. An excellent example is Pokemon Go and other apps similar to it. These apps make moving around a key element of the game, thus inspiring players to move in their surroundings and even explore new places by promising new achievements. This is something we were very inspired by. An app is related to the nature of the course, it is a familiar platform for children to use, and it can be used to gather data.



The Opportunity

Lastly, we required something useful that our app could measure. Given the nature, water, and civic science discussed earlier we turned to algae, something that is visible and something we thought could require more research. The app spreads our researchers all across Finland and even the world, so a wide range of places can be measured. Pictures of algae in addition to location and weather data can be easily measured giving researchers a good mapping of the algae situation. This solution could be extended to other fields of research as well, but this project and document deals with algae as it turned out to be the focus of our research.

We chose to target children around the age of 7 to 13 as they have not made any decisions about their future education yet, have enough autonomy to move outside even alone and have some experience with technology. In addition to this, our chosen age group is quite common in different outdoors organizations such as scouts where our solution could be used. These organizations, children and families in general will benefit from the educational nature of the app. Different algae can be discovered and the app can give educational facts alongside eye-catching visuals.

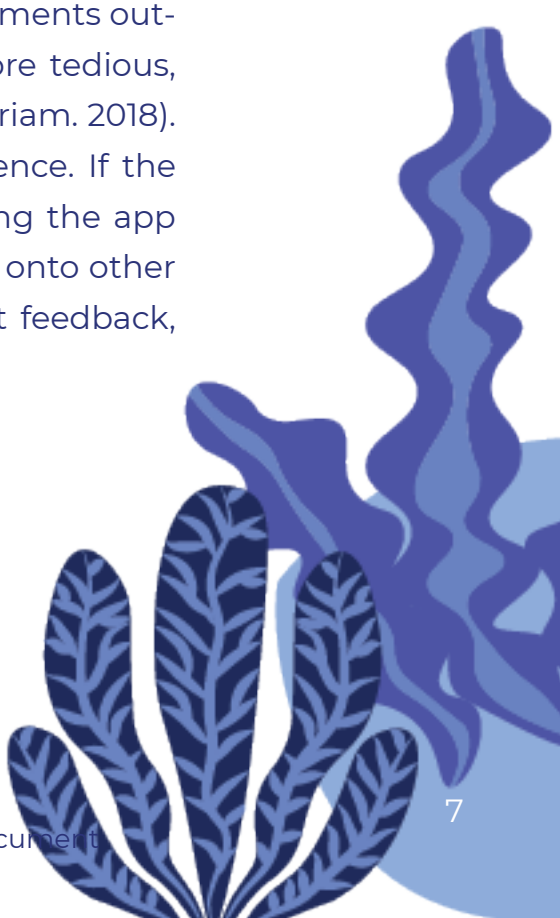
The Opportunity

Our 10-year Vision

We hope that our app could engage children in taking part in science and to explore their aquatic environment. We hope to see that in 10 years more children have taken up higher education and are thus starting a new scientific revolution. We also hope that our app encourages children to care more for their environment and to re-establish the connection mankind has had with nature. Nature shouldn't be taken for granted and we hope to foster a give and take relationship with nature.

Our solution, Bloom, differs from other civic science efforts with children by streamlining the process. The app is really fast to use, and children are very proficient with phones anyway. The app also gives gratification to the user through the use of interesting graphics and game mechanics that encourage the user to do more. The scientific content includes fun facts, taking measurements using the phone and having the data go to actual research. Taking photos using the mobile phone is easy enough to guarantee that the data is at least mostly useful. Clearly wrong pictures are not accepted and poor quality might lead to disqualification later on in the research.

If one is to take measurement devices and go perform experiments outside in the "traditional" civic science way the process is more tedious, although possibly more scientific (Makuch, Karen & Aczel, Miriam. 2018). Thus, Bloom aims to be at least the starter kit for civic science. If the process of moving around in nature and taking photos using the app is something that the user explores it's much easier to move onto other experiments, those that might not include as much instant feedback, later on.



Background Research

Our design process started with identifying a problem which followed collecting data. The process also involved discussions with many stakeholders and researchers, who became important influencers to both ideation and validation of our concept. For data analysis we chose a qualitative method because it better reflects the experiences of individuals and gives us a better understanding of the research issue.

Key Finding 1: Educational value of algae

After initially looking into the wide range of natural waters and its different compositions, we came to our first decision-making crossroads. The first key finding that guided us, came from our interview with Alexandra M. Lewandowska, an Assistant Professor in Marine Functional Biodiversity at Helsinki University. Learning from Lewandowska's knowledge on aquatic biodiversity and the problems that occur when it's out of balance, we became interested in plankton and especially phytoplankton, the community of plant based particles in the sea. (Lewandowska, 2020).

From further research, we found out that phytoplankton is responsible for 50-85% of earth's oxygen production (EarthSky, 2015). In addition, they work as a "biological carbon pump" absorbing around 50% of earth's carbon dioxide. They are also the primary producers in the aquatic food chain. Without phytoplankton, our waters would become extinct of other species, such as fish, altogether. All this makes the almost unnoticeable species in waters crucial to our ecosystem as a whole (Lindsey and Scott, 2010).

Background Research

Research on phytoplankton led us to further narrow our focus to algae, or 'the green gold', as it is referred to in marine biology. The name comes from its multiple possibilities for usage in the future. Algae is heavily researched for its potential to fulfill human needs such as nutrition, electricity production in the form of bio-fuels and as raw material e.g. in bioplastics (Wolkers et al., 2011).

We saw the importance and potential of algae as an important educational value to be contributed to kids through our solution. These insights became embedded as game features in our concept. Game credits became vitamins, omega 3-fatty acids and protein, all found in algae. The different ways to utilize algae created the foundation for our game characters and also further educational information provided through the game.

