Virtual Reality for Education

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VR for.us

BREAKING NEW GROUND
AALBORG UNIVERSITY

Title: Virtual Reality for Education

AALBORG UNIVERSITY

Theme

4th Semester: Entrepreneurial Master

Project period

Spring Semester 2021

1st February 2021 – 3rd June 2021

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Total No. of pages: 80

No. of prologue pages: 7

No. of body pages: 62

No. of appendix pages: 11

Submission date: 3 June 2021

Synopsis

This Master's Thesis aims to identify how to develop an MVP of a product that can help to get a competitive foothold in the education market.

One part of the thesis is understanding the startup potential in the VR education market by analysing the market, competition and alternative products.

Another part is creating an MVP for this market. The overall process is framed with Design Thinking, Lean Startup and Agile methodologies. Design Thinking is applied when we explore and solve various problems, Lean Startup when testing our hypothesis, and Agile methodology for actual product development.

In the thesis, we also describe how our startup is going to operate in terms of organisational structure. Also, technological aspects for startup creation are researched to develop the first prototype.

Subsequently, the first prototype is introduced, tested with potential users, and described further development regarding the selected market.

Signatures by the group members confirm that the participation of the participants was on equal terms. Each of the group members is responsible for the project content.

Abstract

In general, the Virtual Reality (VR) market is growing as the number of users who hold such devices is increasing. In 2020 market size was $2.6 Billion, and it is projected to be $5.1 Billion by 2023. And yet the VR market is still not matured which gives a chance of business potential.

As the VR market is getting bigger with more users possess VR devices, and technology becomes more available, the VR technology can be used for learning and teaching subjects that might be hard to understand (e.g., higher scale concepts such as the universe). Moreover, over the years VR has advanced (in terms of price-performance in the consumer market) so much that users can even interact with surrounding digital objects which potential can be used also by learning and teaching.

The area of interest of this thesis is to use VR technology in education by identifying a business potential. Which led to the thesis' research question: how to develop an MVP of the product "Odyssey" for VRfor.us to get a competitive market foothold in the education market?

In this research, we aim to develop a minimum viable product to get a competitive market foothold in the education market. The thesis analysis theory of what is VR technology, its history, benefits and challenges for better understanding the technology itself. Also, Design Thinking, Lean Startup and Agile methodologies are being researched for the process of developing a product and used for creating the prototype.

The thesis also studied why Virtual Reality is a disruptive technology and its possible market size for the education market. Moreover, the competition, its types, competition environment also has been researched which later is being applied for potential competitors for the startup.

The importing findings of this thesis are discovering the environmental education niche which might be a good starting point in the education market. From the competition analysis, VR in environmental education can be a good starting point as the competition is low.

This thesis has been finalized by illustrating how the Design Thinking, Lean Startup and Agile methodologies were used to make the prototype. Subsequently, suggestions have been proposed on how further development should be done in order to have a product for the target education market.

Keywords: Virtual Reality, Education, MVP, Prototype, Design Thinking, Lean Startup, Agile methodology

Acknowledgements

We would like to say thank you to all the people who helped during this thesis. First of all, we would like to gratefully thank Claus Andreas Foss Rosenstand for the guidance and advice during the project. Also, to Edvinas Danevičius who found time for us to consult and help us with product development. Our families and friends who gave us the support of making this project happen.

Reading Guide

Following the "Introduction", the subsequent chapters are written to answer the research question (RQ) and its work questions (WQs). Each chapter which starts with a work question is answered by finding, analysing, and applying theory in this research. Subsequently, this thesis is finished by concluding this research, followed by the "Bibliography" and the "Appendix".

This thesis is written following the American Psychological Association (APA) 7th edition (surname, the year of publication). Referenced are placed after referenced content: after sentence, if just a sentence or sentence group has been referenced or after paragraph when there is more than one referenced sentence. The complete list of references can be found in the Bibliography chapter.

Figures and tables are identified by "Figure" or "Table" following by their numbers and brief descriptions. Numbering is based on the chapter, and figure/table order, for example, the first figure in Chapter 3 is "Figure 3.1 The disruptive innovation model (Christensen et al., 2015)".

Glossary of Terms

Abbreviation	Phrase
2D	Two-dimensional
3D	Three-dimensional
XR	eXtended reality
VR	Virtual reality
AR	Augmented reality
MR	Mixed reality
RQ	Research Question
WQ	Work Question
HMD	Head-mounted display
DIA	Discovery-Incubation-Accelerate
VUCA	Volatility, Uncertainty, Complexity and Ambiguity
PC	Personal Computer
SBU	Strategic Business Unit
PESTEL	Political, Economic, Societal, Technological, Environmental and Legal
MVP	Minimum Viable Product
SDK	Software Development Kit
UX	User eXperience
S&M	Sales and Marketing
R&D	Research and Development
LiDAR	Light Detection And Ranging

Contents

Table of Figures and Tables

1 Introduction

The area of interest is virtuality reality (VR) applied for education. As it is written in the article “A Conceptual Basis for Educational Applications of Virtual Reality” (1993) by William Winn, it can be argued that there are two main types of experiences in VR-learning – first-person and third-person. The first one usually is being related as non-symbolic and the latter as a symbolic one (Winn, 1993).

Non-symbolic experiences are a natural occurrence for people. For example, day-to-day interactions with the surroundings. This type of experience also involves decisions, which are not interviewed by the consciousness (absence of deliberate reflection). Subsequently, real-life tasks are solved on hand at the time (e.g., when a person will use a hammer, she/he will know immediately that the hammer will bounce back without knowing Newton's 3rd law). As a result, some of the knowledge comes without reflection from consciousness (Winn, 1993).

The third-person experiences usually involve symbols. In this context, symbols mean some kind of communication agreement (e.g., specific world occurrences are described in a certain way). Moreover, learning based on a symbol system (text, spoken language, or computer) is unavoidably not a reflection of one's own experience but somebody else’s. And this can bring issues of understanding a symbolic content because each person has his/her world and understanding of things (Winn, 1993).

The first-person learning experiences can be reached through VR technologies because it allows different ways of interaction similar to the real world (Winn, 1993). Furthermore, VR learning can bring more excitement and interaction, which prompt student-centred learning experiences (Martín-Gutiérrez et al., 2017).

Learning performance and cognitive skills can be enhanced by using VR/AR technologies. Also, these technologies decrease disturbance levels and create affirmative attitudes when certain education goals have to be reached (Martín-Gutiérrez et al., 2017).

1.1 Motivation and Idea

1.1.1 VR Market

Nowadays, VR technologies are becoming more popular every year. As a result, the VR market is growing and the number of users who hold such devices is increasing too (Kotler & Armstrong, 2018). This trend also can be found in worldwide consumer VR software and hardware market size: in 2020 market size was $2.6 Billion, and it is projected to be $5.1 Billion by 2023 (Statista, 2020a).

Knowing that the VR market is growing, we believe that introducing VR technologies and dedicated learning content can yield profit from helping students to construct an understanding of concepts in their own ways because virtual reality has the capabilities of simulating the world as it was real. This could lead to a better understanding of a particular subject.

1.1.2 VR Education

Every student has their own unique cognition and forcing uniform education may hinge on their ability without them knowing it (Radianti et al., 2020; Winn, 1993). Uniformed education is achieved partly through standardization of symbolic proxies such as formulas, symbols and terms which means to be ready for learning per se, students need to learn the uniformed symbolic system (Winn, 1993).

A more natural way of learning is learning through the first-person, which means the learners experience and learn at the same time. Since experiences are individualistic, direct acquisition of knowledge helps observers personalize learning proficiency and achieve knowledge with higher learning quality in comparison with uniformed education teaching methods (Lindgren et al., 2016; Winn, 1993).

With VR we can construct the digital twin of the real world that can be manipulatable and safe. Interaction with the digital twin can help develop instant causality awareness while learning by doing and observing (Lindgren et al., 2016; Radianti et al., 2020). Moreover, the learning activity can skip the mediator of symbolic representation and contact directly with the phenomena from which the experience is drawn (Kotler & Armstrong, 2018). Learning by doing and observing might help learners to acquire knowledge better with increased learning motivation (Lindgren et al., 2016; Radianti et al., 2020).

1.1.3 Space and Earth Simulator

Compared to the universe, Earth is very small. But for us - humans - it is our home, and from our first-person perspective, Earth is very big. We take our living on Earth as a natural process of our existence, and yet, to fathom the idea that Earth is but a small part of something bigger we call the universe might be difficult. Being a part of that bigger system, Earth itself is a highly complex network with a consequential phenomenon that may be hard to understand without a holistic approach over a long period of time.

Our team thinks that VR can help people to understand concepts of Earth and Space better by providing an educational platform where people could interact, manipulate, and ultimately study Earth in the universe directly with Earth as a complex system by itself, or in another word, experience the universe as a "Divine Being". Furthermore, a user will construct her/his understanding of that surrounding without having a mediator (e.g., books, lessons, speeches etc.).

We believe Space and Earth simulator can be a good case where the VR technology exposes itself as a good supporter for understanding subjects with hard-to-grasp concepts.

1.2 Outcome

1.2.1 Shifted Idea

At the beginning of this product, we focused on having a Space and Earth simulator which would allow people to understand subjects that require larger-scale concepts. At the end of this project, while doing analysis, talking with people, prototyping, we understood that to continue further with this business, we should pivot our focus to be Sustainable Development Goals oriented. For example, teaching things about the environment and how certain factor change the Earth. This would give us a unique selling point in the VR education market.

1.2.2 Created Prototype

In this project, one of our goals is to provide a prototype. As the time for the project was limited, and the pivoting was done at almost the end of the project, the prototype itself holds universe simulation functionality, such as gravitation, planets rotation etc. Also, it is targeted to be a VR app which also requires additional work such as VR technology adoption. The video showcase of the prototype (2 minutes and 39 seconds) can be found here, and we recommend viewing it before further reading:

https://youtu.be/u91qxPn0QXc.

1.3 Research Question

How to develop an MVP of the product "Odyssey" for VRfor.us to get a competitive market foothold in the education market?

This research question is divided into 4 work questions (WQs), that is addressed through the report:

WQ1: What is VRfor.us?

VRfor.us is a virtual reality focused startup, where we plan to be founders. To understand the nature of this startup, first, we explain what virtual reality technology is, its alternatives and what kind of features it has by using literature analysis.

We also provide theory on what the company is and how this startup plans to look in future as well as the customer segment it addresses. In this section, we present our current team, their profiles and what kind of skills they hold. Moreover, this startup is tech-based, so we are planning to adapt commonly used startup practices and processes such as the Lean Startup (Ries, 2011) for prototyping iterations, and Agile methodology (Fowler & Highsmith, 2001) for regular technology developments. For the customer segment, this section explores the possibility and potential of some age groups by building personas (Aulet, 2013) in order to identify the fit target group.

To make VRfor.us functional from the business perspective, we provide the initial value of VRfor.us by using Value Proposition canvas (Osterwalder et al., 2014) and provide details of the business plan by using the Business Model Canvas (Osterwalder & Pigneur, 2010).

WQ2: What is the market foothold for VRfor.us?

The majority of VR applications at the moment focus on the commercial and consumer market sectors (Grand View Research, 2021). On the other hand, VRfor.us is prone to the educational VR market which might be less competitive than the commercial and consumer market.

To efficiently target the VR education market and gain a sustainable foothold, it is essential to answer the question: how big the market is. Some tools and techniques, such as TAM-SAM-SOM analysis, incorporated with initial market intelligence and empirical data from statistics service such as Statista.com are employed to discover the profitable market size to VRfor.us.

WQ3: What is the competition for VRfor.us?

The VR application for educational purposes at the moment does not have yet a fierce competition environment, but it is by no mean a competitors-free market. In order to understand the external environment, we go through overall research on the current similar VR solutions.

Furthermore, we carry out an external environment analysis using some tools such as Porter's five forces analysis (Porter, 1979) to analyse the current situation of the VR market for education. The uncontrollable environment factors also are analysed in this section by employing tools such as PESTEL analysis.

Finally, in this section, we map out the quality control criteria that the team use to assess the fitness of VRfor.us. In order to achieve this, some tools such as the "Blue Ocean Strategy" value curve (Kim & Mauborgne, 2005) is employed.

WQ4: How to develop an MVP of the product "Odyssey" for VRfor.us?

One of the main goals of this project is to deliver an MVP for our first product – the "Odyssey". In our case, the MVP is based on the Lean Startup methodology (Ries, 2011). In order to test some certain functionalities, a vertical prototype (Beaudouin-Lafon & Mackay, 2002) is used.

We clarify why and how we used Design Thinking (Laursen & Tollestrup, 2017), the Lean Startup (Ries, 2011) and Agile (Fowler & Highsmith, 2001) methodologies to achieve our desired product goals, how we created our MVP (used technologies, prototyping sessions), how we tested assumptions (usage tests with people), identify quality criteria and received the feedback from potential users (surveys).

In this section, we also provide theory about MVP, prototype strategies and types, how we used Design Thinking (Laursen & Tollestrup, 2017), the Lean Startup (Ries, 2011) and Agile (Fowler & Highsmith, 2001) for developing our product. Furthermore, we provide some technical details on why certain technology solutions were chosen.

1.4 Publication Design

Table 1.1 provides this project publication design which is based on RQ and WQs. Each of the chapters answers a different work question which later is finalized in the "Conclusion" chapter.

Table 1.1 Publication Design

Chapter	Title	Question
1	Introduction	RQ: How to develop an MVP of the product "Odyssey" for VRfor.us to get a competitive market foothold in the education market?
2	VRfor.us	WQ1: What is VRfor.us?
3	Market	WQ2: What is the market foothold for VRfor.us?
4	Competition	WQ3: What is the competition for VRfor.us?
5	Designing MVP	WQ4: How to develop an MVP of the product "Odyssey" for VRfor.us?
6	Conclusion	RQ: How to develop an MVP of the product "Odyssey" for VRfor.us to get a competitive market foothold in the education market?

1.5 Research Design

How the thesis would look like is one "wicked question" we faced during the research process. To tackle this problem, we employed a hermeneutic approach, which refers to the shifting between the whole and the parts of the research. In our case, the whole of the research is represented by the research question (RQ) and the parts are represented by the work questions (WQs). Moreover, the work has been problem-orientated, because we constantly focus the process on the problem, with the philosophy that a report is never better than the problem it addresses.

Using the hermeneutic approach, as our goal shifted from doing project management to providing an MVP, we also changed our research question. During the making process of this thesis, both the RQ and WQs have changed as they are interconnected, for example, at the beginning our RQ was "How to do project management for VR.for.us to get a competitive market foothold in the education market with "Odyssey" design as an MVP?" At that time, one of the WQs was "How to do project management for an MVP for VRfor.us?".

The project is split into two parts – business and prototypes parts. Regarding the business part, it follows the Lean Startup methodology (Ries, 2011) together with Design Thinking (Laursen & Tollestrup, 2017). Meanwhile, the prototype part – Agile methodology (Fowler & Highsmith, 2001) with Design Thinking (Laursen & Tollestrup, 2017).

Publication design and Research design follow the concept proposed in the research paper "Designing Engaged Scholarship: From Real-World Problems to Research Publications" by Mathiassen (2017). Publication design and Research design are part of the iterative process where each of the work questions targets different goals. In this case, Publication design refers to our master thesis report, and research design refers to our overall process of the research.

2 VRfor.us

WQ1: What is VRfor.us?

This chapter unfolds the work question “What is VRfor.us?”. In the subchapter “VR Technology” we analyse what VR technology is, its history, what kind of alternatives exist, and what kind of benefits and challenges VR technology has.

In the second subchapter “VRfor.us - the Company“ we describe our current and future teams. Also, we explore what an organization is, and how we are planning to manage our company.

Finally, in the chapter “VRfor.us - the Product “Odyssey” we explain briefly what our product is, how Design Thinking, Lean Startup and Agile methodologies are being used along the process of creating the MVP of “Odyssey”. Moreover, we describe our target group, initial value proposition and business model.

2.1 VR Technology

Virtual Reality (VR) is a fully generated environment that user can interact with (Sherman & Craig, 2019). Meanwhile, Virtual Reality systems may consist of synthetic surroundings where the participation of a user is illusional. Furthermore, VR systems depend on three-dimensional (3D), stereoscopic and head-mounted displays with or without supplemental interactive modalities of hand/body tracking sensors and binaural sound. Moreover, impressiveness and multi-sensory experiences are the main factors of VR systems (Earnshaw, 1993).

The goal of virtual reality is to give the possibility for humans to interact in a virtual environment where people could interact with computers as it would be in the real world, for example, talking with human avatars, writing a letter. Furthermore, in the use of data gloves, VR objects can be moved to another place as it is being in the real world (Figure 2.1) (Terashima, 2002).

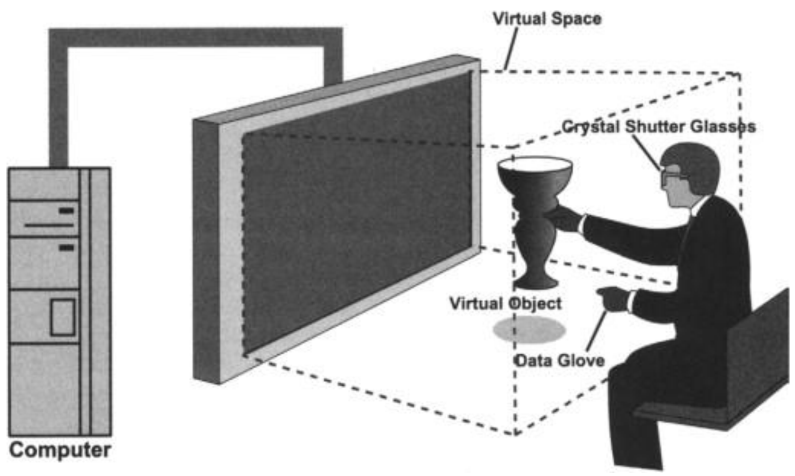

Figure 2.1 Another explanation of VR (Terashima, 2002)

There are two main types of VR setups – mobile and computer-connected. The first one is based on using a smartphone and a VR smartphone mount (e.g., Google Cardboard) which combination results in VR setup.

Meanwhile, computer-connected consists of a Head-Mounted Display (HMD) with a high-resolution landscape-oriented screen, where visuals for left and right eyes are displayed. In this setup, the computer passes information to the glasses. Often, the computer-connected setups include additional sensors (e.g., position, orientation etc.) (Mozilla Developer Network, 2021b).