Key Finding 2: Tangibility of microalgae

Our interview with Anne Ojala, a Researcher and Lecturer on Ecosystems and Environment in Helsinki University, led us to our second key insight. Ojala specializes in microalgae research and educated us on different algal species as well as their occurrence in the Finnish waters. Microalgae, as we found out, is the most common type of algae in Finland. It floats on top of water and can be found in any humid place; sea, lake, pond or even snow. The easy accessibility steered our choice to focus on microalgae. Although problematic, since the filamentous algae can not always be detected through the eyes. Once they occur in larger communities, blooms, they become visible. Making the invisible visible became part of our design; the algae creatures appearing from water (Ojala, 2020).

Background Research

Larger blooms of microalgae occur twice a year in Finland; first in the spring and second in late summer (Ojala, 2020). However, we became aware of the tension between kids experimenting with algae with bare hands since the latter bloom consists of toxic blue green algae that shouldn't be touched. This affected designing our solution in a way that kids should not be encouraged to go play or swim in the water while blue green algae is blooming in large numbers.

Due to toxic algae species as well as their slimy texture, algae has a bad reputation. In our first interview with a user group representative Aava, aged 10 years, this tension became apparent to us for the first time. Her first reaction towards algae reminded us that at first impression isn't an appealing material. However, the importance of conserving the waters seemed to spark her interest. Also, algae as a source of food was not unfamiliar or unappealing (Karvinen, 2020).

Although its enormous benefits and future potential, we realized that our solution should address the unappealing quality in a positive manner and enhance the reputation of algae, a goal that Ojala, as a committed algae researcher, enthusiastically shared our vision.

Background Research

Key Finding 3: Two-way interaction via app

The tensions in tangibility influenced our design in important ways. First, the problem of toxic algae blooms led to the idea of having an app. A two-way interaction through our game where research institutions could communicate through the app to warn users of local toxic blooms and when not to go near water.

Two-way interaction would also bring up the possibility of gaining more observations from certain locations, a need that was brought up by Timo Pyhälahti, a Senior Coordinator on Remote Sensing and Civil Observational Systems at SYKE, Finnish Environment Institute. Both toxic blooms and demand for closer observations are detected from satellite pictures, which are commonly used for monitoring algae blooms. However, the downside of this monitoring is that you are not able to zoom in close enough to recognize a certain species, for example. This is where our citizen observations would become handy (Pyhälahti, 2020).

When designing our concept one of our main goals was to develop a solution for research purposes. We wanted it to store data for one of more research purposes. Vast collections of different kinds of information from algae and water systems would increase the quality of research. The strategy of only looking into just one data point is inefficient while having a larger amount of data in hand (Greely, 2007). Technology advances enable sharing information world wide and rapidly evolving algorithms enable efficient data processing. This was something we found very interesting and through our interviews we learned that there is some kind of database currently available in SYKE but our solution would take it even further.

Background Research

Key Finding 4: Collecting the right data

Following our design principles that included fun, sensory-rich learning and easy accessibility, we had to choose a feasible way to collect data that would be super fun yet safe to explore with.

Already from our interview with Ojala we had some knowledge of the type of data that should be collected and we started to build our concept based on that information. Anne had told us that one of the most useful insights that kids would be able to observe are colour of the water, size of the algae blooms and measurements from local weather conditions. All of those could be easily done by taking a simple photograph. Anne also specified that pictures should be panoramic and it would be beneficial if they were to capture the whole shoreline of the lake or the sea.

Because the scope of the project was ten years we also introduced another idea which we thought would produce valuable data for researchers - a spectrometer (Edinburgh Instruments, 2020). During our research we learned that there are already some simple spectrometer applications available on your mobile phone. With a spectrometer, our solution would be able to detect for example what species the algae represents as well as composition of the object being analyzed. We got confirmation from Anne Ojala that spectrometers would bring very valuable data to researchers and that we are on the right track.

When our concept was roughly finalized we had our last interview with Postdoctoral Researcher Elina Peltomaa from University of Helsinki to validate our solution. Elina shared our vision and also believes that with an application like this, civic research truly has a part of the research in the future. She mentioned a couple of the key factors that she thought would be the most important in our solution.

Background Research

Firstly, one of their challenges today is to have data from several locations because it is time consuming. With the help of our application researchers would have “eyes” all over Finland simultaneously and the amount of data would increase significantly and this would mean more accurate findings. Secondly, researchers would also get long-term data from the same station point which could give more accurate data on how water systems are changing over the years. Elina did mention currently there are a few automatic sensors in some lakes across Finland, but that they require a lot of maintenance since algae tends to grow around them and clog them, besides, they are quite expensive.

This interview also officially confirmed the “must-haves” in collecting data. Which are:

- **A horizontal picture** with a shoreline in order to capture the vegetation on land and algae in the water. This photo also provides information regarding the change in time of that specific lake.
- **A close-up picture of the water color**, in a clear cup, with an attachable spectrometer, in order to measure the level of brownification of water, given the fact that lakes are getting more brown everyday because of the changes in the in-water vegetation,
- **The location and weather**, which can be collected by the user’s phone. This points out where the data is collected from and the prevailing weather situation.

Additional “nice-to-know” information would be:
- **Water temperature**, given the fact that algae species have their prefered water temperature for blooming,
- **The water pH-levels** because the abundance or lack of algae species get to modify the pH-level of water of the whole lake.

Technology for the Transformation

System overview

After analysing insights from our research, we formed our solution concept as a civic science project. The civic science project allows us to collect sufficient data for research purposes and to engage kids in the gamified process of collecting data. From technological perspectives, a civic science project requires four applications - the applications for data collectors, for data analysts, for data storage and APIs to connect all applications in the system. In our project, we were supposed to create a mobile application for kids to collect data related to algae, a web application for researchers to monitor collected data, a cloud database to store all essential data, and APIs to transmit data across the system.

From the interview with Timo at SYKE, Finnish Environment Institute, we learned that the institution has already been building an extensive backend system to store and analyse data related to algae. However, their pain point was that current data is being collected via only satellites from far away, so the close-up information about algae is missing. Therefore, the technical scope of our project focused on building the application for kids to collect close-up data related to algae, the location of algae and the weather information that day.

Technology for the Transformation

To build that mobile application, we implemented React Native to shorten the development process. From our team member experiences, by using React Native, we can use the same code for deployment on iOS as well as on Android. This implementation means a considerable saving in development time and cost, compared to coding a native application on IOS or Android. As the concept was in the early phase and required a lot of testing and modifying, shortening development time was important for our team.

In addition to the software on mobile, some hardware components were required to collect all “must-haves” and “nice-to-know” data. These components were a spectrometer lens that is attached to a mobile phone, a pH meter, and a personal thermometer. To our team assessment, all the necessary hardware components were easy to make at home or buy in local shops.

Technology for the Transformation

Envisioned Physical Design

The first physical component was a spectrometer that is attachable to a mobile phone. A spectrometer is used widely in scientific labs around the world. According to Michael O. (2017), a spectrometer is a measuring device that collects light waves of an object. Certain light waves are often associated with certain materials; therefore, with a spectrometer, scientists can identify the materials that make up the objective. In our context, a spectrometer could help identify the exact types of algae and their components that ordinary human eyes can't recognise. There are poison and non-poison algae, so knowing the types of algae is crucial and "must-have" for the research purposes.

An image of a USB spectrometer (Source: USB Spectrometer. 2019)

As you can see from the image above, a spectrometer can be made into a small piece without highly advanced technology. On YouTube, there are also many tutorials to make a personal spectrometer to collect and analyse light data. Therefore, the concept of having a spectrometer attached to the smartphone was feasible for our research activity.

Technology for the Transformation

Moreover, the current technology already enabled a spectrometer to be small enough to fit on every smartphone. That technology was developed by Jie Bao, a physicist at Tsinghua University in Beijing, China, and his colleague Moungi Bawendi, a chemist at MIT, according to Popular Mechanics magazine in 2015. Soon, kids won't need a separate spectrometer to collect algae information.

The second and third physical components were a pH meter and a personal thermometer. Like a spectrometer, these components could be made at home. There are a lot of YouTube videos demonstrating that process. However, our team suggested that kids can buy a pH meter and a thermometer from local shops to reduce the complexity and maintain the high accuracy in the process of collecting data. Besides, these products can be reused for different purposes.

In our context, a pH meter and a personal thermometer help kids to report the pH level in the water and the water temperature to the researchers. This information is "nice-to-know" for the research purposes, so kids don't need to buy the equipment unless they already have them.

An image of a pH meter
(Source: GrowGuru. 2020)

An image of a thermometer
(Source: MedVision. 2019)

Technology for the Transformation

Envisioned User Interface

Bloom is a fun and interactive game for kids building off of the experience of geocaching by using Augmented Reality while being able to monitor the algae blooms in the lakes around Finland. By using this app, kids will be able to explore the outdoors and to collect important data about water through various photos and challenges. In return, kids will get to catch cool water creatures that will provide them with educational content regarding the algae world.

The whole Bloom app experience is designed in a way to be attractive, engaging and geared toward kids. This is why, before starting to design the app, we made a research and competitors analysis in order to understand what was the success factor in the design of an app for kids, and what kind of characteristics we should pay special attention to. Hence, we decided that our app had to consider the following:

Simple characters,
Simple storyline,
Some funny jokes,
Challenges,
Simple UX and easy navigation
Feedback in order to learn what made them fail and keep trying,
Bright, vibrant, and multi-colored landscape


bloom
Log in
Create an account

Technology for the Transformation

The name

Starting from the name, we decided to name the app Bloom given that it is a short and attractive name which has a direct link to the matter of research, the algae blooms.
For the logo, we chose a bold and geometric font which makes the logo look more playful and happy. We also deliberately chose that the “b” of bloom was not going to be in capital letters in order to keep the name informal.

bloom

Logo

Bloom monsters

Every time a kid completes a challenge, a kid gets a monster as a reward. The design of each monster was based on the view of a real species of algae under the microscope, but modified in a way to look cute, funny and playful. The goal of this was to modify the perception of the kid towards the algae and make it something you want to keep catching. This is why the monsters have bold shapes, bright colors and anthropomorphic features like eyes, mouth, eyes and hands. Also, each monster is named after the original algae species, in order to get the kid introduced to the algae biodiversity.

Chlorella

Arthrospira platensis

Rhodophyta

Technology for the Transformation

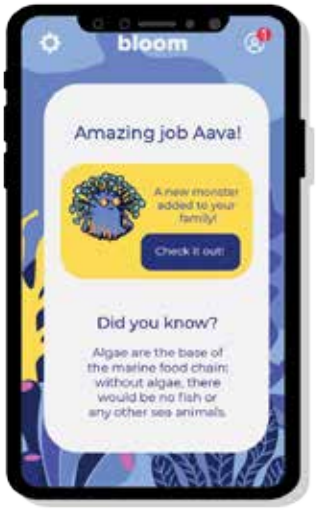
Bloom family

After completing several challenges, the kid starts to collect the Bloom monsters and to keep them in his Bloom family library. With this feature, we allow the kid to look at his achievements and we foster the communication between the kid and his friends, given the fact that they will start sharing their conquests and will get excited about it. By adding this aspect, we engage and incentivize kids in the pursuit of more monsters.

Exploring monster family in Bloom app

Educational part

As for the educational part of this Bloom game, we decided that we wanted kids to learn more about the algae and its characteristics. This is why whenever you catch an algae species, you get to see information about it and you also get the resources this certain algae species produces (such as proteins, vitamins and omega-3). With this amazing resource kids are able to personalize their monsters like buying them clothes or even cool “Elton John looking” glasses. Also, we added fun facts like “Did you know that the US Navy has run ships and planes on non-polluting fuel made from the oils in algae” in the welcome screen.