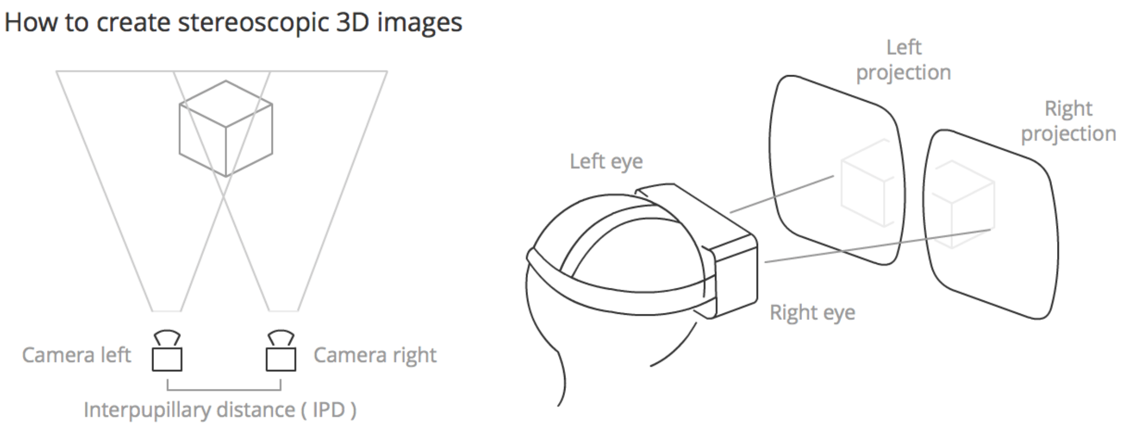

Figure 2.2 Stereoscopic vision (Mozilla Developer Network, 2021b)

The depth perception can be achieved through stereoscopic vision. Humans and most animals also used stereoscopic vision to feel the depth of the 3D world. This being reached through eyes where each of it has a slightly different image (Mozilla Developer Network, 2021b). Figure 2.2 illustrated how 3D images are displayed in HDMs to create a 3D virtual environment.

Based on the article "Genre transgression in interactive works" by Rosenstand (2011), VR technology can be classified as a simulator, because simulators can help to trigger relations that not necessarily exists (Rasmussen & Barrett, 1995, as cited in Rosenstand, 2011). Moreover, the simulators behave as a communicator, meanwhile, users become more as participants than listeners or spectators as depicted in Figure 2.4 below (Rosenstand, 2011).

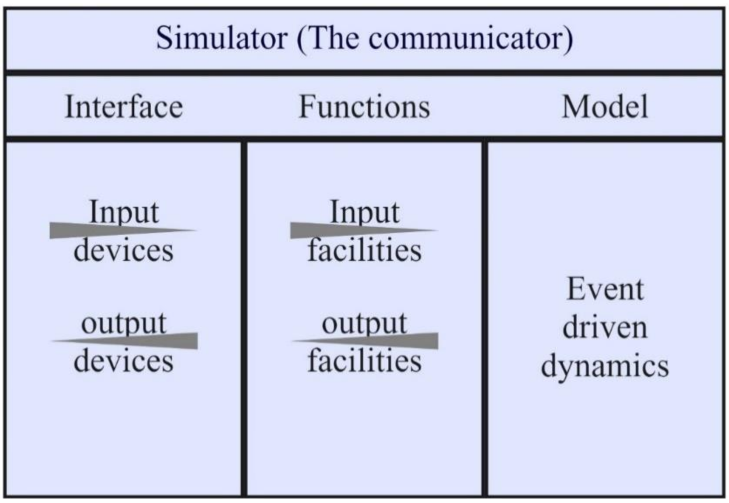

Figure 2.3 The simulator by Rosenstand (2011)

As can be seen in Figure 2.3, the simulator has three components: the interface, the functions, and the model. The interface layer usually is used for getting user input (e.g., joysticks) and providing out received from the function part. The model component is a construct (in the VR case built in the VR application). The functions layers act as controller or middleware where it gets input from interfaces and based on the input access specific model events. The same goes when the model component generates output: function decide to which interface output devices it must be sent (Rosenstand, 2011).

Figure 2.4 provides relationship between the communication and the user. In the VR case, users can be treated as participants, as the users prompt model changes through interaction with the interface. On the other hand, model in help with functions components, can be seen as simulators (Rosenstand, 2011).

Genre	The communicator	The communicated*	Situated user role*
Didactic	Teacher	Matters mentioned	Learner*
Epic	Narrator	The told	Listener
Dramatic	Model*	The modelled*	Spectator
Simulative	Simulator	The simulated	Participant

Figure 2.4 Simulative genre by Rosenstand (2011)

2.1.1 History

The concept of VR as a window for users to perceive the virtual world and act realistically has been mentioned as early as 1965 (Cipresso et al., 2018). Since then, many applications were developed such as the first VR system “The Sword of Damocles” with the first head-mounted display (HMD) invented by Sutherland in the ’70s, the Visually Coupled Airborne Systems Simulator (VCASS) built by the USAF in the ’80s or the Virtual Wind Tunnel built by NASA in the ’90s (Mazuryk & Gervautz, 1999).

The ‘90s was also the time for the first VR entertainment systems. A company called W-industries successfully launched a product named “Virtuality 1000DS” which were also a multi-player game system. However, the installation of this entertainment system was complicated. At that time, the home entertainment market was rapidly rising, as a result, SEGA and Nintendo introduced low-cost PC-based VR games (Mazuryk & Gervautz, 1999).

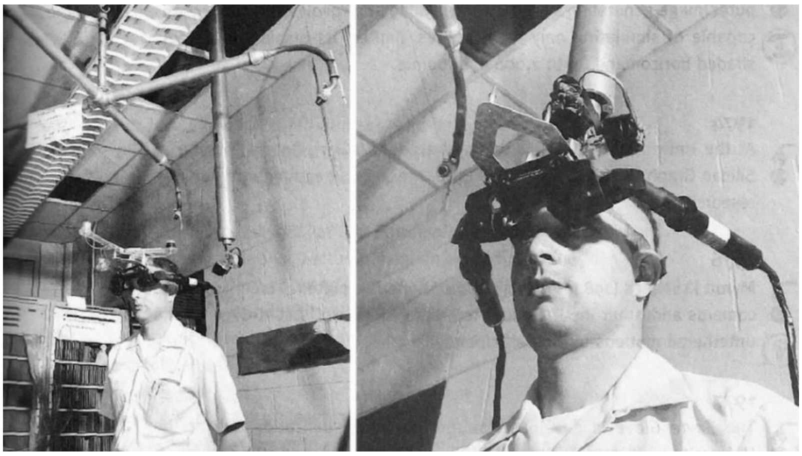

Figure 2.5 The Sword of Damocles HMD system (Storyhunter, 2016)

Although VR technology is still improving, present-day developments of immersive technologies (objects visualization and advanced interactions) let people experience a higher level of immersion. For instance, by using HTC Vive or Oculus Rift individuals feel more disconnected from the real world (Radianti et al., 2020).

Figure 2.6 Oculus Quest and hand tracking feature (Oculus Blog, 2019)

Size and ease of use have improved. For example, Oculus Quest provides a hand tracking feature by using VR monochrome cameras, which mean users do not need to have Oculus controllers anymore (Oculus Blog, 2019). And yet, this is not the end. In near future the world can expect even more developments in the VR field, for instance, Facebook Reality Labs (FRL) is working on glasses that will be almost the same size as the actual glasses (Facebook Research, 2020).

Over time, price VRs is reducing, and the performance – increases as well. From the price and performance point of view, when Oculus released "Rift" in 2016, it was sold for $599 (Seattle Times technology staff, 2016) and a separate computer was needed to use this product. In 2020 Oculus released "Quest 2" starting from $299 (Robertson, 2020) which is a standalone device, and could run VR apps without an additional computer.

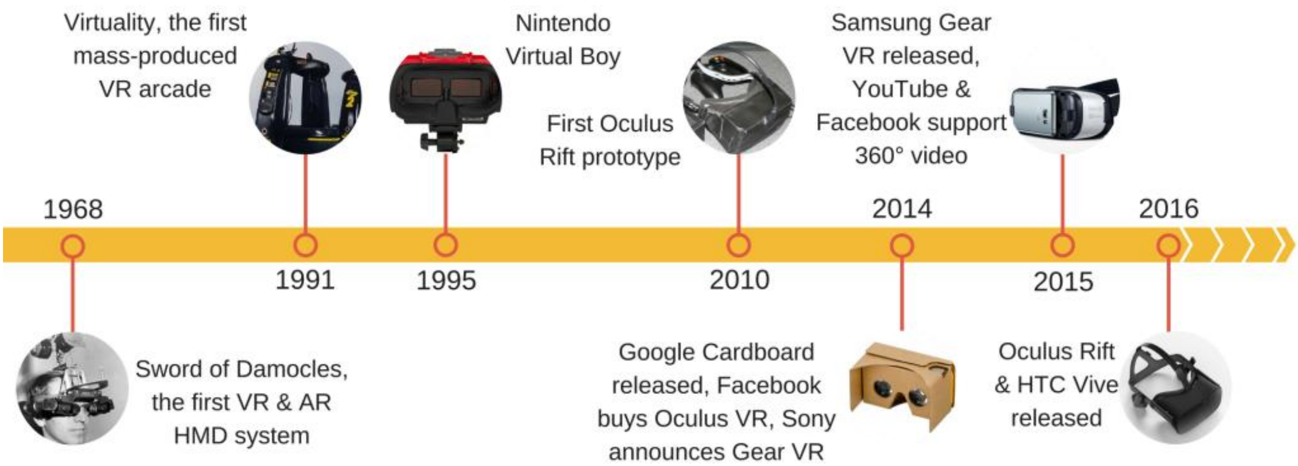

Figure 2.7 Virtual reality over the time (Storyhunter, 2016)

2.1.2 Similar Technologies

Virtual reality is an attempt to replicate the physical world into the digital version of it and make it interactive. This implies the working "realm" of virtual reality is Digital (Table 2.2), not Physical (Table 2.1). In the Digital realm, mixed reality (MR) introduces possible objects into the digital version of the real world. Subsequently, Augmented virtuality brings a digital replica of real objects into a possible world. The farthest from reality is Virtuality which creates fully imaginary worlds (Farshid et al., 2018). In the case of physical reality, as illustrated in Table 2.1, bringing in digital objects (real or possible) will give us Augmented reality, for instance, holograms.

Table 2.1 Physical world "realm" based on Farshid et al. (2018)

	Physical construct	**Digital construct**
Real object	Physical Reality	Augmented Reality
Possible object	Prototype? Sketch?	Augmented Reality

Table 2.2 Digital world "realm" based on Farshid et al. (2018)

	Physical construct	**Digital constructs in real world scenarios**	**Digital constructs in possible world scenarios**
Real objects	None	Virtual Reality	Augmented virtuality
Possible objects	None	Mixed reality	Virtuality

Virtual Reality (VR) is a digital workshop/playground in which users can participate immersively. In terms of immersive participation and simulation power, it is hard to find a technology that can replace VR technology with head-mounted displays (HMD). Also, AR technology with holograms can somewhat be employed to partially create an immersive environment, but current technology is not yet that advance and AR is by definition bound to the physical world since it is VR's realm of existence (Farshid et al., 2018). This means that virtual reality can gives a more immersive experience in comparison with augmented reality. In general, technologically wise, there is virtually no direct competitor to VR technology.

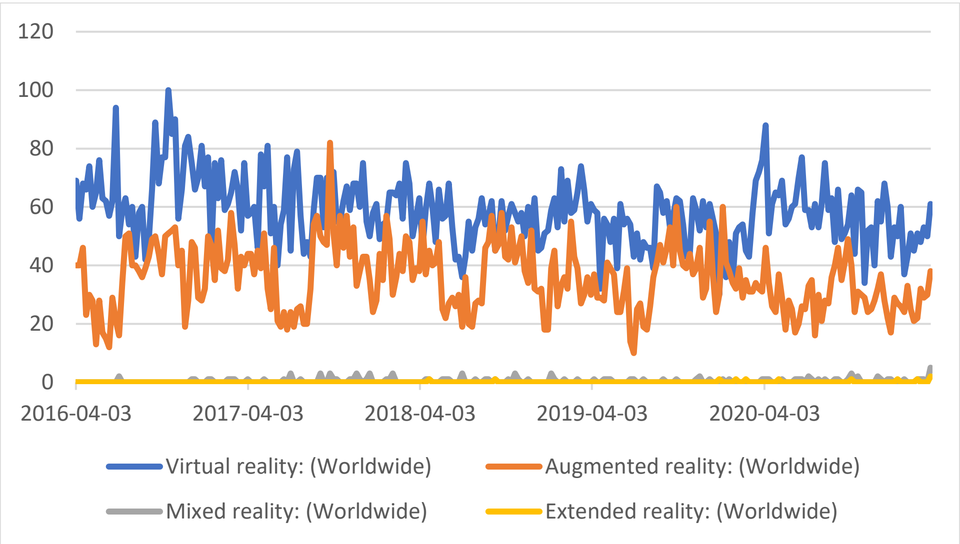

Figure 2.8 Comparison of VR, AR, MR and EX trends in 5 year period (Google Trends, 2021)

On the other hand, AR, VR, MR can be named as extended reality (XR). All those types of technologies can serve similar or the same purpose because they are part of the physical and digital realms. Knowing that XR technologies often can be identified as competitors to each other. However, relatively speaking, VR can be seen as superior in terms of attention-drawing from the public, as can be seen in Figure 2.8. In the recent five years, according to Google Trends keywords worldwide search, "virtual reality" search is always on top trending showing VR superior popularity to the public.

2.1.3 Benefits and Challenges

Virtual reality has many benefits which make VR application separated from other technologies such as PC. For instance, VR can help to reach better levels of immersion and enable interaction with the digital environment and improved imagination. In this case, immersiveness comes from computer-generated 3D surroundings. Regarding interaction, VR systems can detect inputs made by users, and based on their input directly respond. Imagination is improved when VR provides non-existing environments (Liu et al., 2017). Also, a VR environment can make users feel as they have visited a distant place without physically being there (Lee et al., 2017).

Virtual reality might have possible benefits in helping to understand topographic features such as the rise and fall of the landscape. Moreover, through the participation of users, the ecosystem experience can be seen as more "real". Also, collaboration in the team may be improved in help with VR technologies by increasing participants presence (Dede et al., 2017).

Comparing to physical activities, VR is relatively safe because it provides an environment where the practice of competencies can be made (Shute et al., 2017). For example, laboratory practising in a VR simulation keeps users safe from dangerous sources such as chemicals, fire, equipment malfunction, etc.

However, VR may come with many issues. Firstly, a longer stay in a VR environment can cause sickness for some people. Secondly, VR can be too overwhelming which results in a loss of actual focus. Regarding visualized text in VR, it also can be difficult to read. Finally, some tasks can be difficult to be performed in the virtual reality environment (Dede et al., 2017).

2.2 VRfor.us - the Company

VRfor.us project is not only about providing a virtual reality learning experience but also understanding the potential to become a startup. Moreover, even though officially the VRfor.us is not yet registered as a company, the beginning of the company can be observed now.

2.2.1 Team

Currently, the team consists of two members:

Ugnius Malūkas

- Education background: Bachelor's degree in Software Engineering
- Related experience: product development & management, programming, and R&D skills. Worked professionally more than 4 years in the field.
- Role: Executive Officer

Ninh Thế Vĩnh Thịnh

- Education background: Bachelor's degree in Construction Engineering and Business Administration
- Related experience: business and production skills. Worked professionally with consultancy, manufacturing and trading. More than 4 years of experience in production and manufacturing.
- Role: Operation Officer

It is planned that at least one person will join our startup as a founder:

Edvinas Danevičius

- Education background: Bachelor's degree in Software Engineering
- Related experience: product development & management, programming, and game developments skills. He holds more than 4 years of experience in the field.
- Role: Technical Officer

With current team members, the competency matrix is quite strong with software and product development and management. However, it is necessary to recruit more team members with professional pedagogy and psychology background since the product is for educational purposes. Besides that, when the product has a clear direction, the VRfor.us team has to find people with knowledge of the game development: sound, level design, project management, game design, arts, writers, testers, user experience designers and programmers.

Figure 2.9 illustrates skillset needed to provide a prototype and MVP. When the products will be more and more developed, the competency matrix must be updated based on the current situation.

Team role	Game developing	Software developing	Product development	Product management	Process management	Business strategy	Pedagogy
CEO	✓	✓	✓	✓	✓	✓	
COO			✓	✓	✓	✓	
CTO	✓	✓	✓	✓	✓		

Figure 2.9 VRfor.us current team competency matrix

2.2.2 Organization

"Lean Startup" book by Ries (2011) suggests in the beginning companies have to save as many company resources as possible. Moreover, the team is going to operate in a flat organization manner because this kind of organization gives all the decision making for its members. The flat organization type also motivates members to be responsible for the task they are doing, and helps with maintaining entrepreneurial spirits (Craig, 2018).

However, the team has decided not to use a hierarchical organisational structure because it might have many disadvantages in beginning. By using a hierarchical structure, a longer communication time can appear which would result in a longer decision-making process (Carzo & Yanouzas, 1969; Craig, 2018). Secondly, entrepreneurial spirits may be lost which would have a negative impact on the startup (Craig, 2018).

2.3 VRfor.us - the Product "Odyssey"

2.3.1 Process

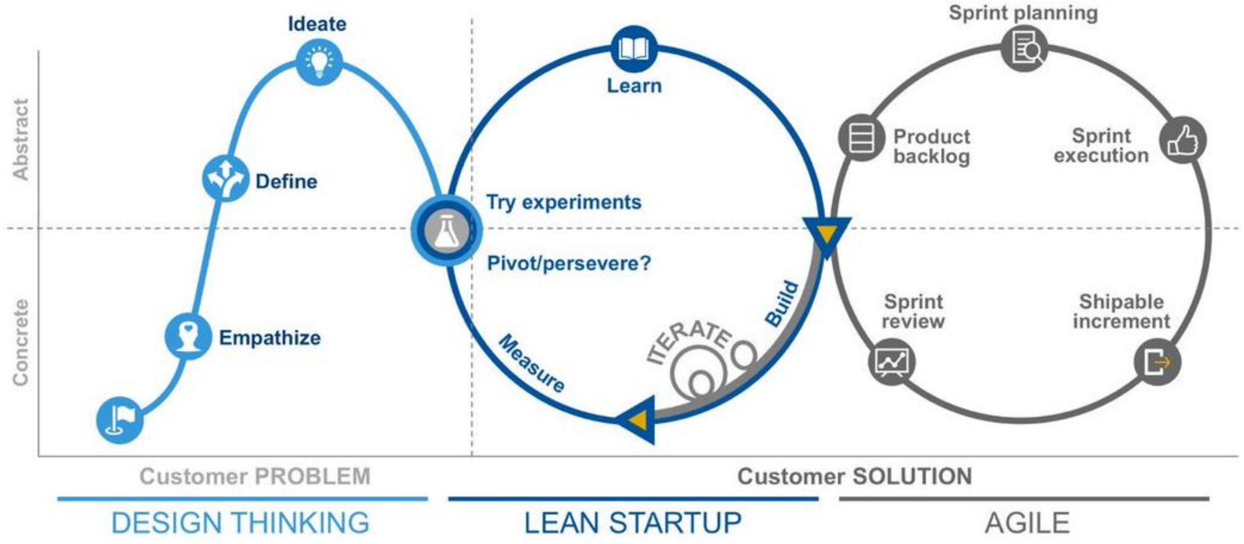

Figure 2.10 Design Thinking, Lean Startup and Agile combination (Blosch et al., 2016)

VRfor.us team is used Design Thinking, Lean Startup and Agile methodologies for product development. Design Thinking is applied when we explore and solve various problems, the Lean Startup when testing our hypothesis and Agile for actual product development (Schneider, 2017). Each of the section described more in detail our process for the product "Odyssey".

2.3.1.1 Design Thinking

"Odyssey" is the first product of VRfor.us which is a solar system simulator with a focus on Earth. Our initial intention for Odyssey is to make it into a solar system simulation with a quasi-digital twin of Earth, on which Earth-related aspects, such as gravitational effects, Earth layers, environmental activities, etc. can be experienced with great flexibility. However, it is impossible to have every aspect available in the first release. Which aspects of Earth to be enclosed in the first release is a wicked question since there is not a right or wrong answer. To efficiently tackle this wicked question, we find it better to use a Design Thinking approach to explore both the question and its possible answer.

Nowadays, Design Thinking is an approach that has received increasing attention in various industries because it is human-centred. In general, the Design Thinking concept is not clearly defined (Laursen & Tollestrup, 2017), it does not have strict rules or standards. Based on the paper "Design Thinking – A Paradigm" by Laursen and Tollestrup (2017), Design Thinking is a learning process. VRfor.us is planning to apply this methodology for the product Odyssey because this approach works well with wicked and ill-defined problems (Laursen & Tollestrup, 2017).

The “Odyssey” aims to help to provide VR application which helps to educate students. Design Thinking is handy because it is useful in creating prototypes based on users’ feedback and the market. Usage of Design Thinking methodology in VRfor.us team is mainly through brainstorming, usability test, personas, quick and dirty prototyping, and extreme user interviews techniques described in “Design Thinking – A Paradigm” by Laursen and Tollestrup (2017) paper.

2.3.1.2 Lean Startup

Coupling with Design Thinking in making Odyssey, VRfor.us has to solve the limited resource puzzle in a VUCA (volatility, uncertainty, complexity and ambiguity) environment. We find it logical to apply the Lean Startup methodology to quickly and sustainably form the VRfor.us venture. Following the iterative cycle of Build – Measure – Learn, VRfor.us concentrates the initial effort to build and release as soon as possible the first minimum viable product (MVP) which is built by using the Design Thinking process. Based on users and market feedback on the MVP, the initial hypotheses concerning the public opinion on “Odyssey” contents, features and usage shall be tested. Based on the confirmation of these hypotheses, there will be the decision to pivot or persevere (Ries, 2011).

VRfor.us is planning to have two iterations of the design of MVP creation because of limited time and resources (consultancy from the experts, user test availability). The MVP design of the first iteration is a VR prototype made in the Unity environment (see 5.4) to test if it is possible to create such a concept with our resources. The prototype included the solar system, physics (e.g., gravity) and features such as playing around with the planets. After that, the first feedback session was conducted to clarify the direction of the product. The second iteration had features and changes proposed from the first interview. It was also planned to test the WebXR feature which would allow us to have a VR application in a browser. Worth mentioning, platform and business model pivoting was also part of the MVP process.

2.3.1.3 Agile

Agile software development (ASD) was introduced in 2001 through a set of rules described in “The Agile Manifesto” (Fowler & Highsmith, 2001). The main purpose of Agile is agility and the ability to rapidly adapt in a dynamic environment. This approach contrasts with a traditional method such as the waterfall model (Hoda et al., 2017).

Agile is an iterative process for project management and software development that helps to deliver value to the customer (Atlassian, n.d.). Moreover, Agile focuses on prioritizing features needed for the product development and concentrates on frequent feedback received by the customer (Cohn, 2005). For example, Agile methodology can be compared to Lean methodology regarding the dedication to high uncertainty problems and providing value to a customer. However, they also differ in the way that Lean Startup is more demand-based (pull) and Agile priority-based approach and mainly used dynamic software environment (Schneider, 2017).

VRfor.us used Agile for software development because the “Odyssey” technological solution can be split into smaller tasks which later, based on their priority, can be solved accordingly. The team chose the Scrum approach which is part of the Agile methodology. In general, Scrum development methodology is used in small teams and followed by series of Scrum sprints. Each Scrum sprint has to be planned by the team members (van Waardenburg & van Vliet, 2013).

2.3.2 Target Group

Although it is our dream to be the provider of everything to everyone, the reality is that we must pick the group of people we can serve best to gain a sustainable foothold at first. That group of people that the product is meant to be sold to is called the target market (Kotler & Armstrong, 2018). Clearly defining the targeted group does not shrink down the market of VRfor.us but enlarges the customer base, gives us a clear direction to the information we need to collect, helps to reach the people that can provide that information and adjust features and prices of the product offering (Kotler & Armstrong, 2018).

Since "Odyssey" is created initially to support immersive learning that helps with natural science subjects, the logical target market is students. Naturally, this market segment is ambiguous and too diverse with many demands from many demographics. To move forward sustainably as a company, it is important to be a major player in a narrow market which is clearly defined markets of particular end-users, which is a group of people that shared common needs and customer pains (Aulet, 2017). We narrow down the target market to students from 13 to 20 years old. The group younger than 13 is skipped due to the reason that VR is designed for older people (e.g., to operate Oculus devices a person has to be at least 13 years old (Oculus, n.d.-b).

In order to focus the market research and future marketing effort, as well as getting all team members on the same page when it gets to "the customer", we find it necessary to build an end-user profile that represents the majority of our end-users. According to Aulet (2013), the end-users may or may not be the decision-makers, but certainly plays an integral part in decision making. In another word, if the end-users show reluctance on "Odyssey", it will be very hard to sell. The end-user profile is a description that consists of characteristics that define the end-users, from age, gender, occupation to fear and wants and needs (Aulet, 2013). For "Odyssey", we have built the following end-user profile for European end-users since the team plans to build the company and to station in Europe.

Table 2.3 "Odyssey" end-user profile based on template from Aulet (2017)

Demographics (be sure to determine which are relevant for your situation, but some general categories are gender, age, income, geography, job title, education, ethnicity, marital status, political affiliations, etc.)	
Age	13-20
Occupation	Student
Residential	Europe
Gender	Male/ Female
Psychographics (as above, this needs to be customized for your situation, but examples are aspirations, fears, motivators, hobbies, opinions, values, life priorities, personality traits, habits, etc.)	
Aspiration	Knowledge
Motivators	Friends/ KOL
Hobbies	Video games
Opinions	Non rigid
Values (they vary but end-users might have one or more)	• Grade • Approval • Academic acceptance

	• Recognition • Knowledge
Life priorities	• School • Hobbies • Gaming
Personality traits	Not yet settled
Habits	• Going to school • Playgrounds • Digital life
Proxy Products (what other products do these end users own and which do they value the most? Which products have the highest correlation with your target end users?)	• PC • PlayStation • Xbox
Watering Holes (e.g., locations, associations, online platforms—and sequence them in priority and indicate intensity of each)	• School • Social media platforms • Gaming centre
Day in the Life (describe a day in the life of the end user and what is going on in his or her head)	• 7am: wakeup • 8-9am: school • 15pm: home • Hanging out • Homework • Hobbies
Priorities (what are your end user's priorities, and assign a weighting to each so that it adds up to 100)	• Acceptance and recognition of parents and peers • Quasi-advantages/edge on others peers/having fun

Based on the book "Disciplined Entrepreneurship: 24 Steps to a Successful Startup" by Aulet (2013), the next step to creating end-user profile is to select a persona, which is a real person to ground the marketing and design effort on reality. In our work we choose not to go with this step but stop at the end-user profile.

Since our age range is large (from 13 to 20 years old) and is within adolescence age (Klimstra et al., 2009), the end-users personalities and temperaments are in the state of forming, changing, and consolidating, which means a transition from being dependent (as children) to being independent (as adults). This process is called personality maturation (Klimstra et al., 2009). In this process, there might be environmental factors that motivate personality trait change (Leung, 2019). Also, in this period, students do not have a fixed identity related to their career, which plays a very important part in personas building. This makes it very hard to build a persona that can effectively represent the whole age spectrum. Splitting the spectrum into several personas, on the other hand, defeats the purpose on effort focusing of building a persona. From this viewpoint, we chose not to continue with a persona as suggested by Bill Aulet (Aulet, 2013).

2.3.3 Value Proposition

As a company dedicated to educational VR, there are many subjects for VRfor.us to spend its resources on. Each product of VRfor.us is an answer to a specific question or rather a solution to a specific problem. In the early stage of the ideation phase, it might be beneficial to keep a vague idea of the product, such as how it looks, what it consists of or the value it brings. After agreeing on a specific approach to the design of the product, it is important to us to get the team members on the same page. For this purpose, a well-defined value proposition built by team members is employed.

The value proposition is built using the value proposition canvas (Osterwalder et al., 2014). The canvas has two parts: a customer profile part on the right and a value map part on the left. The value map (on the left-hand side) explains the VRfor.us value proposition in a more detailed manner in three smaller parts: gain creator, pain relievers, and product and services. “Product and services” describe lists the products and services of VRfor.us, “gain creators” shows how Vrfor.us create gains for the customers and “pain relievers” shows how the products and services ease customer’s pain.

As stated in the book “Value Proposition Design: How to Create Products and Services Customers Want” by Osterwalder et al. (2014), the value proposition design aids in creating, improving, managing value propositions. Moreover, using value proposition assist in having a common language within the organization (Osterwalder et al., 2014). Furthermore, this tool is also very helpful for startup founders because it can help to design, build, test and manage the value propositions of their customers (Jonikas, 2017).

The customer profile part (on the right) drafts the picture of the customer segment how VRfor.us wants to serve. It is also divided into three smaller sections: pains, gains and customer jobs. “Customer jobs” describes what customers target in their professional and personal lives. “Gains” are customer’s desirable results, outcomes or more permanent benefits. “Pains” are bad effects, results, struggles, bad outcomes regarding the customer jobs. Below is the VRfor.us value proposition.

There are also good and bad practices of doing value proposition design. For example, mixing several customer segments, mixing jobs to be done, focusing more on jobs without considering focal and emotional aspects of being too vague in descriptions of pains and gains are a bad practice (Osterwalder et al., 2014).

VRfor.us followed tutorials proposed in the book “Value Proposition Design: How to Create Products and Services Customers Want” by Osterwalder et al. (2014). The focus segment of the value proposition design is students between 13-20 years old. Two reasons why we chose this age group: 1) people only from 13 years old can use VR devices, and 2) we want to keep our content not too advanced.

As it can be seen in Figure 2.11, VRfor.us has defined every part of the value proposition canvas. Starting from the right the team targets the VR education sector, and initial assumptions are mostly related to learning and education. We started by defining the customer jobs which were in three categories: social (e.g., “gain more competitive advantages”), functional (e.g., “get necessary knowledge”) and emotional (e.g., “less-stress”). Then the pains were defined (e.g., “Hard to apply knowledge to the real-life scenarios”, “Some subjects are hard to visualize”) which was followed up with gains (e.g., “Comfortable with school subjects”).

On the left side, product and services were first defined (e.g., “VR content app”). After that, it was followed up by pain relievers (e.g., “interactive, immersive content”) and finished by gain creators (e.g., “Directly captures knowledge”). We also highlighted items (red border) that are the most important at this stage for the VRfor.us.

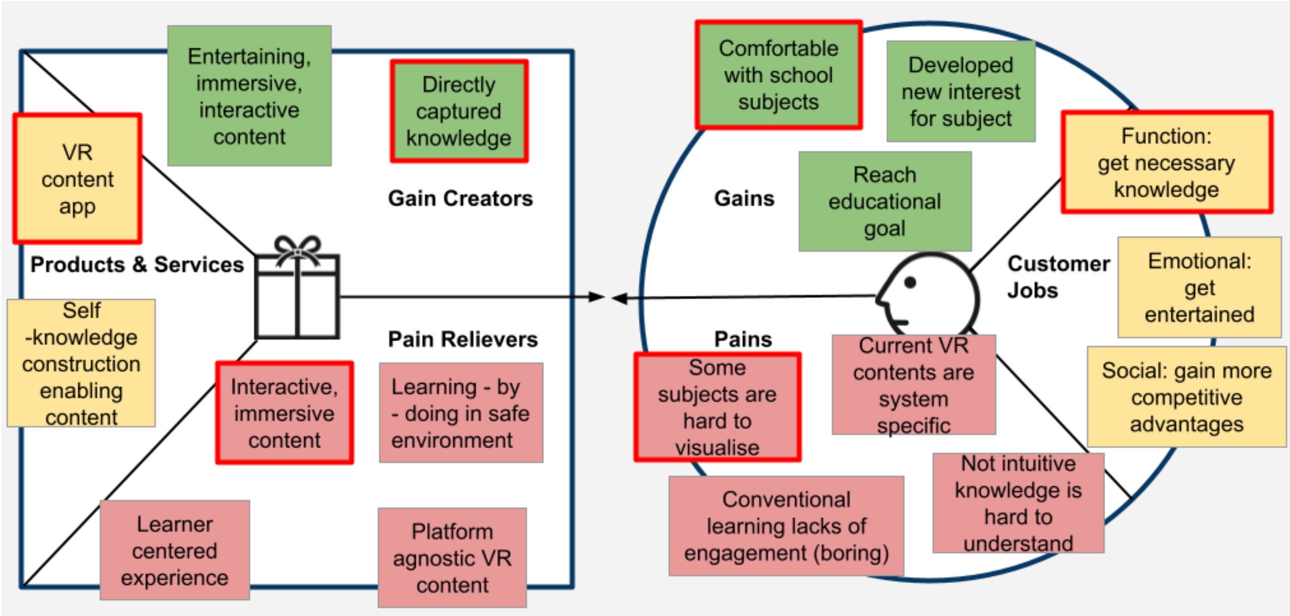

Figure 2.11 VRfor.us value proposition

2.3.4 Business Model

The business model "[...] describes the rationale of how an organization creates, delivers, and captures value" (Osterwalder & Pigneur, 2010). VRfor.us business model is illustrated using the business model canvas by Osterwalder and Pigneur (2010) which includes 9 building blocks, namely key partners, key activities, key resources, value propositions, customer relationships, channels, customer segment, cost structure and revenue stream.

By utilizing the nine building blocks canvas, we aim to describe our venture in a simple and intuitive way (Osterwalder & Pigneur, 2010) to make sure that not just team members, but also future stakeholders and investors can be on the same page. The business model unveiled through the nine blocks could serve as a convenience tool and a good starting point for discussion.

There are other business model canvases, such as platform canvas and lean canvas, but we chose the business model canvas by Osterwalder because we find it is more fit to our intense and purposes. For instance, the lean canvas focuses more on the business itself while the business model canvas considers more about stakeholders (instead of key partners, key activities and customer relationships, the lean canvas makes room for problem, solutions and unfair advantages). In comparison with the platform canvas, at this moment VRfor.us is in the business model forming state and is not suitable for using the platform canvas, which is a tool more suitable for guiding in business model innovation (Sorri et al., 2019).

Below is the initial VRfor.us business model canvas illustrated using the nine building blocks. The company aims mostly to serve students between 13-20 years old, but the actual buyers are families with children (to be more precise – parents). VRfor.us will assist pupils through personal assistance on top of basic self-service, from which they can receive value such as getting comfortable with school subjects. Our key partners would be schools because of the targeted age, meanwhile, the key activities would be engaging participants and analysing data to improve our product. Regarding the key resources, we find EU Government might be helpful because of the various financial initiatives (more in Chapter 4.3) and the developer network as we know many developers who might join our startup in future.

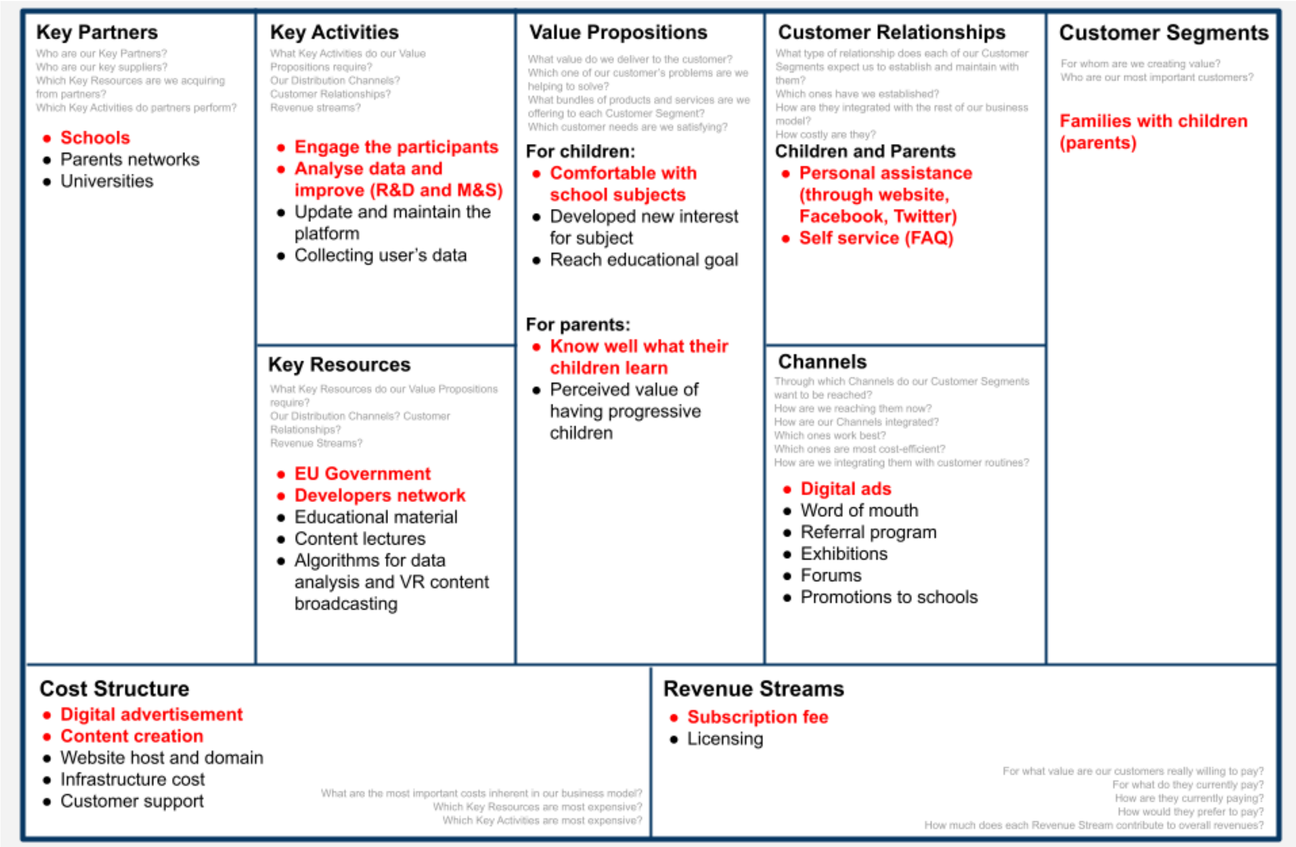

Figure 2.12 VRfor.us business model illustration

3 Market Foothold

WQ2: What is the market foothold for VRfor.us?