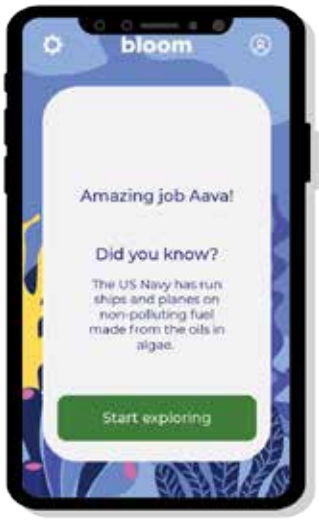
Fun Facts in Bloom app

Technology for the Transformation

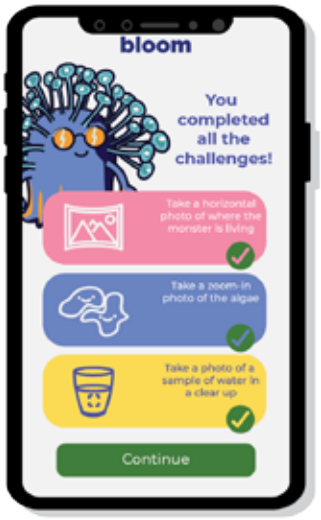
App interface

The interface of Bloom was designed specifically considering the characteristics of our users, the kids. This is why we developed a simple UX with easy navigation. Few buttons, bold texts, bright colors and kid-friendly language were just some of the features that we knew that had to be a present in this interface. Also, we paid special attention in the loops of learning, which is why it is always possible to go back. Feedback after failure is very explicit in order to learn from the mistake and keep trying.

Regarding the rest of the graphic design of the interface, we used an underwater landscape featuring different algae cartoons. This pattern presents hues of blue and certain complementary colors that complement the general graphic design of the UI.



Welcome page in Bloom app



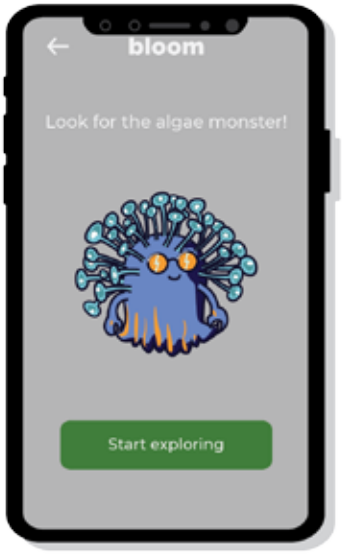
Completed tasks in Bloom app

Technology for the Transformation

Complementary features

Augmented reality

This app uses augmented reality at the point where the user is looking at the lake through the camera on their phone and a monster starts to emerge from the water. The point of the AR is to create an experience that excites the user and motivates him to complete the challenge.



Augmented Reality in Bloom app

Spectrometer

As for the spectrometer, it is used as a tool in a way to complete the challenges while providing valuable data to the researchers. This tool is especially valuable in two tasks. First, in the task of the close-up picture of the bloom, the spectrometer will be able to detect the color of the bloom and identify the algae species. And second, during the task of the close-up picture of the water color, the spectrometer will capture the exact color of the water.

Approvals

This game requires parental approval at the moment of creating an account at the app. At this point it will be mentioned that the app gathers background information like weather and location and uses the spectrometer integrated with the camera in order to complete the tasks of the close-up picture of the bloom and the close-up picture of the water color.

Technology for the Transformation

Journey Map

The kid visits the lake.

The kid notices that there is some algae bloom in the water.

Decides to open his Bloom app and catch that aquatic monster.

The kids completes certain tasks.

Kid catches the monster and adds him to his monster family.

Kid completes the challenge and is ready to leave the place or continue catching monsters.

Technology for the Transformation

Journey Map of the UI

1. Open his Bloom app and sign-in
2. Welcome back -> Click in start playing

3. Camera opens, through the camera, kid looks at the lake. Using AR a monster appears in the scene. ->Click in catch monster