For a startup, it is important that it can sustain itself before it can thrive. This is why finding the starting place to introduce the product is of the highest importance and priority to a startup, especially the ones with disruptive innovations.

This chapter describes the theory of disruptive innovation, which subsequently leads to the reason why we think VR is a disruptive technology. This is followed up by market size analyses for our target market using tools such as TAM, SAM and SUM.

3.1 Disruptive Innovation

3.1.1 Definition

In 1995 Bower and Christensen introduced a term called "disruptive technology". The term addresses the situation when the indirect substitution of current technology (in terms of technology, product and market) over time revolutionizes the industry and outcompetes current leaders (Bower & Christensen, 1995).

Different technological innovations have different performance trajectories which overtime changes. In the sustaining technologies case, a gradual rate of improvement is made in attributes that customers already value. This results in incremental improvements where customers get something more or better of the current technology (Bower & Christensen, 1995).

Meanwhile, disruptive technology provides a very different set of attributes which often are worse in categories that current users assess as important. As a result, mainstream customers do not use the technology at first, unless in new markets or applications. But while disruptive technologies performed less well in the valued attributes, they also created a new one and over time were being valued more, and at some point in time their performance trajectories outperform the current sustaining technologies (Bower & Christensen, 1995).

The diagram (see Figure 3.1) demonstrates performance trajectories of incumbent companies following sustaining approach and new entrance having disruptive technology over the time (the red lines). The blue lines show customers' willingness to pay for performance. As incumbent companies introduce higher-quality products targeting high-end market (higher blue lines), they miss many mainstream customers. This results in an open space where entrants can find footholds in less-profitable segments. When entrants improve their performance of their offerings, they move the market up targeting the high-end market. Subsequently, the dominance of the incumbents is being challenged by entrants (Christensen et al., 2015).

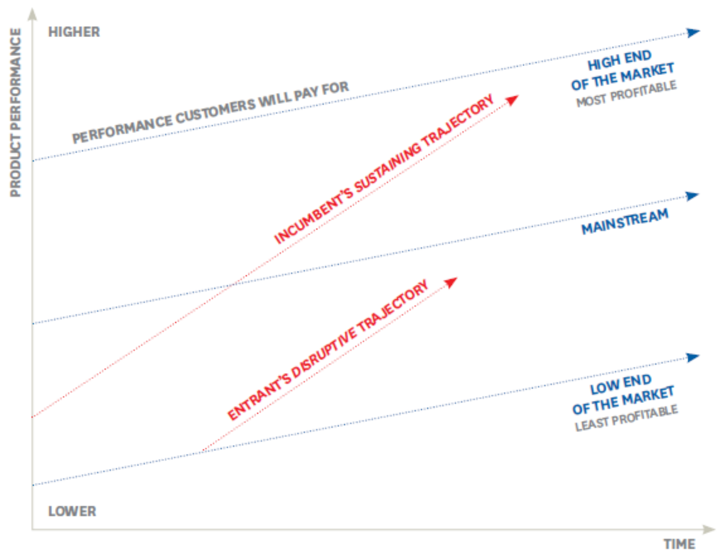

Figure 3.1 The disruptive innovation model (Christensen et al., 2015)

Current leading companies tend to overlook disrupters because disruption can take time. For example, in 1997 Netflix launched as an online website with a large number of movies. At that time most of Blockbuster's customers found Netflix not appealing, it only was attractive for a few customer groups who were neutral about new releases, early users of DVD players, and online shoppers. However, as the technologies allowed to have a streaming video over the internet, Netflix became appealing to Blockbuster's customers. Moreover, Blockbuster failed to respond and eventually, this led to Blockbuster collapse (Christensen et al., 2015).

"A definition and a conceptual framework of digital disruption" by Rosenstand et al. (2018) proposes that researchers and managers can measure a company's potential of being a digital disrupter by using the conceptual framework (Rosenstand et al., 2018). This framework indicates that an incumbent can face digital disruption: a firm can disrupt, distort, and become market dominant. Each phase of a firm can have different customer, purpose and technology which results in different market, actors, and growth (Rosenstand et al., 2018).

Based on the article "What Is Disruptive Innovation?" by Christensen et al. (2015) success of disruption theory made this theory in danger. Many people (e.g., researchers, writers, consultants) tend to use the term "disruptive innovation" when an industry is disrupted, and existing leading companies are being displaced. As it described by authors, different types of innovation require different strategic approaches in tackling those situations. Not every company in a changing market will succeed as a disruptive innovator. Failure to understand that can lead companies to use the wrong tools which end up decreasing their chances of success (Christensen et al., 2015).

3.1.2 VR - Disruptive Technology

As it was described in Chapter 2.1, virtual reality is not a new technology. In fact, its development was available for many years, but the usage of VR was too complicated or was not appealing to the mainstream users. These people only experience the rise of VR technology when its related hardware has become convenient to use and affordable. For instance, Oculus Quest and Oculus Quest 2 integrate necessary hardware for running VR applications stand-alone (Oculus, n.d.-a). This means that gaming computers with VR ready hardware are not needed to run VR applications. As a result, VR becomes more available for broader user groups as the hardware becomes more user-friendly, and as the price is going down (Statista, 2016).

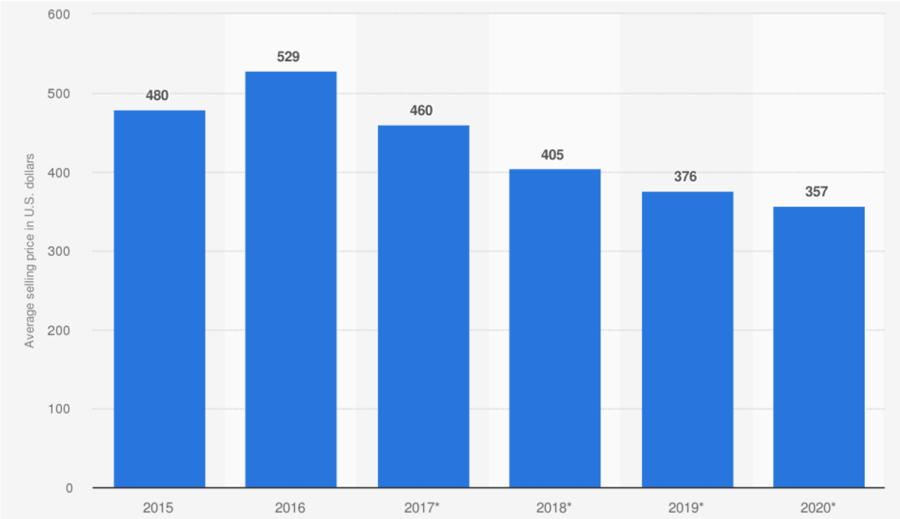

Figure 3.2 Average selling price of VR standalone head-mounted display from 2015 to 2020 in U.S. dollars (Statista, 2016)

Virtual reality shows signs as disruptive technology as it becomes more available for more users. Naturally, VR has own market and application areas, but over time, it can possibly take users from other markets such as personal computers or game consoles.

3.2 Market Size

To estimate the market space for VRfor.us and its first product "Odyssey", we apply the TAM-SAM-SON model, with TAM as the Total Addressable (or available) Market, SAM as Serviceable Available Market and SON as Serviceable Obtainable Market.

The total addressable market, or TAM, is the "market at its broadest sense" (Denault, 2017), or "The universe of potential users or customers" (York, 2018). It means that the TAM is any person that has the ability to use the products, despite of their current wants and needs. The TAM envelopes SAM and SOM, with SOM is the smallest market that covered inside the SAM. The Serviceable Addressable Market, or SAM, is the market that the company can reach while the Serviceable Obtainable Market, or SOM, is the market that the company can conquer realistically (Denault, 2017). There are many metrics can be used to estimate the market in the TAM-SAM-SOM model, but it is important to maintain consistency and later, translate the data into numbers, financially (York, 2018). In other words, TAM is the whole/potential market, SAM – reachable market, and SOM – Sales divided by SAM. For example, for a small company that makes mapping devices using LIDAR (Light Detection and Ranging):

- TAM: total mapping market.
- SAM: 15% of lidar technology application market shares.
- SOM: part of the SAM that the company has the budget to reach.

In VRfor.us case, the TAM can be estimated as the current market size of virtual reality, which is valued at USD 6.1 billion and is expected to reach USD 20.9 billion by 2025 (Reportlinker, 2020). For the Serviceable available market (SAM), It should be the market within VRfor.us reach. Since our first product, "Odyssey", is set to serve the consumer market, it is logical to see VRfor.us SAM as the VR for consumer's market. According to Statista, market share for VR in consumer sector comprises of 53% of the whole VR market (Statista, 2020b).

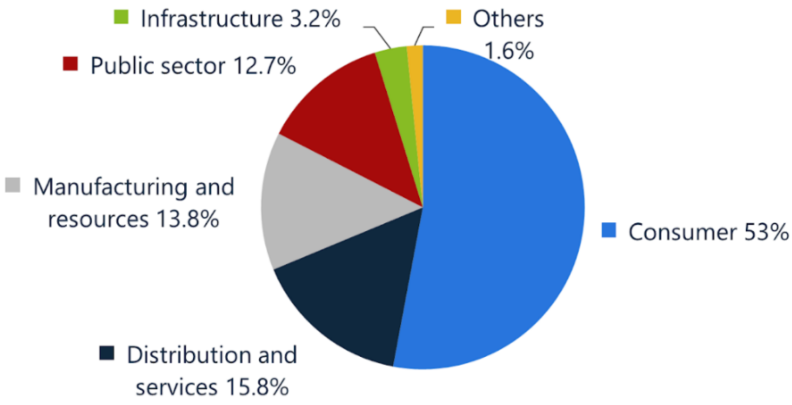

Figure 3.3 Forecast share of VR and AR spending in 2020 (Statista, 2020b)

For the Serviceable obtainable market, or SOM, the educational VR application market seems to be very realistic to obtain. According to Fortune Business Insights, the Educational VR application value in year 2020 is at around USD 500 million and is expected to reach USD 10 billion in 5-year time (Fortune Business Insights, 2019).

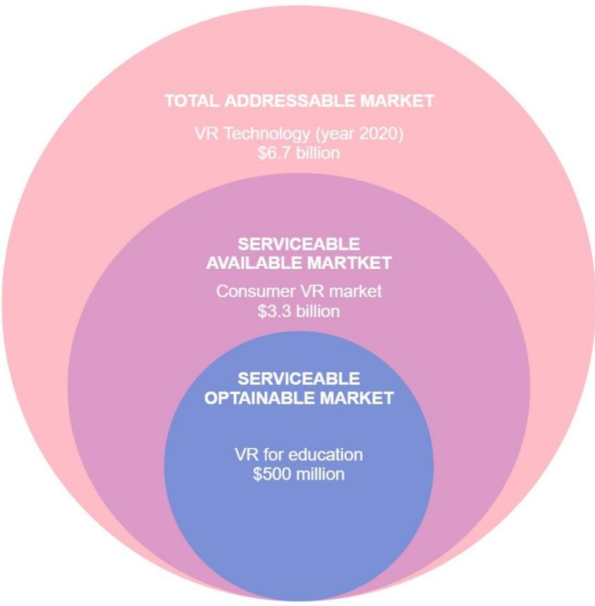

Figure 3.4 TAM, SAM and SOM of VRfor.us

The serviceable obtainable market for VRfor.us is very large because the market is worldwide. Thanks to the internet, it is possible for VRfor.us to reach the whole VR education market because the product can be served online. The portion of SOM that VRfor.us can conquer only depends on the product offering: how much the product matches the end-users want and need. Also, this market is relatively less competitive than other markets (e.g., gaming VR). In the next chapter, we will make a competition analysis to understand more the market landscape and competitors.

4 Competition

WQ3: What is the competition for VRfor.us?

With different markets, there are different competitions. The competition situation of a market influents the way a new entrant penetrates it.

From our point of view, the VR application market for the environment is without fierce competition. In order to decide on a market penetration strategy, such as blue ocean strategy (Kim & Mauborgne, 2005), it is important to study the market especially in terms of competition. This chapter focuses on market competition (blue and red oceans), competitor types, and perspectives of identifying compactors that are based on the theory.

Also, VRfor.us uses the "Blue Ocean Strategy" (Kim & Mauborgne, 2005) for identifying "Odyssey" competitors, value criteria and drawing value criteria canvas of the "Odyssey" product. Subsequently, competition environment analysis is made by using Porter's 5 forces (Porter, 1979) and PESTEL analysis.

4.1 Competitor Types

As it is described in the paper "Competitor Identification and Competitor Analysis: A Broad-Based Managerial Approach" by Bergen and Peteraf (2002), managers who are interested in analysing competitive terrain, identification of competitors becomes a key task to do when defensive is needed against new entrants, preparing attack and response strategies (Bergen & Peteraf, 2002).

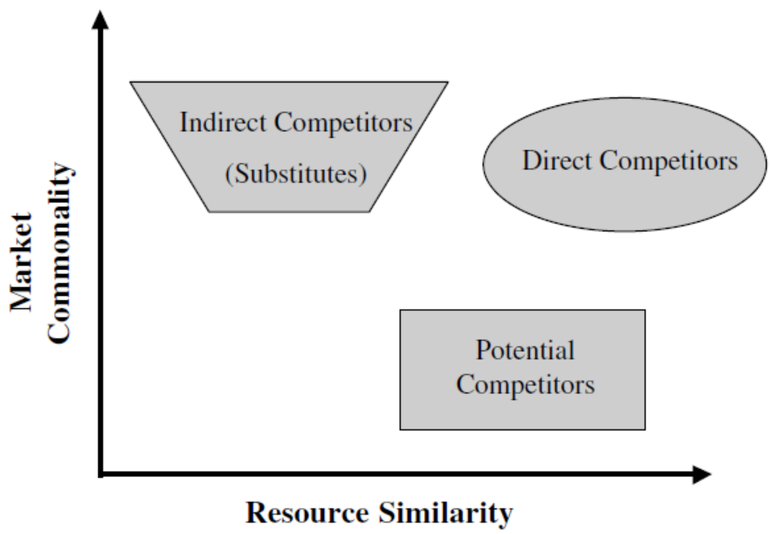

Figure 4.1 Mapping competitors (Bergen & Peteraf, 2002)

Based on Bergen and Peteraf (2002), there are three types of competitors: direct, indirect and potential competitors. Direct competition usually happens when firms have resource similarity and a high degree of commonality considered to be direct competitors (e.g., Intel and AMD in the chipset market). Indirect competition happens when firms serve the same market need but hold and use different types of resources (e.g., YouTube and Netflix as video streaming platforms). The potential competition happens when firms hold resource similarity but differs in the market commonality. For example, restaurants have the same or similar resources (staff, equipment etc.) and those restaurants try to get a reputation for good food and service but address different customer needs (Bergen & Peteraf, 2002).

Over time, competition changes, and indirect or potential competitors can become direct ones. For instance, a competitive firm now holds a similar resource, or a firm starts addressing the same customers. Moreover, the competitive landscape can also change because of the altered dimensions on which firms compete (Bergen & Peteraf, 2002).

4.1.1 Different Perspectives

When the extent and/or direction between two ventures are not equal (Venture A focus more on competing with Venture B than Venture B on Venture A) then competitive asymmetry appears in multimarket competition. For example, for Alaska Air, the main competitor is Northwest, meanwhile Northwest sees the main competitor the other national airlines' company such as Delta. The addressed competitive market structure can be uncovered by using different competitor identification perspectives (DeSarbo et al., 2006).

DeSarbo et al. (2006) identify two main perspectives for identifying competitive market structure – demand-based and supply-based perspectives. The main difference between these two approaches is that the supply-based perspective focuses on the strategic business unit (SBU) of the company, meanwhile, demand-based underlines products and services (DeSarbo et al., 2006).

Gur and Greckhamer (2019) identify four perspectives of competitor identification regarding nature, definition, processes and outcomes: 1) industry-oriented - competition in focused industries, 2) strategic groups-oriented - industries with groups of competitors, 3) manager-oriented - the role of managers' strategic decisions, and 4) customer-oriented - customer preferences. Each of these approaches has a different perspective and focus (Gur & Greckhamer, 2019).

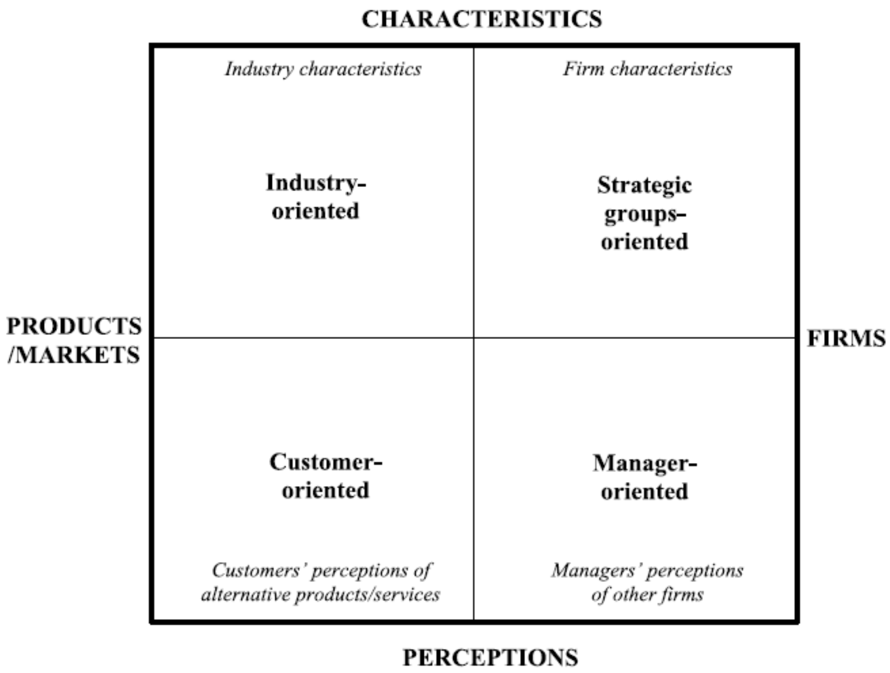

Figure 4.2 Perspectives on Competitor Identification Map (Gur & Greckhamer, 2019)

The perspectives are built on different dimensions of competitor identification (Figure 4.2). The industry-orientated and customer-oriented approaches identify competitors based on products and/or markets. Subsequently, the strategic groups-oriented and manager-oriented ways focus on firms. Also, characteristics of competitors identification are used in industry-oriented and strategic groups-oriented ways. The difference is that the industry-oriented focus on industry and the strategic group focus on firms/ventures. The customer-oriented and manager-oriented are common because they both focus on perceptions rather than characteristics. At the same time these perspectives differ as to the customer-oriented concentrates on capture the perception of the customer, and the manager-oriented – captures the managers' viewpoints.

All together these perspectives propose that characteristics of structure and frontier of product markets and firms and having the perception of managers and/or of customers, are important for the identification of competitors. Furthermore, the inclusion of more than one dimension in research may aid people to create new theoretical and empirical insights (Gur & Greckhamer, 2019).

As a result, the VRfor.us product "Odyssey" is compared with competitors which are products or services focused on the perception of a customer rather than industry characteristics.

4.2 Blue Ocean Strategy

The market can be imagined as a place where two types of oceans exist – red and blue. Red ocean usually refers market situation where boundaries of the industry are known, and the game rules of competition known (Kim & Mauborgne, 2005; Mi, 2015). In this "ocean" rivals try to outperform each other by obtaining a larger share of the market. The red ocean has a lot of participants, and as a result, the profits and growth of companies are diminishing (Kim & Mauborgne, 2005).

The blue ocean market has been described as a space for highly profitable growth. Although blue oceans can also exist under existing industry boundaries. In other words, "blue ocean" – is a market space potential that is large, deep and has not been already defined (Kim & Mauborgne, 2005).

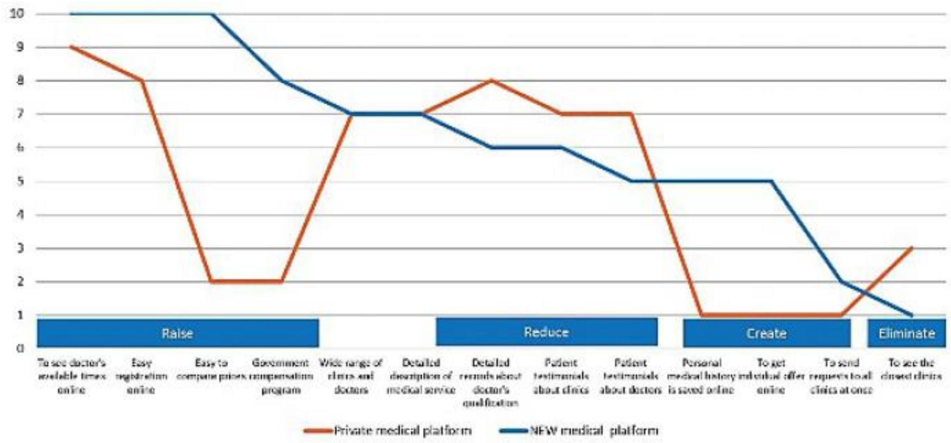

Figure 4.3 An example of the "Blue Ocean Strategy" canvas and value curves of the product/service and its competitors (Jonikas, 2017)

Kim and Mauborgne propose a strategy called the "Blue Ocean Strategy" (2005) which helps to unlock a new demand by focusing on innovative value assuming that boundaries of the market and industry structures are not fixed (Jonikas, 2017). This usually is achieved by distinguishing product/services and low cost which later can be visualised in the strategy canvas (Kim & Mauborgne, 2005) that includes value criteria curves of the market players.

In the book "Startup Evolution Curve: From Idea to Profitable and Scalable Business" (2017), D. Jonikas suggests having four steps of building the strategy canvas. The first step requires the definition of criteria which will be perceived and measured. The second step involves finding out how each of the criteria is important for own customers. The next step includes evaluating the offer of the product/service and how it delivers value for the potential customers. It might be achieved through filling a table which would be used in the fourth step. The last step is focusing on drawing the value curve of the product/service and its competitors. The chart gives an overview of what quality criteria the product/service has. As suggested in the book, the value proposition can be updated with the highlighted value criteria identified in the canvas (Jonikas, 2017).

We used the "Blue Ocean Strategy" in subchapter 4.4 where we identified quality criteria for our desired application based on competitors and market analysis. We also defined value criteria based on our thoughts on what such an application should have. We have not asked potential customers because we believe this must be done when we have a tangible application where potential customers can have a base ground for their opinions. That is why the second step has been done only by us, not with our potential users. We also filled a table where we judged competitors based on the features, we feel might be important. Subsequently, we drew out the canvas and identified value criteria for our product.

4.3 Environment Analysis

With the above analysis of competitors, we believe that the competition for VRfor.us regarding the initial product "Odyssey" is not too hard to overcome. The market for VR for education can be considered blue ocean (Kim & Mauborgne, 2005), meaning there is a market space which can be explored.

To unfold the market environment in detail, we analyse using Porter's five forces model (Porter, 1979). The five forces in Porter's model are the threat of new entrants, bargaining power of suppliers, the threat of substitute products or services, bargaining power of customers and the industry jockeying for position among current competitors or the rivalry within existing competitors.

For the new entrants' threat, it is a considerably high-pressure situation since it is rather easier now to get a developer tool kit powerful enough to help design a VR application. VRfor.us main cost structure lays upon the hosting service and founders' personal effort (mostly time and opportunity cost). We value this threat as high due to the ease of entrance for any interested individual or teams.

The supplier for VRfor.us are domain and hosting services, which is very cheap at the moment and can be substituted easily. Furthermore, if "Odyssey" is to be released on VR stores such as Valve, HTC Vive, and Oculus store, it would be quite easy, and we will not rely on them as our main distribution channels since VRfor.us is built to serve that purpose. With this analysis, we rank suppliers' bargaining power as low.

VRfor.us is ultimately a supplement tool for education that is entertaining and intuitive. This makes other conventional tools such as books, other media such as video (YouTube, Vimeo, Dailymotion, etc.) and AR for education our substitute product/services. On the one hand, our main concern is that the sheer volume of existing material of mentioned platforms may solve potential user's need for knowledge inquiry before the need for VR immersive experience arises, which is VRfor.us *raison d'etre*. On the other hands, the mentioned potential substitutes cannot provide an immersive experience, which is the selling point of VR technology.

Based on this analysis, we think that the main threat is from video services and AR for education, but only on a medium level.

The most intimidating threat is the bargaining power of buyers since it is very easy to switch from using "Odyssey" to using another application. An additional point is that it is very easy to choose another application or VR game with the same purpose if there is any sense it is not mandatory for education. We consider this threat the highest.

The competition analysis using Porter's five forces model is illustrated in following figure:

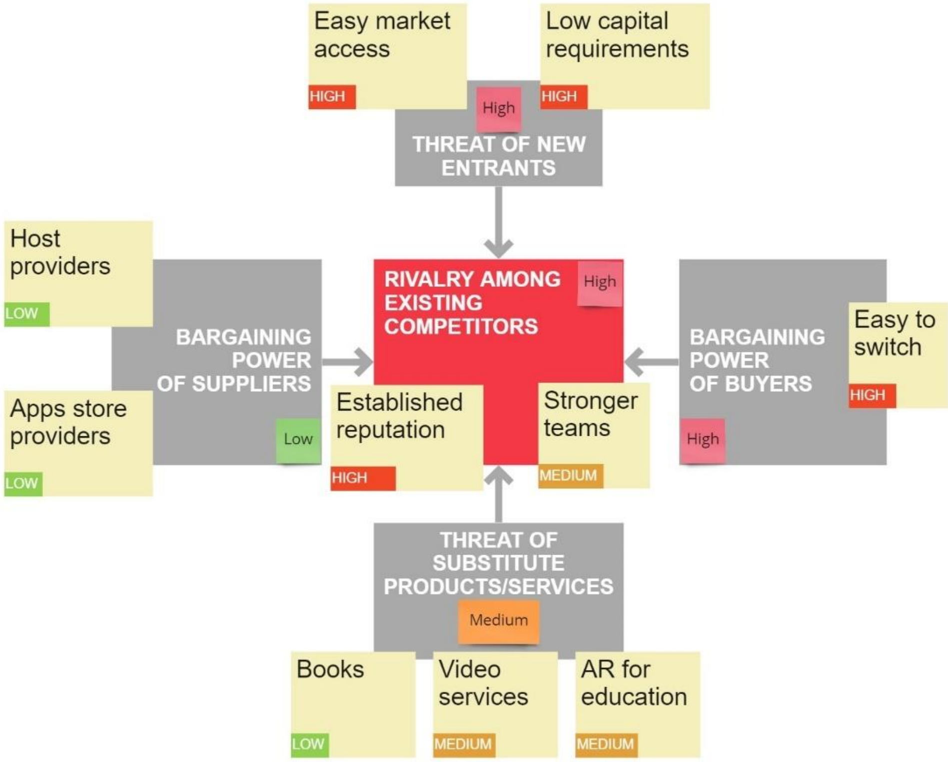

Figure 4.4 VRfor.us competition situation analysis using Porter's 5 forces model (Porter, 1979)

Following the book "Startup Evolution Curve: From Idea to Profitable and Scalable Business" (Jonikas, 2017) beside the competition analysis, it is necessary to analyse the uncontrollable environment factors and the internal environment of the business using tools such as PESTEL analysis (for environmental factors) and SWOT analysis (for internal factors).

Probably came from the EPTS analysis tool by Aguilar (1967), the PESTEL analysis is a tool to look into macro-environmental factors including political (P), economic (E), societal (S), technological (T), environmental (E) and legal (L). using this tool, the macro-environmental factors are carefully unfolded to give a better holistic view of the environment in which the business exists. In VRfor.us case, that environment is Europe since VRfor.us at the moment intended to be a European company for the European market because European countries seem to care more and more about the environment (Thiessen, 2020) as well as the fact that the team wants to build the company in Europe and compete here first.

According to the research "Virtual Reality and its potential for Europe" by Bezegová et al. (2017), the policy background in Europe is generally supported VR technology development and application strongly. For instance, the Horizon Europe programme provides more than 90 billion Euros for research and innovation with the available fund. Content creators in VR can benefit from Horizon Europe Media programme. VRfor.us can also use this kind of support and initiatives for making product/service available everywhere by asking funds from Broadband Europe and Wireless Europe initiatives, which aim to provide 5G and high-speed internet connectivity for Europe (100Mbps by 2025). This can help VRfor.us tremendously in providing system-agnostic VR platform/content, preferably on the WebXR platform.

Moreover, the application "Odyssey" aims to aid teaching global environmental phenomenon, which suits the trend in Europe. VRfor.us can benefit in two folds in this case, since an environmental education VR application would be compatible with said social trend but also the political support. For instance, horizontal 2027 second pillar is "Global Challenges and European Industrial Competitiveness" with "climate, energy and mobility" as one of the big cluster (Thiessen, 2020). It is also compatible with sustainable development goals (SDGs), especially goal number 13: Climate action (Thiessen, 2020). It is also compatible with sustainable development goals (SDGs), especially goal number 13: Climate action.

According to Bezegová et al. (2017) VR technology is now on the "slope of enlightenment" and this technology is considered to be "increasingly accepted and demanded". On the economic side, the VR headsets now are not as bulky and clumsy and expensive as before, which meant that wireless headsets such as the Oculus Quest and Quest 2 are cheaper, more elegant, and convenient. On the legal aspect, VRfor.us and other tech companies alike are strongly influenced by the General Data Protection Regulation (GDPR).

The macro environmental factors can be summed up in the following table:

Political	Economic	Social
- Horizon Europe 2027 program - Broadband Europe and Wireless Europe initiatives - EU Governments limits face-to-face learning during the pandemic	- VR market is growing - Hardware is getting cheaper	- Slope of enlightenment - High acceptance and adoption rate - European care more about the environment and Earth
Technological	**Environmental**	**Legal**
- 5G and high-speed internet (100 Mbps in 2025) - Hardware technology advance - Software development tools are available - Mobile phones can be transformed into VR devices	- Environmental concerns are trending	- GDPR - Copyrights - Other rules and regulation

Figure 4.5 VRfor.us PESTEL analysis

The above PESTEL analysis result shows that environmental concerns are not just the trend but also have a social and political impact. Thus, it is wiser to steer VRfor.us first application direction into addressing environmental issues using VR technology, especially the SDGs number 13 (climate action). In the initial idea, VRfor.us concentrated on providing cosmos experiences to deliver solar system educational content. By Using the PESTEL analysis, we see that it is more beneficial for VRfor.us to steer the "Odyssey" to climate-related issues.

4.4 Competitors

Nowadays VR applications can be found in platforms such as Steam, Oculus Store, PlayStation Store etc. Some of those platforms are more product-oriented for example, Oculus Store can be used only with Oculus products, meanwhile, others are more system-agnostic, for instance, Steam. That is why competitors must be looked at not only on one platform. Worth to mention, that some VR application can run on a browser, which might extend the competitor list.

In this analysis, we treat ourselves as potential competitors for currently existing companies as we share similar resources but might target a different market. Moreover, for VRfor.us some competitors can be more direct than the others because they also might target a similar or same market as we intend to do. Descriptions of the individual competitors can be seen below in subsections of this chapter.

Seven main features are selected as the key aspects of the "Odyssey" product - interactivity, educational, entertaining, system-agnostic, can run on the browser, on-earth view. In this context, interactiveness means that the application is action-based. Education – how much the product focus on the educational side. "Entertaining" criteria represents the content available to entertain people, in other words, being not boring. System-agnostic – can the product run on multiple platforms or has limitations of running just in one platform. "Runs on browser" represents apps availability to run on a browser. "On-earth view" and "Universe view" represent on-earth, on a human scale and in the universe with a bigger scale where people can play/interact with the environment.

Worth mentioning that all the values are between 0 and 10 and are given based on our thoughts which involved analysis. The research process involved reading and checking how the products work. Some of the values might be not precise because we based them on our opinions. Also, the good for environmental data representing the "Odyssey" is our plan for how the product will look like in the future.

Table 4.1 Data for creating value criteria curve

	Interactivity	Educational (climate issues)	Entertaining	System-agnostic	Runs on browser	Universe experience	On-earth experience
Odyssey (Now)	7	0	6	10	0	0	5
Odyssey (Future)	8	10	8	10	10	8	10
Unimersiv "Explore the International Space Station"	2	0	7	5	0	7	3
Earth2	2	0	5	?	?	2	10
Universe Sandbox	10	0	10	10	0	10	0
Solar System VR	2	0	3	9	0	5	0
OVERVIEW	0	0	5	9	0	8	0

Spacetours VR	7	0	8	10	0	9	0
WebbVR	8	0	8	10	0	9	0
Star Chart VR	2	0	4	9	0	6	3
Titan of Space PLUS	5	0	5	9	0	5	0
Celestrion	3	0	4	5	0	3	0
Space Engine	6	0	9	8	0	6	5
Trash Rage	8	5	10	10	0	0	0

Based on Table 4.1 we formed a value criteria curve also known as "Blue Ocean Canvas" (Figure 4.6) from which the "Odyssey" value curve can be seen. The main quality criteria where "Odyssey" is targeting to be the best are system-agnostic, runs on browser and on-earth experience. At this phase, prices are not taken into consideration since we are focusing on making the MVP. The prices are going to be considered when we get feedback from the MVP.

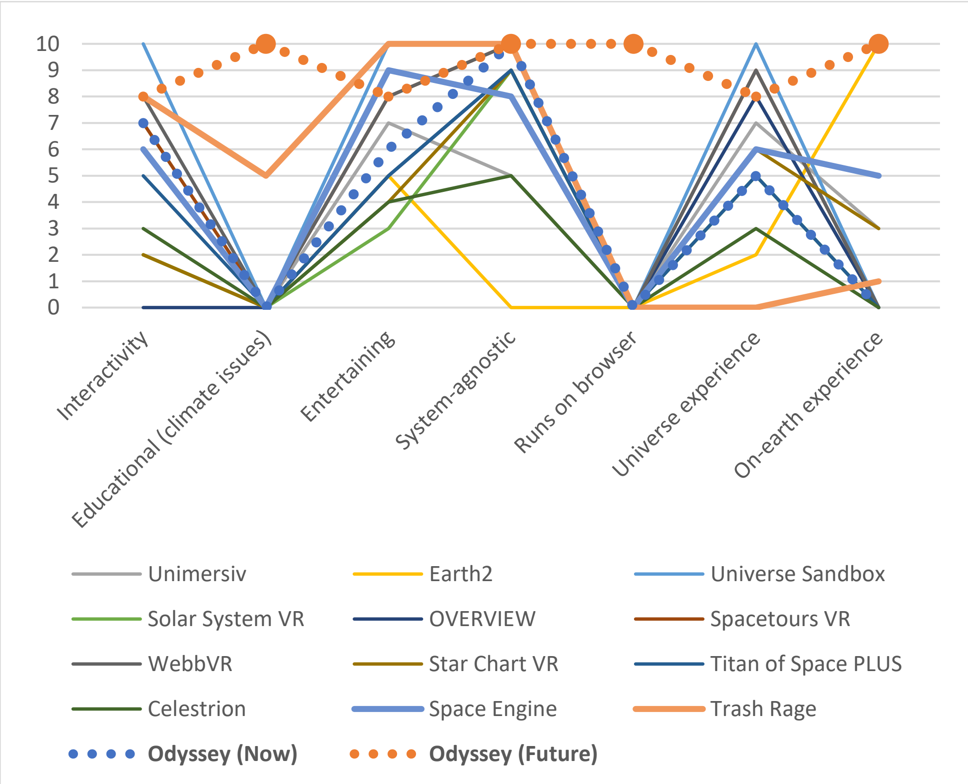

Figure 4.6 Value criteria curve

4.4.1 unimersiv

"Unimersiv" (https://unimersiv.com/) is an educational VR content provider and one of its products called "Explore the International Space Station". This product focuses on providing space station experience rather than learning about the universe and Earth.

4.4.2 Earth2

"Earth2" (https://earth2.io/) is a geographical-linked digital construct Earth that is used to trade virtual real estate at least at present time. "Earth2" is not for educational purposes and not interactive. This app is available at earth2.io.

4.4.3 Universe Sandbox

"Universe Sandbox" (http://universesandbox.com/) lets a user interact almost fully with celestials that can be chosen from a rather wide range. Moreover, this app is also a very entertaining game that might have some educational effect, such as make users more interested in astrophysics. Since it is a game, "Universe Sandbox" at the moment does not have an on-Earth mode that lets users experience phenomena on the human scale. The game development team is also impressive with a diverse portfolio from software engineers to spaceship physics engineers.

4.4.4 Solar System VR

The "Solar System VR" (https://store.steampowered.com/app/1379970/Solar_System_VR/) is an educational VR non-interactive model of the universe, where the user experiences the view of astronauts in a spaceship travelling through the solar system. The experience given by this application is quite great, but the lack of interaction with celestial makes users simple bystanders on a journey through the planets. It is not very entertaining but quite informative with the option to visit planets' surface.

4.4.5 Spacetours VR

Like "Solar System VR", "Spacetours VR" (http://spacetoursvr.com/) gives users a trip through the solar system from inside a spaceship without interacting with non-interactive celestials. The visual experience of "Spacetours VR" is quite impressive with a detailed depiction of the ISS. Although quite informative about the planets in our solar system, the user interface makes users read from multiple panels, which makes it feel a little complicated.