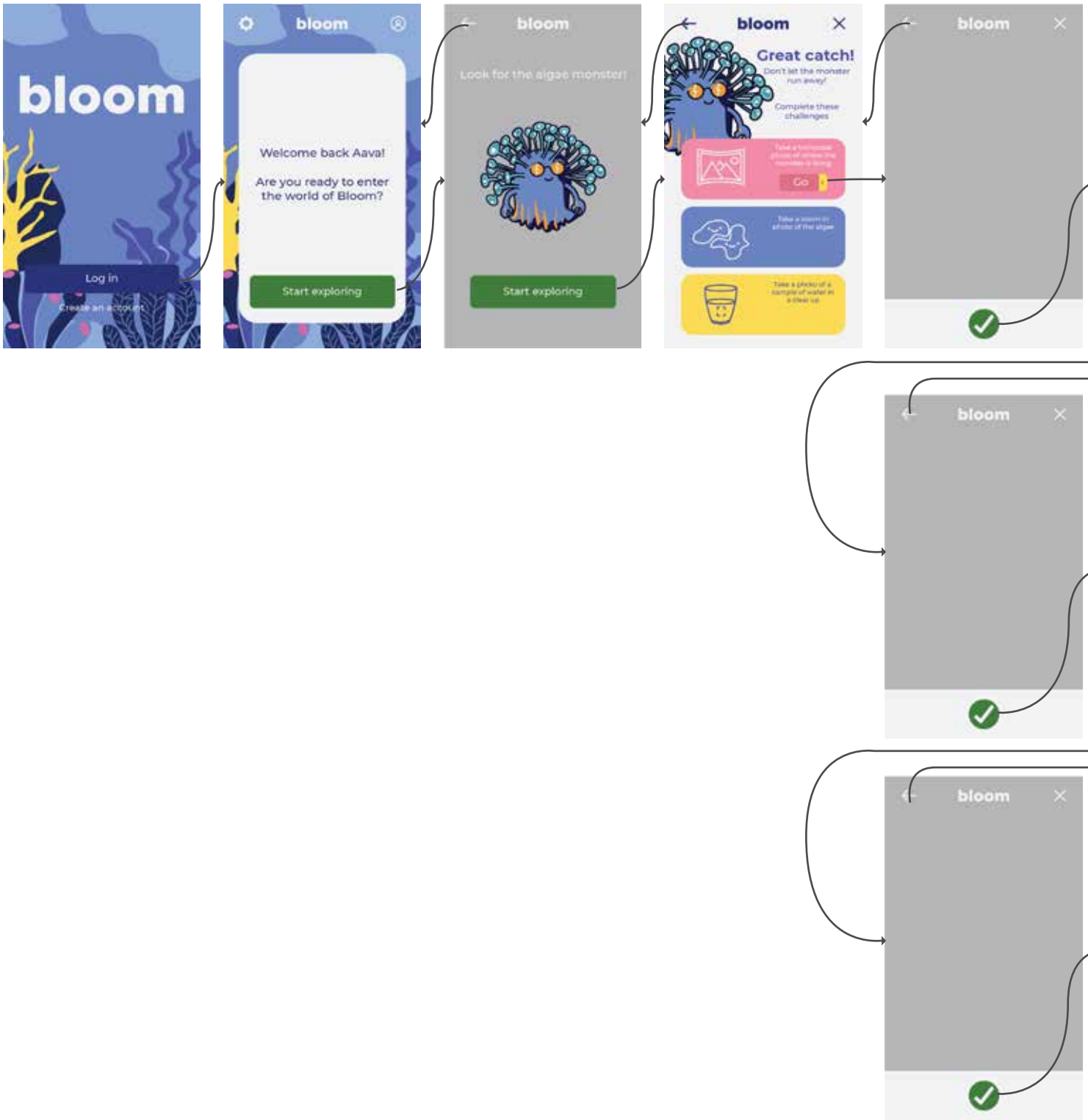
4. The app presents the tasks to be completed -> Click on the first task panoramic photo of the lake
5. Camera opens and takes the panoramic photo of the lake
6. Back to tasks to be completed -> Click on the second task close-up photo of the bloom
7. Camera opens and takes the close-up photo of the bloom
8. Back to tasks to be completed -> Click on the third task close-up photo of the water color
9. Camera opens and takes the close-up photo of the water color
10. Main tasks to be completed. App gathers the weather and the location as a background task

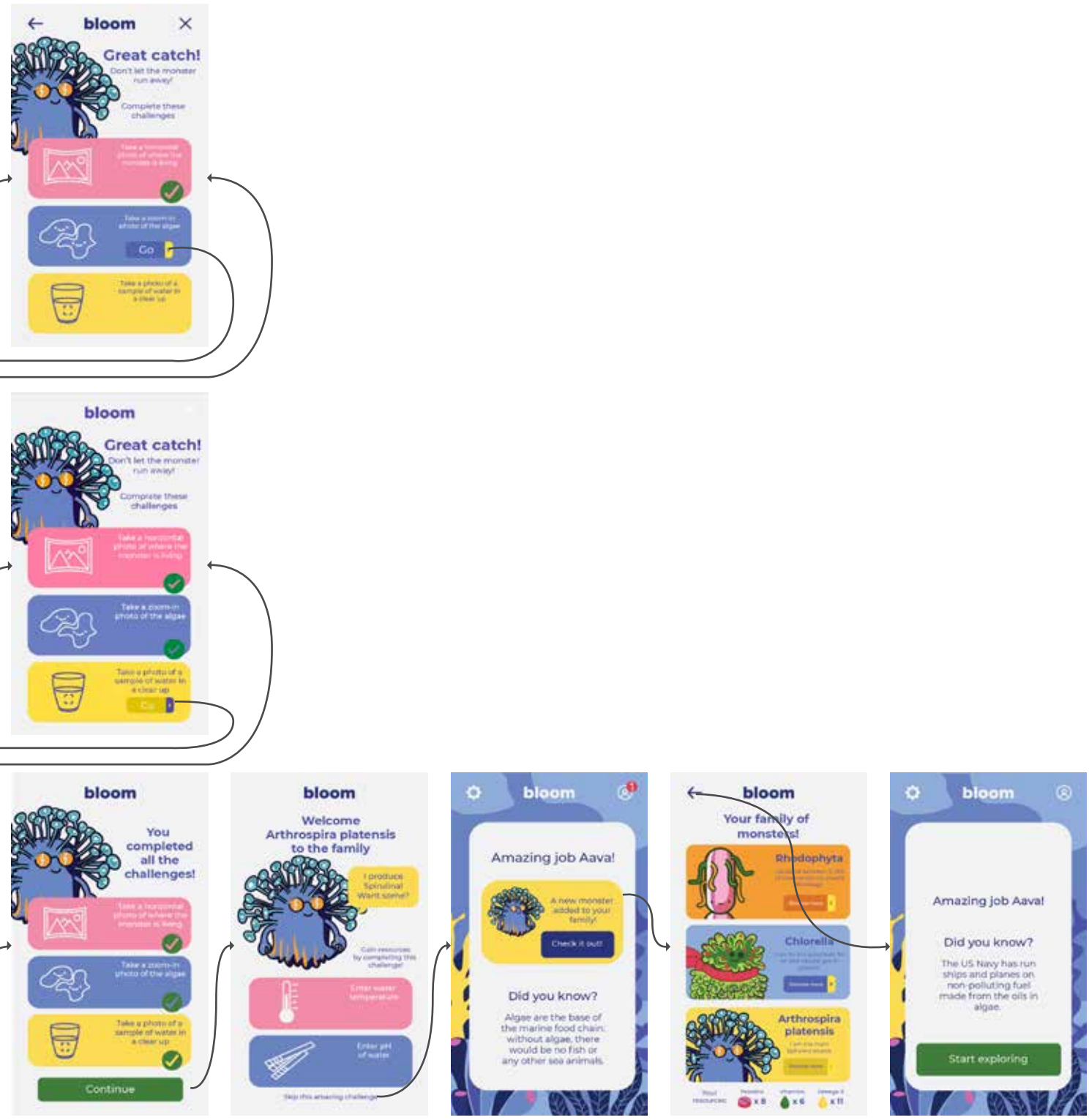
11. Extra tasks to gain resources -> Click on the first extra task, insert water temperature
12. Insert water temperature
13. Back to extra tasks to gain resources -> Click on the first extra task, insert pH level of water
14. Insert pH level of water