4.4.6 OVERVIEW

"OVERVIEW: A Walk Through the Universe" (https://www.overviewexperience.com/) is a solar system VR simulation. In this simulation, planets are not interactive. "OVERVIEW" is very informative since it is a documentary VR. One of its most impressive features is the on planet view. Detail depictions of planets' surfaces give users awe feeling over the different worlds.

4.4.7 WebbVR

"WebbVR: The James Webb Space Telescope Virtual Experience" (https://webbtelescope.org/) is a very interesting universe simulation that is interactive. The "feeding the black hole" feature is a fun experience. The simulation is very informative with a scale comparison feature where users can compare the space telescope with other available entities such as a car, a horse or an elephant. Users can try building their own solar system on building mode. This amazing application could have been better with on planet view.

4.4.8 Star Chart VR

"Start Chart VR" (http://www.escapistgames.com/sc.html) is a solar system and real-time night sky simulation. The planets in this simulation are not interactive. On the bright side, this app provides a limited human-on-planet view but is not interactive either. "Star Chart VR" is informative about the solar system celestial sizes, shapes and rotary position, and constellation position.

4.4.9 Titan of Space PLUS

"Titan of Space PLUS" (http://www.drashvr.com/titansofspace.html) is a narrated space travel through the solar system. The celestials in this application are not fully interactive and can only be rotated. It is more of an informative sequence of cutscenes with narration, text to read and limited controllable elements.

4.4.10 Celestrion

"Celestrion" (http://dsky.co/apps/celestrion/) is an informative VR simulator of solar system and is not interactive. This app gives users basic information on the solar system, for instance, relative sizes, shapes and rotary trajectory of planets. With it fantasy-like graphic design, it might be more appealing to younger users or fans of the fantasy genre.

4.4.11 Space Engine

"Space Engine" (http://spaceengine.org/) is a photorealistic interactive 3D planetarium that models the universe. This planetarium simulation does not have an exclusive on-planet view (human scale). Exploration purpose is the main point of this simulation. The surface rendering using NASA data makes it detailed enough.

4.4.12 Trash Rage

Set in a futuristic scenario, "Trash rage" (https://giantlazer.com/trash-rage/) gives users a chance to create a better place for humanity by sorting trash. It directly sends the message to the user that trash should be handled correctly with an entertaining-ensured range of requiring interactive movements. The theme, on the other hand, is limited and the play duration is quite short.

4.4.13 Overall competition

The competition scan showed that it is relatively hard to find VR applications that directly address climate-related issues similar to the "Odyssey". Therefore, we consider the space/universe applications as the main competitors.

5 Designing MVP

WQ4: How to develop an MVP of the product "Odyssey" for VRfor.us?

To successfully brings the product to the market, it is important to get right the wants and needs of the customers the product addresses. There are several ways to decipher customer demands, one of which is employing the minimum viable product (the MVP).

The creation of MVP to itself has many types and approaches. Depends on the nature of the product, a specific prototype strategy has to be chosen to make the MVP. The are several prototype techniques that help follow strategies and deliver an MVP.

In this section, we also provide information on what kind of technologies "Odyssey" is using or planning to use. Also, the creation of the "Odyssey" MVP is being described in detail on how Design Thinking, Lean Startup and Agile methodologies were used. Moreover, we provide information on how the product was tested and what we learned from the meeting with potential users. Subsequently, we provide details of how the product should look if the product is being further developed.

5.1 What is an MVP?

According to (Ries, 2011), an MVP is a partly developed version of the real planned product (MVP). MVP can lack many features of the final products. It is essential that the MVP would have the most needed functionality that users could start using the product, and a product provider could collect information from the users in help with it (Ries, 2011).

MVP is part of market-defining and at this state idea pivoting can be inevitable. Having minimum needed features allows to reflect and generate feedback from users and customers, which later can help to retrospect the direction of the product and business. Meanwhile, putting more effort into additional "nice-to-have" rather than "need-to-have" features would be redundant since the pivoting will render these additional efforts as useless (Ries, 2011).

One of the main aspects of the MVP is to test a defined hypothesis. The hypothesis is an assumption for the product (Ries, 2011). For instance, there is an MVP of a chat program, which can connect and chat. Creators of this app believe that chatting through emoji is the needed functionality of their chosen user segment. The hypothesis, in this case, would be, that the emoji is an essential part of chatting.

An MVP can be even a stop-motion video. When Dropbox was creating their product, they used stop-motion techniques which allowed them to communicate their idea to potential users without spending resources on the actual product. This lets them to better understand their customers and the product they were creating. Having all that they started building actual product when Dropbox knew how the product should look like (Ries, 2011).

The definition of an MVP is being defined in many ways. Steve Blank (2010) defines the minimum viable product as a customer development tactic that helps to reduce engineering resources to make the product usable by early adopters as soon as possible. Moreover, Lenarduzzi and Taibi (2016) have made a systematic literature review to understand what the most used MVP definition is. They concluded largest part of the MVP terms are derived from the ideas of Ries (2009) and Blank (2010).

To generalize, an MVP is a version of a new product, which allows a team to collect the maximum amount of validated learning about customers with the least effort (Ries, 2009). The MVP has just those features (and no more) that enables the product to be deployed (Blank, 2010). It is an iterative process of idea generation, prototyping, presentation, data collection, analysis and learning (Ries, 2009).

5.2 Prototypes

According to Beaudouin-Lafon and Mackay (2002) is a physical representation of one part of the whole of an interactive system. For example, a prototype of a book is the cover and/or some pages. In this prototype, the content is not of the highest importance because it is more important to show that the book with cover is possible to do.

5.2.1 Prototype Strategies

The article “Prototyping Tools and Techniques” by Beaudouin-Lafon and Mackay (2002) specifies four ways of making prototypes, or four strategies: horizontal prototypes, vertical prototypes, task-oriented prototypes, and scenario-based prototypes. Moreover, Figure 5.1 illustrates how horizontal and vertical prototypes can be understood by applying Beaudouin-Lafon and Mackay (2002) theory on (Rosenstand, 2011) simulator figure.

Horizontal prototypes consist of a part or an entire layer of the system at the same time (e.g., interface, functions or model layer). For instance, the horizontal prototypes of a user interface can holistically capture the user interface from the user viewpoint and through that unfold issues such as consistency, redundancy and coverage (Beaudouin-Lafon & Mackay, 2002).

A vertical prototype, on the other hand, is a slice of one or more features from the outer layer through the whole system (Beaudouin-Lafon & Mackay, 2002). For example, a vertical prototype of a vehicle would be the headlight system alone, starts from the switch to the wires and ends up at the headlight itself, fully functional.

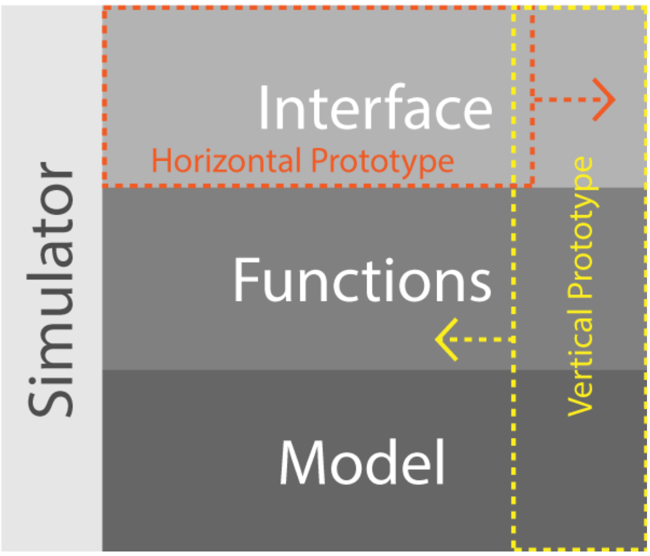

Figure 5.1 Vertical and horizontal prototype strategies based on Rosenstand (2011) and Beaudouin-Lafon & Mackay (2002)

Task-oriented prototypes focus on the individual tasks that a user must complete when interacting with the system (Beaudouin-Lafon & Mackay, 2002). For instance, if a computer user wants to use the PC, the need to be completed tasks would be turning on the machine and enter the pre-set password using input devices. Task-oriented prototypes only consist of the required functions for completing the selected tasks (Beaudouin-Lafon & Mackay, 2002). In the turning on the computer cases, those function would be the on-off button, keyboard and mouse connection and the computer screen. Function such as the booting sound can be skipped.

Scenario-based prototypes are similar to task-oriented prototypes, but they are focused on real-life scenarios, not individual tasks (Beaudouin-Lafon & Mackay, 2002). One example can be, when a car manufacture prototypes to test driving in the mist would consist of the headlight functions, signal light functions, driver's camera functions, obstacle detect functions and maybe autopilot function.

In the "Odyssey" project, we mainly use horizontal prototypes for having MVP and vertical slices - for testing the ability to make certain features (e.g., running on a browser). Other strategies – task-oriented and scenario-based prototypes – might be used later in future when the project must be pivoted or add additional functionality that would require such cases that those prototypes cover.

5.2.2 Prototype Techniques

An MVP can have many forms ranging "extremely simple smoke tests" to "early prototypes" (Ries, 2009) and its appearance can vary depending on the nature of the product. Table 5.1 lists some of MVP types based on Duc and Abrahamsson (2016)

Table 5.1 Types of MVP based on Duc & Abrahamsson (2016)

MVP types	Detail
Explainer video	A short (30 seconds to 1 minute) animated illustration that explains the product.
Landing page	Website customers are redirected from the marketing campaign. This website describes the products and let customers communicate with the startup.
Wizard of Oz	A manually functioned user interface (UI) that looks automatic. Use to give customers user experience (UX) before the function is built.
Concierge MVP	A manual service that let customer go through the exact same steps which users would experience with the real product.
Piecemeal MVP	The same to Wizard of Oz, but functioned by existing tools (not manually)
Mockup MVP	Physically built illustration of the products, such as wireframe and papers, without any functionality
Public project proposal	Such as project on Kickstarter and other crowdsourcing sites.
Single feature MVP	A prototype with the most important function of the real product.
Rip off MVP	Successful as a product, but then pivot to other direction.

Overall, an MVP is a tool to communicate the abstract concept of the products with minimum effort and features. Some of those types are more tangible than others. We consider that "Wizard of Oz", "Concierge MVP", "Piecemeal MVP", "Mockup MVP", "Single feature MVP", "Rip off MVP" can be tangible which means that users can touch or interact with them. These types of MVPs can be considered as protypes.

In the VRfor.us case, the product "Odyssey" is made as a computer program. Moreover, creating such a program does not require a lot of resources because members of VRfor.us have the required experience to deliver a product. Therefore, the "Odyssey" prototype is targeted to be a single feature because it allows testing on users and receiving feedback.

5.3 Technology

As it was described in Chapter 4, the "Odyssey" product targets to have a learning experience in the universe and Earth and be able to run on a browser. To achieve that we have selected Unity engine because it allows to prototype fast. Another goal is to run a VR application on a browser that user could use our products without going into a specific platform. This can be achieved through WebXR technology. Moreover, in the "Odyssey" one of the goals is to educate people on what can happen to Earth if certain aspects change (for example, pollution, temperature, sea level, etc.) while being on earth. For that, the ArcGIS map fits well because it describes detailed Earth visualization in a 3D world while using the Unity engine. Unity, WebXR and ArcGIS maps SDKs (software development kits) are described below.

5.3.1 Game Engine - Unity

Unity is a cross-platform game engine that is developed and maintained by Unity Technologies. The engine supports over twenty-five platforms (e.g., iOS, Android, Windows, Linux, PS4 etc.). Moreover, this engine allows the creation of 2D, 3D, XR games and apps. Most importantly, the core development features of the Unity engine are free for personal use when revenue of funding is less than $100,000 over the last twelve months (Unity Technologies, n.d.-a).

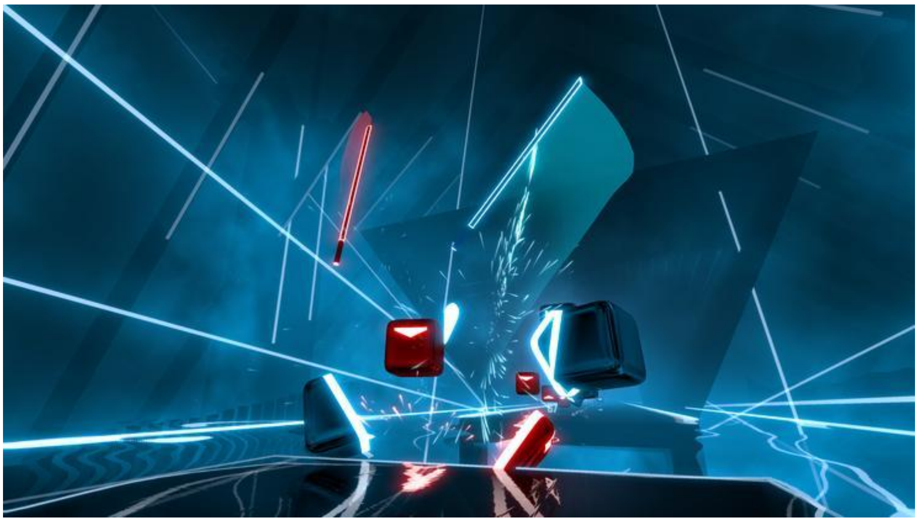

Figure 5.2 "Beat Saber" game uses the Unity engine (Unity Technologies, n.d.-b)

As described in the article “What is the best game engine: is Unity right for you?” by Dealessandri (2020), Unity is a good engine for beginners because it provides tools for students and aspiring developers free of charge. Furthermore, the Unity toolkit reduces complexity when working in 3D (Dealessandri, 2020).

Unity is fast and Agile when creating prototypes and new concepts. For example, a team, that tries to develop a new game concept, can have fast results with Unity because this game engine allows having fast development iterations (Dealessandri, 2020).

Unity engine supports the creation of Virtual Reality contents by providing a toolkit for interactions, high-definition rendering, spatial audio, and others (Unity Technologies, n.d.-b). Unity can support multiple XR platforms such as Oculus, Windows Mixed Reality, Google VR etc (Unity Technologies, n.d.-a). This allows focusing more on the content than on the hardware aspects.

On the other hand, Unity has disadvantages as well. As noted by Dealessandri (2020), Unity is not suitable for big projects, promotes bad code practices, not artist friendly as might other engines are and lacks some UI features. But overall, at this stage, we do not consider these things as disadvantages because Unity is used as a prototyping tool in the “Odyssey” product.

5.3.2 WebXR

WebXR is a toolkit that provides functionality for running virtual reality and augmented reality on the web (Mozilla Developer Network, 2021a). Moreover, WebXR is a product of the Immersive Web Community Group where companies such as Mozilla, Google, and Microsoft and others are contributors to this organization (Google Developers, 2021).

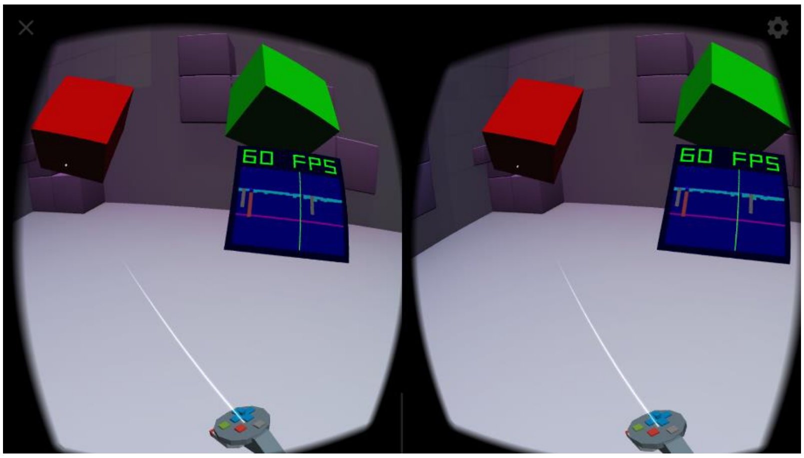

Figure 5.3 WebXR app example (Medley, 2018)

WebXR also has a plugin for the Unity engine which is called “WebXR Exporter” and it is developed by Mozilla. It allows developing VR content on Unity which later can be generated as a WebXR browser.

5.3.3 ArcGIS Maps SDK for Unity

ArcGIS is a platform/toolkit (developed by a company named Esri) which consists of a high-quality set of location services, data and mapping tools. This platform/toolkit can be integrated into other products/services which work and requires location and mapping (Esri, n.d.).

Esri company has released a software development kit (SDK) which allows access to maps and 3D content from ArcGIS Platform in Unity. This can aid to develop interactive, photorealistic 3D and XR experiences (ArcGIS Developers, 2021).

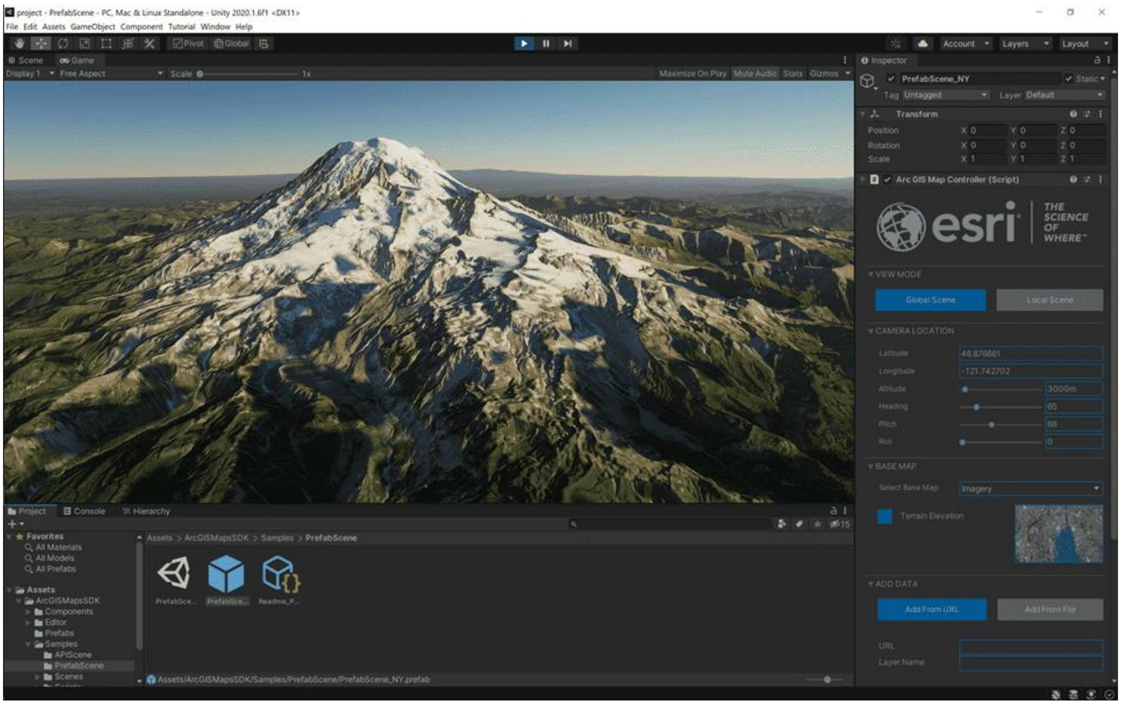

Figure 5.4 ArcGIS integration for Unity (ArcGIS Developers, 2021)

5.4 "Odyssey" Development

Unity game engine was selected for developing the "Odyssey" product because of the features described in subchapter 5.3.1 and because VRfor.us team members have some experience with working with this engine. Other engines (e.g., Unreal Engine 4) were not considered for product development as it would require learning the technology and its processes of developing prototype application.

In this project, we managed to perform two development iterations. Both iterations were focused on understanding if our team can create such an application. As a result, we provided a VR app that has planets that spin around the sun based on gravity, a VR controller, planets grabbing, etc.

Before starting to create the product, we asked a few people if they struggle to understand concepts that require a higher scale (e.g., universe). As we understood, some people fail to understand such information when a scale is very important.

As it was described in Chapter 2, we used Design Thinking, Lean Startup, and Agile methodologies for our product development. Design thinking was used when we were exploring and solving problems. For example, we had a problem where a user should understand gravitation. The solution for it was creating a universe where people could play with planets and interact with them (e.g., grab and through a planet).

The Design Thinking was followed up by Lean Startup and Agile methodologies. The Lean Startup was used to identify and test business hypothesis such as does a user learn something by interacting with planets in the

"Odyssey" or does the app solve the learning problem. Meanwhile, Agile was used for developing the prototype. Both – Lean Startup and Agile – are iterative processes. The big difference between them that Lean Startup is business-hypothesis-driven development where experiments and pivoting is essential parts (in our case, we identified features that could be implemented). In the Agile case, it is driven by product development where the focus is put on delivering the most important features based on constraints (e.g., time and resources).

Based on our process we have created a diagram (Figure 5.5) which represents graphically how we used Design Thinking, Lean Startup and Agile methodologies. It illustrates that this project had one Lean Startup iteration which included two Agile iterations, and that Design Thinking was used across the whole project.

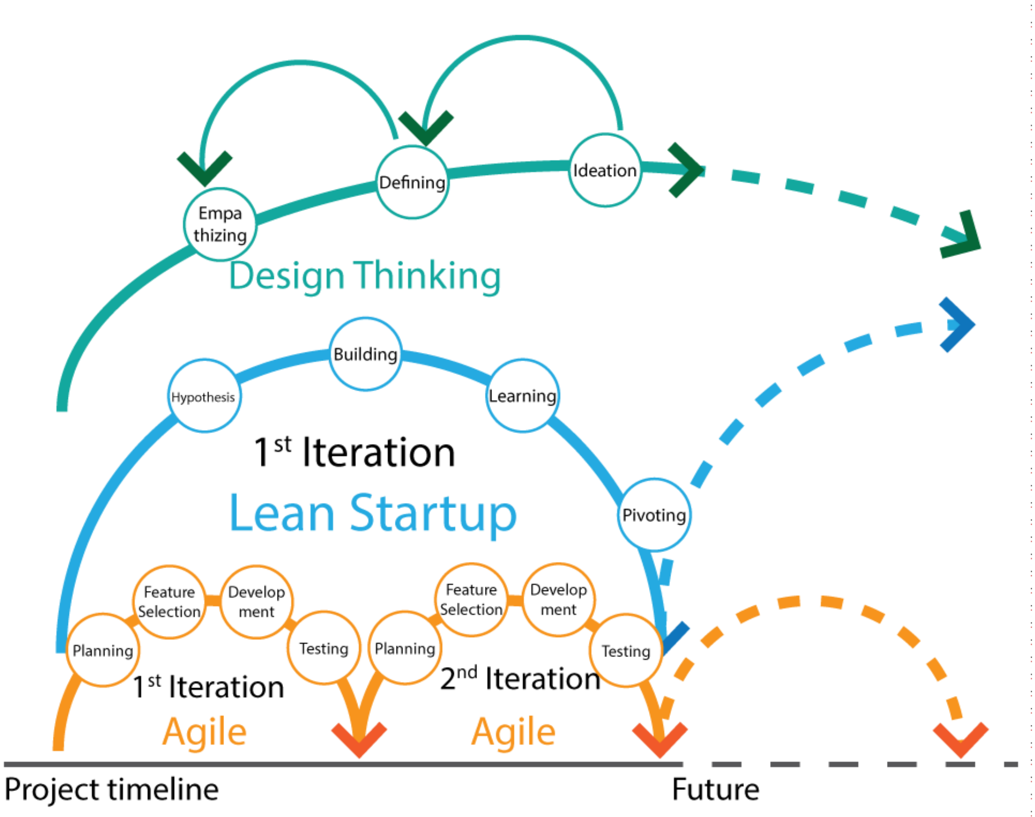

Figure 5.5 Timeline of the "Odyssey" project

Our current team consists of only one guy with IT technical knowledge (Ugnius Malūkas), and delivering MVP required additional help because of the limited time. We asked help from our future founder Edvinas Danevičius who together with Ugnius performed two Agile sprints after which a prototype was created. In this phase, Ninh Thế Vĩnh Thịnh was responsible for making sure we are following our 1st Lean Startup iteration goals.

During the 1st and 2nd iterations, the focus was put on proving that our team can create a VR application, and user experience (UX) parts. Since the application was being created from scratch, it was important that the app would be usable. Failing to do so, might be not appealing for users.

Both iterations are based on the hypothesis that people fail to understand concepts that include scale, and such application would help to tackle this problem. Subchapters 5.4.1 and 5.4.2 are focusing on product development which uses the Agile methodology for achieving goals. The validation and pivoting were done after the second development iteration. The reason was that competition analysis shown signs that our application should focus more on Earth and Sustainable Development Goals rather than the universe alone.

5.4.1 1st Development Iteration

In the first development round, we brainstormed how the app might look like and what features must be implemented. The process was straightforward: we had a hypothesis (people fail to understand larger scale concepts) and a possible solution for it (create VR universe and Earth application). We brainstormed features and prioritized them based on our resources and time availability to implement the highest priority features. Later, to validate our work, we performed testing on users.

5.4.1.1 Selecting Features

In this phase, we already have brainstormed the features we would like to have in the final product. We prioritized those features considering if the feature has an impact on the overall outcome. For example, a solar system created in the simulator was very important in this phase because it is the base of the app.

Table 5.2 Features for the "Odyssey"

Indication	Title	Description	Priority	Decision
1	Planets' models	Model planets for the universe	high	yes
2	Solar system-based gravitation	Make system where planets would use gravity from the Sun.	high	yes
3	Planets grabbing	Make system that would allow grabbing planets.	high	yes
4	Stars	Model and show stars.	low	
5	Flood when moving moon	Moving the moon back and forth to see how the moon influences the water in Earth.	medium	
6	Music in the background	Play music in the background.	low	
7	Player movement control	Let user move around the simulation.	high	yes
8	Planets spinning	Make planets to spin around their axies.	low	
9	Intro scene	Make an intro scene where players could try some game features.	medium	yes
10	Time control	Time control would allow going back and forth in time. In this case, time could indicate the simulation time.	low	
11	On planet selection	A border outside a planet would indicate that the planet is selected/on hover.	low	
12	Ray-casting	Lines going outside the controller.	medium	
13	Eclipse	Eclipse watching feature. It can be in two ways: (1st way) watching the eclipse from the planet (e.g., Earth) and (2nd way) from in the space seeing how the moon covers the sun. It would be handy to have a time control feature to go further or back.	low	

13	Narrator	A voice or text providing specific information about certain planets/actions.	low	

Table 5.2 provides information on which features were considered for the first iteration and the priority. As it can see from the table not all features were selected, only “Planets’ models”, “Solar system-based gravitation”, “Planets grabbing”, “Player movement control” and “Intro scene” features were implemented. Moreover, some other things were implemented that are not listed in the table, for example, Unity Skybox (background), pre- and post- colour processing etc. This was not listed because we did not consider them as actual features.

5.4.1.2 Development

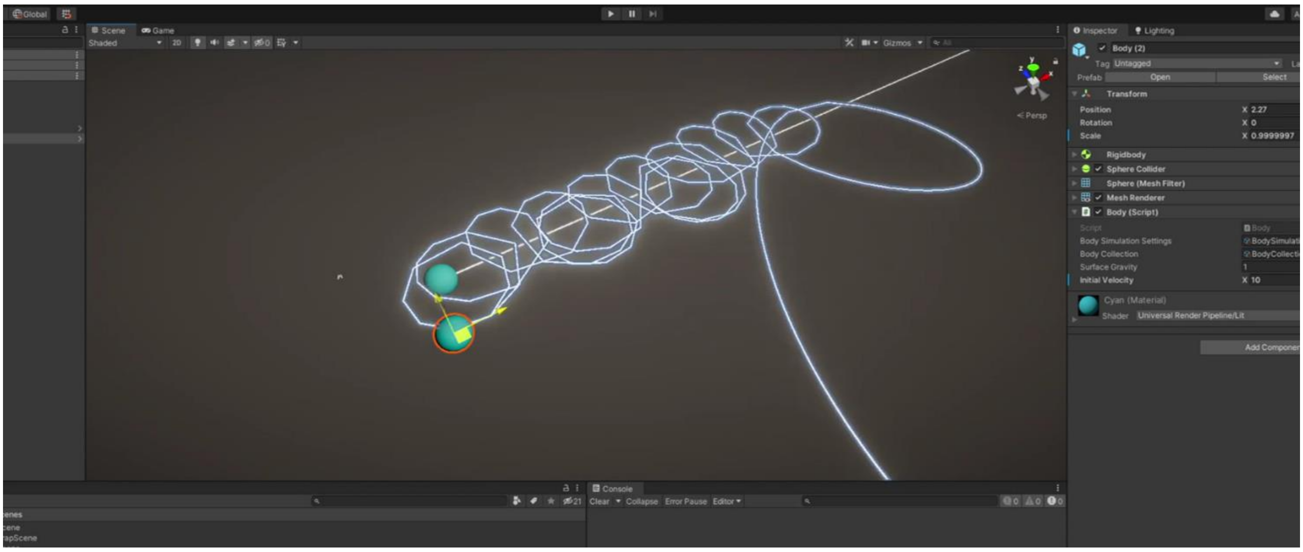

Figure 5.6 Snapshot from the 1st development iteration

After we selected features, we started working on implementation. We used Unity engine and Unity programming libraries which allowed us to implement Virtual Reality functionality. Figure 5.6 shows a snapshot from the development phase of how we worked on the gravitation of the planets’ feature. Planets in the “Odyssey” are many times smaller than actual planets, we had to tweak gravitation parameters that they could look realistic in our simulation (Figure 5.7).

Figure 5.7 Planets movement and their distances based on gravitational effect.

The next important feature was planets grabbing (Figure 5.8). As our planets move dynamically around the sun thanks to the gravitation feature, we could implement planets grabbing which allow us to grab planets and throw them somewhere in the universe. This feature adds interaction to the simulation.

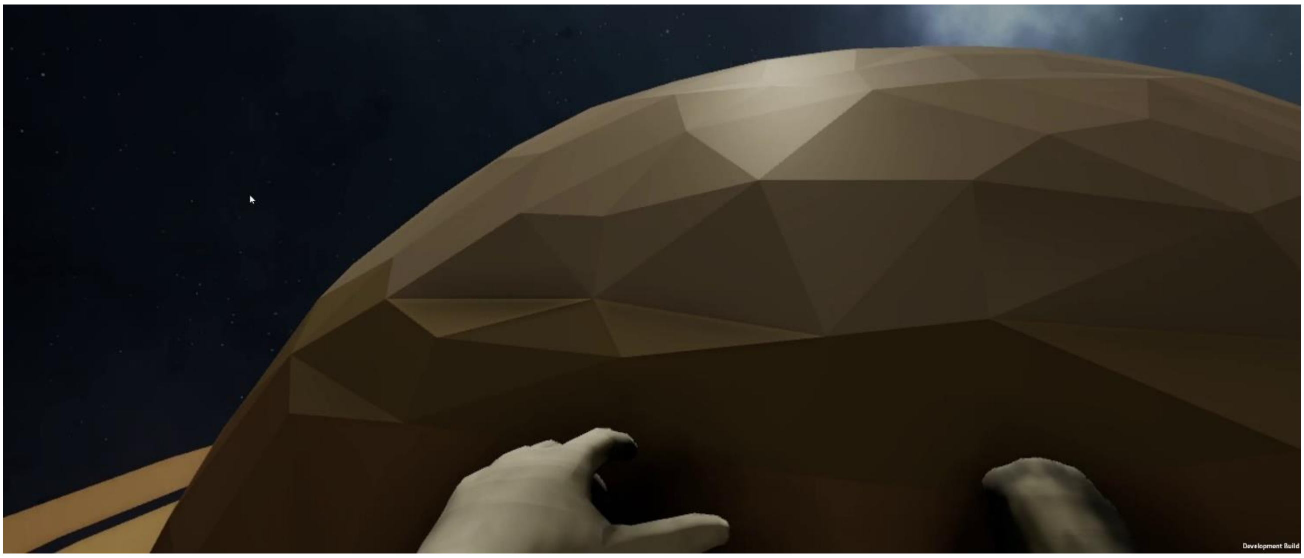

Figure 5.8 Planet grabbing feature

In Figure 5.9 it can be seen the intro scene where a player can get accustomed to the simulator and test features such as grabbing, moving around. We chose a white colour that it would be clear that is like a lobby before entering the universe.

Figure 5.9 Intro scene

During this phase, we also tested the WebXR technology on a separate project. We tried to generate a browser app from the Unity environment. As we tested, it was clear that Unity virtual reality toolkit does not support browsers. For the app to run a browser, the “Odyssey” project must be remade with WebXR oriented toolkit such as WebXR Exporter for Unity.

As we tested WebXR Exporter in the Unity environment, it felt that this toolkit is still in the early stage because it lacks some important feature such as different special keys handling of different controllers. Moreover, browser apps have some lag that brings motion sickness. Therefore, we decided to postpone this feature now and save it for future development rounds.

5.4.1.3 Testing

The testing phase was performed with people aged between 19 and 27 years old. The testing was done in three stages: question before the test, app testing and question after the test. After the test, we analysed what new features should be in the next sprint and what should be fixed. All question and answers can be found in Appendix A.

Figure 5.10 Testing prototype after the 1st development iteration

Questions that were asked before the test mostly consisted of general questions such as asking how a person imagines planets simulation, how it can help to learn. Also, what people expect that such information should look like. Most participants described that simulation must consist of planets which users would be able to interact with, for example, get information about planets, see how their trajectories appear around the sun.

Whilst users were testing the app, we asked them to comment loudly about what they are doing in the simulation. This allowed us to get more information about how users feel in the app. For instance, one participant said that she feels strange while not seeing the ground under her feet which results in slight motion sickness for her. Also, all participants said that they need either teleporting or a faster move feature that could allow the move faster.

After users finished testing the app, we have asked them questions that were related to how they felt in simulation, what they liked, how dizzy they felt etc. Most of the participants felt more dizziness in the intro scene than in the actual simulation. Furthermore, some people said that sound would be nice to have as well. Many individuals indicated that information near planets is missing, and they would like to see the narrator when possible. Moreover, test attendees mentioned some bugs, for example, control of the Z-axis was not working as expected, and sometimes it was hard to grab planets.

Table 5.3 Our proposed features for the next development iterations

Features Questionnaire
1. On planet selection: A border outside a planet would indicate that the planet is selected/on hover.
2. Ray-casting: Lines going outside the controller.
3. Eclipse: Eclipse watching feature. It can be in two ways: (1st way) watching the eclipse from the planet (e.g., Earth) and (2nd way) from in the space seeing how the moon covers the sun. It would be handy to have a time control feature to go further or back.
4. Flood when moon is being moved: Moving the moon back and forth to see how the moon influences the water in Earth.
5. Time control: Tim control would allow going back and forth in time. In this case, time could indicate the simulation time.
6. Narrator: A voice or text providing specific information about certain planets/actions.

At the end of the test session, we proposed people new features that we thought might be useful to have (Table 5.3). We asked participants to prioritize the list. After putting all results together, it appeared that having the narrator and the “Eclipse” features are most desired. Meanwhile, “Ray-casting” and “Time control” features were the least needed. Table 5.4 provides a features priority list of the participants.

Table 5.4 Prioritization of the proposed features results

Indicator	Title	Ramunė	Jaunė	Emilija	Average	Rank
1	On planet selection	2	3	5	3.(3)	3
2	Ray-casting	3	6	6	5	6
3	Eclipse	5	1	1	2.(3)	2
4	Flood when moon is being moved	6	4	2	4	4
5	Time control	4	5	4	4.(3)	5
6	Narrator	1	2	3	2	1

Based on the comments made during the test, we aggregated results and made a table which represented if additional features that can be done. Table 5.5 illustrates features that were aggregated from user comments. Users might use different words or sentences, but we extracted them by the ideas. For example, one person said that she likes to move faster. Another person – teleporting. The idea is the same – teleporting/faster pace. Table 5.6 Indicates which user mentioned which possible feature.

Table 5.5 Aggregated features based on users' comments

Aggregated Features
7. Music: Play background music.
8. Visit planet: Visit planet from inside.
9. Teleporting / faster pace: Make either faster walking or teleporting.
10. Zoom in / out: Zoom in and zoom out the solar system.
11. Sun melts planets: When a planet touches the sun, it starts melting.
12. Ground under the feet: Some people felt strange not to see ground.
13. Planets reset position after they have been moved: After planets are being moved from their spaces, bring them back.
14. More stars: Add more starts, e.g., milky way
15. Add comets.
16. Add satellites.
17. Sighting of planetary surfaces: Whan planets are being watched from nearby, allow user to see some details of that planet.
18. See what kind of chemical elements planets contains: See information about planets' chemical structure.
19. Hints giving: The app should give hints to not distort learning.
20. Planet's creation tool: Planet's creation tool for a user
21. Information about planets: Provide information about the planets.
22. Guess the planet game: When a person is teleported into a random planet, she/he has to guess which planet it is.

Table 5.6 Aggregated features that were mentioned/found by users

Indicator	Title	Ramunė	Jaunė	Emilija	Sum
7	Music		yes	yes	2
8	Visit planet		yes	yes	2
9	Teleporting / faster pace	yes	yes	yes	3
10	Zoom in / out	yes	yes		2
11	Sun melts planets	yes			1
12	Ground under the feet		yes		1
13	Planets reset position after they have been moved		yes	yes	2
14	More stars	yes	yes		2
15	Add comets	yes	yes		2
16	Add satellites		yes		1
17	Sighting of planetary surfaces		yes	yes	2

18	See what kind of chemical elements planets contains	yes		yes	2
19	Hints giving		yes		1
20	Planet's creation tool		yes		1
21	Information about planets	yes		yes	2
22	Guess the planet game	yes			1

Table 5.7 illustrated which bugs were found by users and Table 5.8 shows who experienced which bugs. Bugs in this context can mean usability issues, functional inaccuracies etc.