15. Catches the monster and sees a fun fact -> Click to see monster family
16. Explore monster collection
17. Back to main page -> Keep catching monsters

Technology for the Transformation

Journey Map of the UI




bloom
Great catch!
Don't let the monster run away!
Complete these challenges
Go
bloom
Great catch!
Don't let the monster run away!
Complete these challenges
Take a zoom-in photo of the algae
bloom
You completed all the challenges!
Take a zoom-in photo of the algae
Continue
bloom
Welcome Arthrospira platensis to the family
I produce Spirulina! Want some?
bloom
Amazing job Aava!
A new monster added to your family!
Check it out!
Did you know?
Algae are the base of the marine food chain: without algae, there would be no fish or any other sea animals.
bloom
Your family of monsters!
Rhodophyta
Chlorella
Arthrospira platensis
bloom
Amazing job Aava!
Did you know?
The US Navy has run ships and planes on non-polluting fuel made from the oils in algae.
Start exploring

Technology for the Transformation

Prototyping

In order to prototype this app, we had several prototyping stages. The purpose of each one of them was to understand the workflow and the user experience, and to gain insights to improve it.

First we did a low fidelity prototype in Miro, in order to determine how the workflow of the app would work. At this first stage we discussed and analyzed the first prototype as a team and made the first changes in the roadmap.

As a second prototype, we made a rough prototype in Figma which we tested with people that were not related to or had any prior knowledge of our project. This prototype worked as a way to get feedback from the user of where they were interested in clicking and to see if they understood the general concept.

As a last prototype, we added the graphic design of the interface to the Figma prototype and we tested it with kids. By doing this, we were able to understand what were the weaknesses of our design and be able to improve them. We noticed that the kids did not click on certain buttons so we had to change the layout in order to guide them to the places we wanted them to go. While testing this last prototype with Finnish kids, we discovered that we made our whole app in english and kids of this age were still learning english so they struggled with understanding the language in a way that their mothers had to explain to them what to do. With this we learned that if we want to implement this concept, we have to translate it to Finnish.

If you want to see how Bloom works in action, you can see our demo in the following link:

https://youtu.be/DfrqggzM6Co

You can try and test our Figma prototype in the next link:

https://www.figma.com/proto/lOGt9jkpvOJMbo5Pnh6jVi/NEPPI-2020?node-id=30%3A21&scaling=scale-down

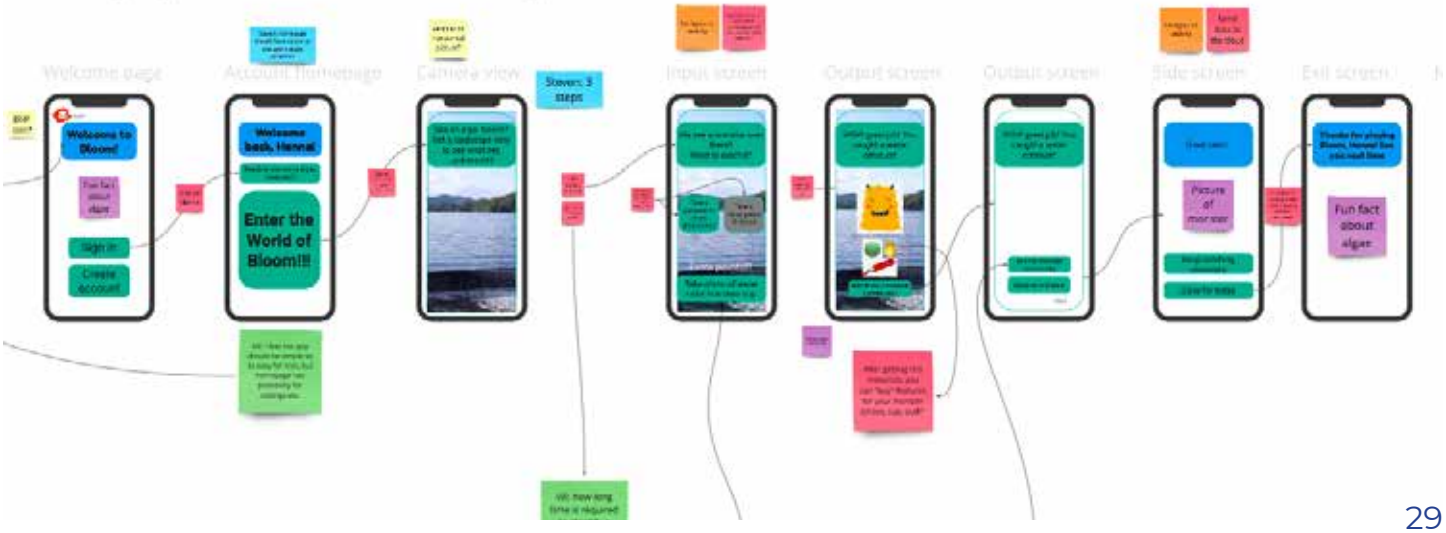
Kid Testing

Interview with Elina Peltomaa

User Journey

Researcher Journey

App Roadmap



The Ecology

Power Relations and Possible Arrangements

Mapping out the power relations within the Bloom community requires a proper breakdown of the stakeholder ecosystem. As has been elaborated in our solution overview in section 1 on The Opportunity, Bloom is intended to create a valuable network between the primary stakeholders, the **kids** interacting with the app and the **researchers** collecting and developing insights from the crowdsourced data. However, within this stakeholder ecosystem we also identified several secondary stakeholders. For example, the **parents** of kids play an important role in the decision-making of their kids' activities; this relationship means that complete transparency is all the more crucial in acquiring any users. This responsibility also extends to organizations or institutional networks planning activities for families or kids, such as **educational systems** and **scout groups**. Conversely, **universities** and **research institutes** such as the Finnish Environmental Institute SYKE play an important role in our solution as well in order to utilize resources and eventually scale.

The Ecology

Money, Value, and Viability

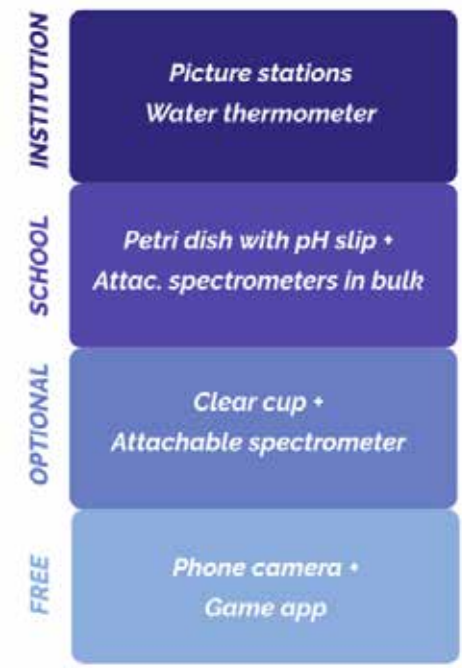
It's worth noting that building Bloom would require some initial investment. The next steps in its development would require a minimum viable product (MVP) that can be pilot tested and iterated upon. Two members of our team are experienced in User Interface design, however the ability to then develop this solution would require either outsourcing or on-boarding a developer skilled enough to create an MVP. Assuming an average monthly salary of 3425 EUR for one full stack developer in Finland ("Full Stack Software Developer in Finland", 2020) and approximately 4 months to build our MVP followed by 6 months of improving and iterating, developer costs would be 34,250 EUR.

The second cost associated with initial investment is the manufacturing of Bloom's attachable spectrometer. As is stated in section 3.2 on the Envisioned Physical Design, a colloidal quantum dot spectrometer would cost only a few dollars in manufacturing costs. With an estimated pilot test group of 40 kids and an assumed cost of 4 EUR to manufacture a microspectrometer, this would require an additional 160 EUR.

Therefore, upfront costs for MVP development and product iteration phases as well as costs associated with microspectrometer manufacturing would equal to 34,410 EUR.

The Ecology

However, once developed, our project must be financially sustainable and therefore requires monetization. Our revenue model relies on making profit through a few key areas. First, for all users, the basic app (no need for accessories) could be provided for free to any interested users. However, for any additional features in the game, users can pay for the microspectrometer and clear cup. As a business-to-business option, we can also sell our accessories in bulk to school systems. Finally, the top value capturing opportunity is through research institutes that could fund our venture entirely. This has the added benefit of acquiring revenue by, for example, renting out Bloom accessories to families. A breakdown of our revenue model can be seen in the figure below.



Bloom Revenue Model

The route of partnering with or receiving funding from a research institute is what solidifies the business viability of our solution. Announced by the Ministry of the Environment of Finland, the Evo Natural Park in Hämeenlinna is set to be the first science national park in the world (University of Helsinki, 2020). According to algae researcher Elina Peltomaa, our solution, alongside standardized picture stations and water thermometers throughout the park, could be of significant interest to them as they most certainly would want to include family activities in their services.

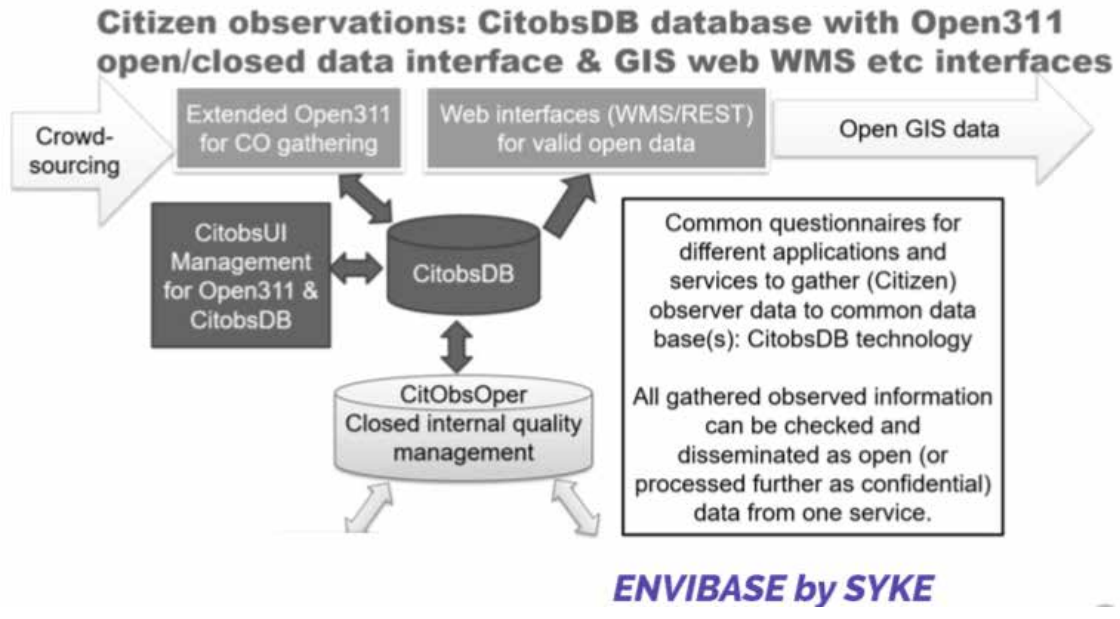
Overall, with upfront costs equal or close to the salary of one added employee, a well-designed revenue model and a potential partner already set in place, we believe that Bloom could certainly be a viable solution.

The Ecology

Security, Ethics, and Sustainability

As it is a heavily discussed topic around the world, it goes without saying that the idea of kids sharing their data might cause some concern among parents; this is one of the primary reasons parents stand as stakeholders in our solution. Building trust with families about the security of our platform and the confidentiality of all data collected would require complete transparency on behalf of our team but also on behalf of SYKE, whose Envibase data service we believe would be ideal to build our platform on top of.

An ongoing project at the Finnish Environment Institute, Envibase "concentrates on the development of information systems and processes used in the collection and utilisation of multi-source environmental data" (Finnish Environment Institute, 2016). One of the sub-projects of Envibase is in citizen observations in environmental monitoring, wherein crowd-sourced data can be sent in, monitored for quality and then disseminated as either open or confidential data from one service.



Envibase Citizen Observations data service

The Ecology

A thorough explanation of how Envibase functions and what value it brings to researchers could ultimately decrease concern of parents, yet the ethical issues of data privacy would be an ongoing battle, as it is in many other data-centric solutions.

In terms of the sustainability of Bloom, a primarily app-based solution with a focus on interactions with nature fulfils the goal of intertwining technology and the outdoors without producing waste. The only threats to the sustainability of Bloom are the physical accessories such as the microspectrometer and the clear cup. In order to reduce unnecessary overproduction, national parks could instead rent our equipment as opposed to sell it, further promoting a reuse/sharing community. Another opportunity to reduce waste is to capitalize on algae's properties to manufacture our clear cups. For example, at the Arizona Center of Algae Technology and Innovation, assistant professor Taylor Weiss is "leveraging the power of algae to produce plastic" (Charbel, 2019). Harnessing this type of technology would not only be appropriate for Bloom's area of focus, but would also eliminate any issue of plastic waste.

Publicity of this Document

Here we state whether or not we authorize open sharing of our transformation document.

Since we don’t have any confidential information from our interviews and research, we can state that this can be shared and published anywhere.

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bloom

Transformation Opportunity Bloom: Gamified Data Collection on Microalgae

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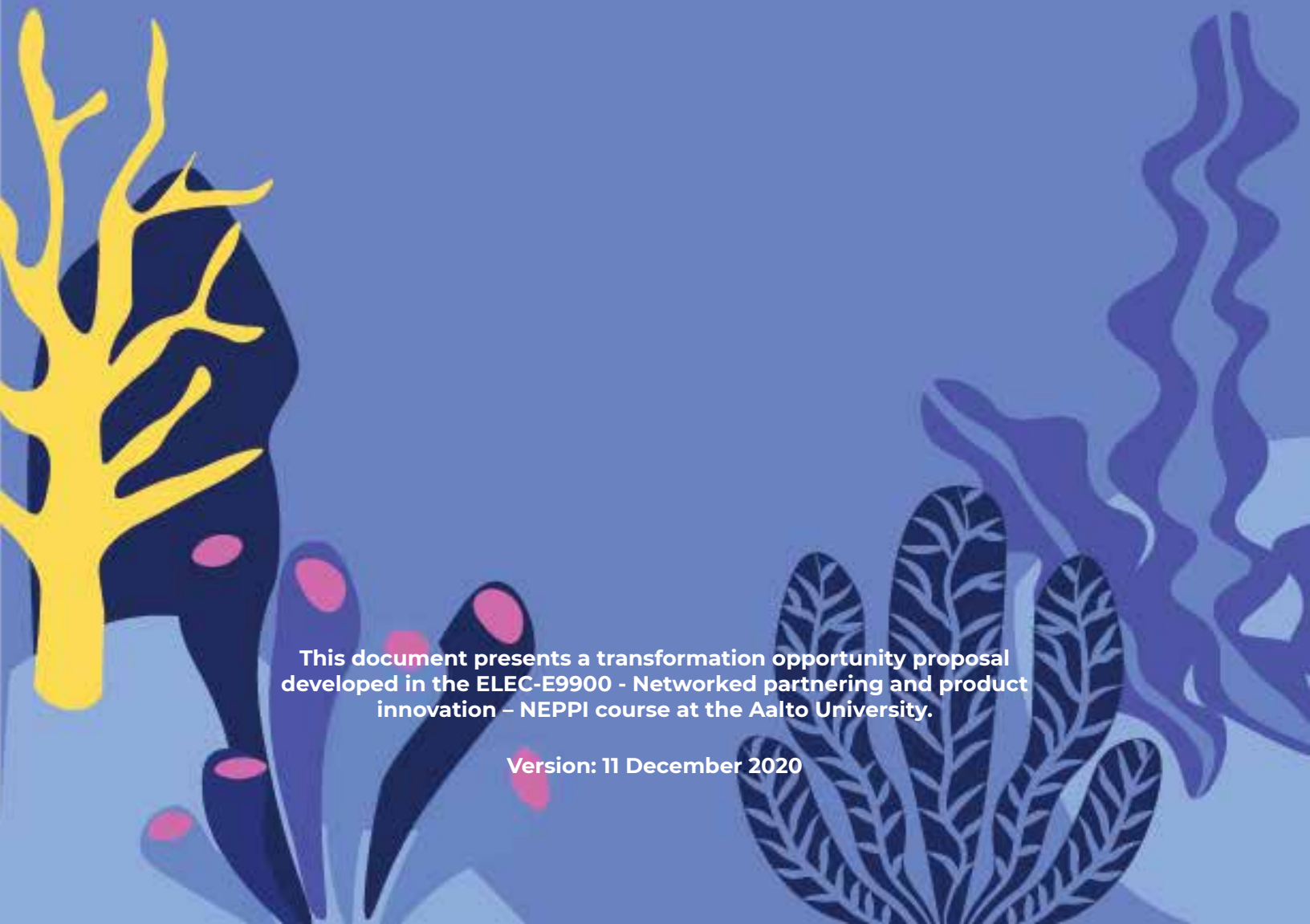

This document presents a transformation opportunity proposal developed in the ELEC-E9900 - Networked partnering and product innovation – NEPPI course at the Aalto University.

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