Table 5.7 Bugs found by users

Found Bugs
1b. Planets grabbing: Hard to grab planets.
2b. Z-axis control: Many people had problems with controlling Z-axis.
3b. Doors: Many people failed to find entrance to the simulation.
4b. Easy to get lost in space: It is easy to get lost when exploring space.
5b. Missing instructions: Missing instructions how to use the app.

Table 5.8 Bugs that were mentioned/found by users

Indicator	**Title**	**Ramunė**	**Jaunė**	**Emilija**	**Sum**
1b	Planets grabbing	yes	yes		2
2b	Z-axis control	yes			1
3b	Doors	yes	yes	yes	3
4b	Easy to get lost in space			yes	1
5b	Missing instructions	yes			1

As we analysed all the gathered data from the first iteration testing, we were ready to move to the second development round.

5.4.2 2nd Development Iteration

The second development iteration followed the same Lean Startup iteration (1st iteration) which focused on the same hypothesis as the first development iteration. The second development round was based on the users' feedback from the first development round and our additional thought about how the product can move forward.

5.4.2.1 Selecting features

In Chapter 5.4.1 in the testing phase users gave many ideas how the app can be improved. To addition to that we also thought that it would be nice to have features as "Planets explosion" and "Planets spinning" which were not discussed during the first development round.

Table 5.9 Additional features

Aggregated Features
23. Planets explosion: Planets explode on collision.
24. Planets spinning: Planets are spinning around.

Table 5.10 illustrates features that were implemented or consider implementing in the second development round (the full list of features can be found in Appendix B). In the “Questionnaire Features” part the “Rank” column represents feature priorities. In this case, 1 is the most needed feature, and 6 is the least needed. In the “Proposed Features” and “Bugs” sections, the rank means how many people indicated features/bugs during the interview. The “Difficulty” column shows how difficult is to implement based on our opinion and skills. The “Decision” column indicates whether we planned to implement those features, and the “Status” column represents if we have made those features.

Table 5.10 Features planned for the second sprint

Indicator	Title	Description	Rank	Difficulty	Decision	Status
Questionnaire Features						
1	On planet selection	A border outside a planet would indicate that the planet is selected/on hover.	3	medium	yes	**done**
2	Ray-casting	Lines going outside the controller.	6	easy	yes	**done**
Proposed Features						
7	Music	Play background music.	2	easy/medium	yes	**done**
9	Teleporting / faster pace	Make either faster walking or teleporting	3	easy/medium	yes	**done**
10	Zoom in / out	Zoom in and zoom out the solar system	2	medium/hard	yes	**todo**
12	Ground under the feet	Some people felt strange not to see ground	1	easy	yes	**done**
13	Planets reset position after they have been moved	After planets are being moved from their spaces, bring them back.	2	easy/medium	yes	**done**
21	Information about planets	Provide information about the planets.	2	medium	yes	**done**
Additional Features						
24	*Planets spinning*	*Planets spinning*		easy	yes	**Done**
Bugs						
1b	Planets grabbing	Hard to grab planets.	2	medium	yes	**done**
2b	Z-axis control	Many people had problems with controlling Z-axis.	1	medium	yes	**done**
3b	Doors	Many people failed to find entrance to the simulation	3	easy	yes	**done**

5.4.2.2 Development

As it can be seen from Table 5.10, we implemented almost all planned features, except “Zoom in / out” feature. Also, it could seem illogical thing that we have implemented the “Ray-casting” feature even though this feature was the last needed functionality by users. In fact, we have implemented this functionality because the

"Information about planets" was quite dependant on it as we wanted to have more interactive information showing.

In total, we considered 24 features and 5 bug fixes. But because of the time limitation, for this sprint, we chose only the feature described in Table 5.10. Moreover, the selection of the features mainly consisted if it is feasible to create fast (e.g., some features as "Visit planet" could take one development sprint alone). Our goal was to create an app that users would know the difference.

The images below illustrate some features made in this development round. The whole functionality cannot be illustrated in images because they include motion (e.g., movement). Figure 5.11 shows the "Ray-casting" feature, Figure 5.12 – the "Ground under the feet", and Figure 5.13 depicts two features – "Information about planets" and "On planet selection".

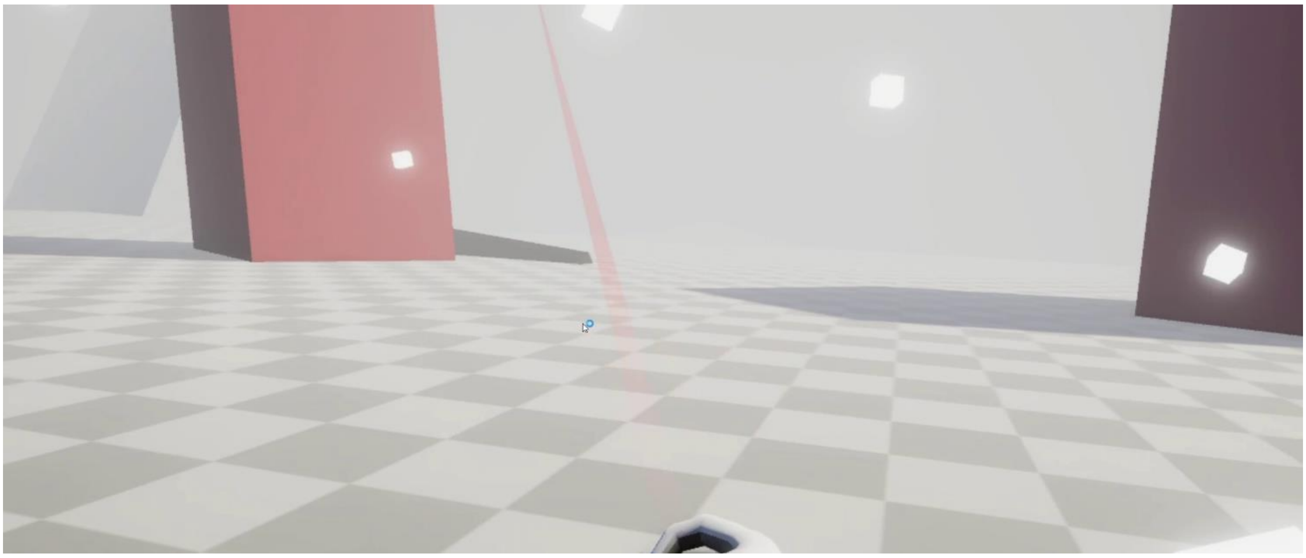

Figure 5.11 "Ray-casting" feature

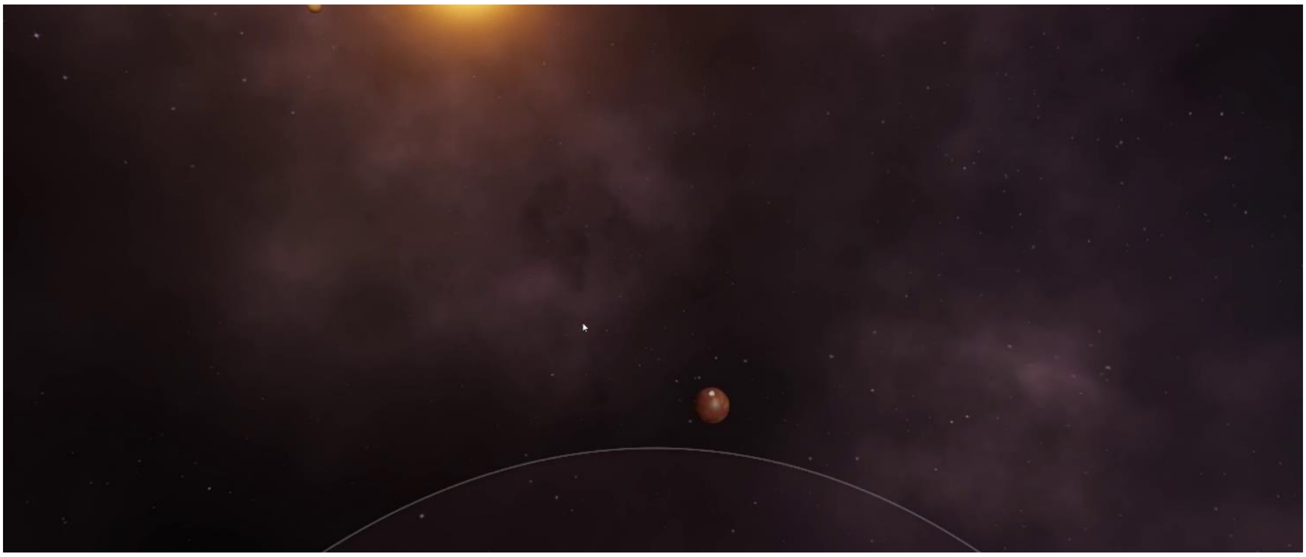

Figure 5.12 "Ground under the feet" feature

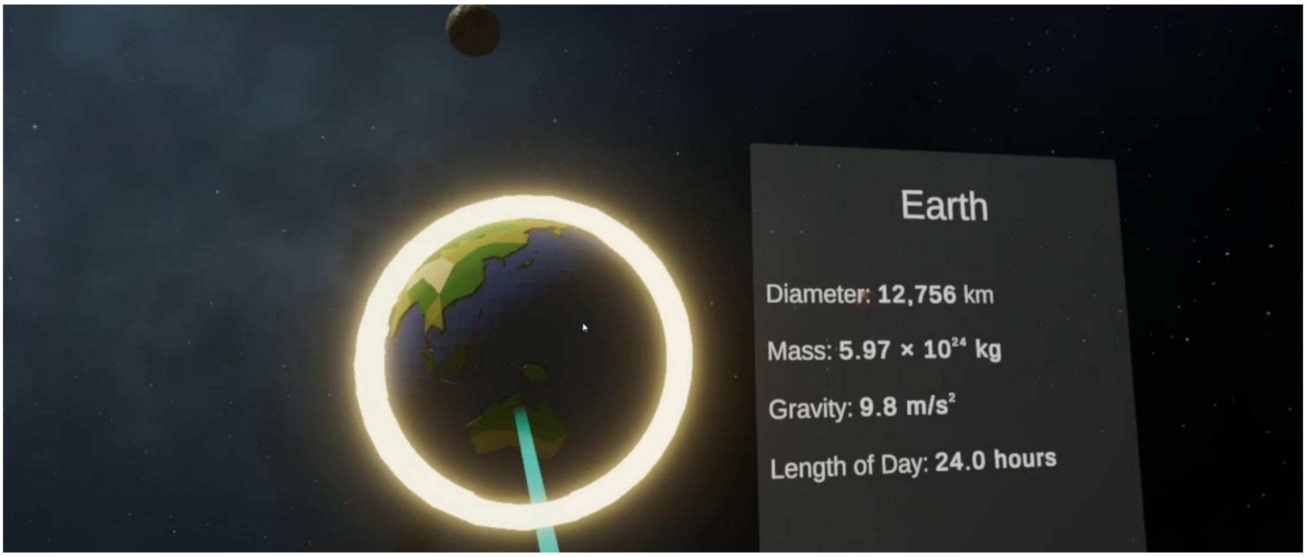

Figure 5.13 "Information about planets" and "On planet selection" features

5.4.2.3 Testing

The second testing was done with people whose age was between 19 and 29 years old. This time we tested the app on 5 people from which 3 individuals have not seen the app before. The remaining two persons have tested the app in the first development round. All question and answers can be found in Appendix C.

Figure 5.14 Testing prototype after the 2nd development iteration

Questions before the test were asked only for people who have not been in the first iteration testing. We have decided to do so because prior testing questions of the 1st and 2nd iterations were the same. Attendees answered questions similarly, people expect to see the universe that was taught at school. At the same time, answers from participants differed: some people prefer having simulation which is game-based with some action, others – exploration/learning-based platform.

Table 5.11 illustrates our suggested feature for future iterations. In total we proposed 10 features related to learning about the environment, later this list was rated by users. The result can be seen in Table 5.12. As it can be seen, many people prefer "Temperature" and "CO_2 changes" features. The least preferred features are "Sand dunes" and "Eclipse".

Table 5.11 Our proposed features for the next development iterations

Features Questionnaire
1. Temperature: (on Earth view) Temperature changes, what happens in Earth
2. CO_2 changes: (on Earth view) CO2 changes, what happens in Earth
3. Time: (on Earth view) Seeing how cities changed over the time
4. Eclipse: (on Earth view) Eclipse watching feature. How does eclipse appear?
5. Tsunami: (on Earth view) How does tsunami appear?
6. Flood: (on Earth view) How does flood appear?
7. Tornado: (on Earth view) How does tornado appear?
8. Oil spills: (on Earth view) What happens when a lake/see/ocean is being polluted with oil?
9. Sand dunes: (on Earth view) How do sand dunes appear?
10. Deforestation: (on Earth view) What happens when forests are being cut?

Table 5.12 Prioritization of the proposed features results

Indicator	Title	Ramunė	Jaunė	Estepa	Simon	Anne	Average	Rank
1	Temperature	2	1	1	2	1	1.4	1
2	CO_2 changes	5	2	3	3	2	3	2
3	Time	1	6	6	4	3	4	3
4	Eclipse	10	4	9	5	9	7.4	9
5	Tsunami	9	3	4	6	6	5.6	4
6	Flood	8	10	5	1	8	6.4	7
7	Tornado	6	5	7	10	7	7	8
8	Oil spills	3	7	10	7	4	6.2	6
9	Sand dunes	7	8	8	8	10	8.2	10
10	Deforestation	4	9	2	9	5	5.8	5

We also asked people to comment while they were testing the "Odyssey" prototype. Some participants expressed that they would like a different type of music in the background or additional features that have not been implemented yet. Many of those comments showed people preferences, so sometimes not every comment fits our goal. Based on users' comments, we made additional features list (Table 5.13) and a list where can be seen which person would like a new feature (Table 5.14).

Table 5.13 Aggregated features based on users' comments

Aggregated Features
11. Instructions: Instructions on how to use the app.
12. Extreme weather conditions: Show how extreme weather conditions appear.
13. Manipulate environment: Users can manipulate the environment, e.g., cutting trees.
14. Landing animations: When approaching a planet some animation would have performed for better experience
15. Planets' radar: Show positions of planets in some small view (e.g., radar)
16. Planets' attributes explanation: Explain why some planets flies faster or slower because of their mass.
17. Climate change: Show what happens when climate change, e.g., see levels rises, animal migrate etc.

Table 5.14 Aggregated features that were mentioned/found by users

Indicator	Title	Ramunė	Jaunė	Estepa	Simon	Anne	Sum
11	Instructions	yes	yes				2
12	Extreme weather conditions				yes		1
13	Manipulate environment					yes	1
14	Landing animations				yes		1
15	Planets' radar			yes			1
16	Planets' attributes explanation			yes			1
17	Climate change			yes			1

Some people indicated bugs (e.g., usability, functional etc.) such as information panel issues, or difficulties with planets grabbing (list of bugs in Table 5.15 and people who indicated those bugs are in Table 5.16).

Table 5.15 Bugs found by users

Found Bugs
1b. Saturn rings: Saturn rings hides the information box. Also, looking under the Saturn rings, they disappear.
2b. Planets grabbing: Some people had issues with planets grabbing.

Table 5.16 Bugs that were mentioned/found by users

Indicator	Title	Ramunė	Jaunė	Estepa	Simon	Anne	Sum
1b	Saturn rings	yes	yes			yes	3
2b	Planets grabbing	yes	yes		yes		3

5.4.3 Next Iterations

During the Lean Startup methodology, simultaneously with product development and testing, the competition analysis was done for the "Odyssey" product (see Chapter 4). It was clear that if continue focusing on the universe simulator, we might end up with the high competition. That is why we have decided to shift our focus to be on the Earth view simulator.

Having that in mind, we have concluded to come up with a new Lean Startup hypothesis: the on-Earth view with low-resolution graphics is acceptable for the users if the consequential impacts of applied changes are clear. This led us to brainstorm new ideas which also were given to users after 2nd development iteration to hear their feedback.

From the second iteration testing results, it can be seen that users would like to have "Temperature", "CO_2 changes" and "Time" features if the app targets to have a new direction. Below image presents how those three features might look like in future releases.

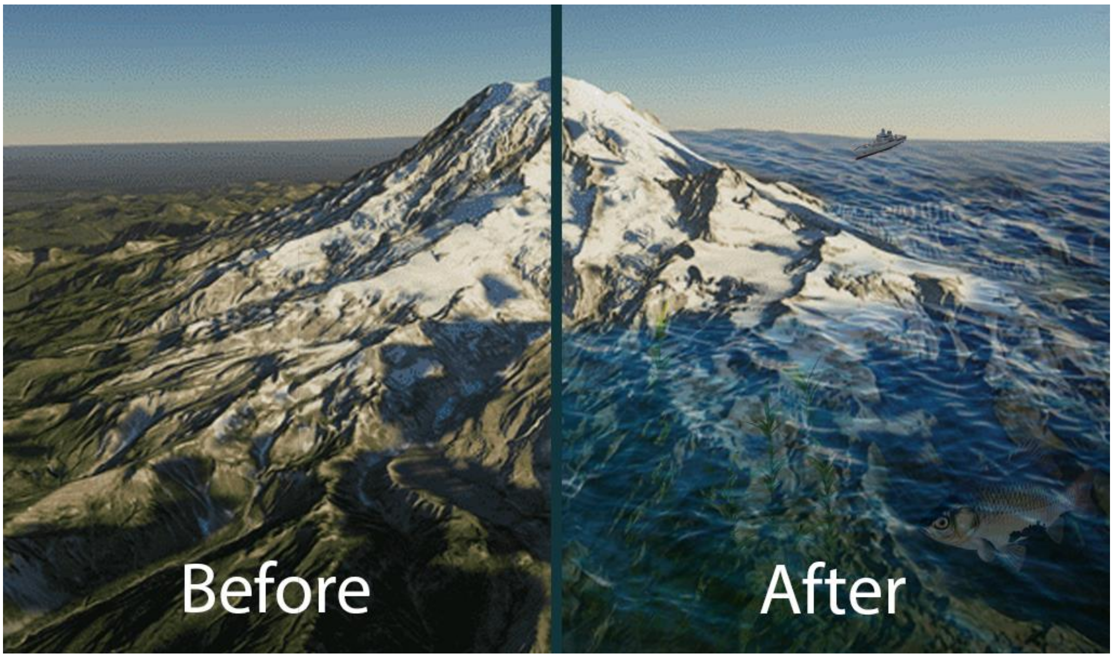

Figure 5.15 "Temperature" feature

Figure 5.16 "CO_2 changes" feature

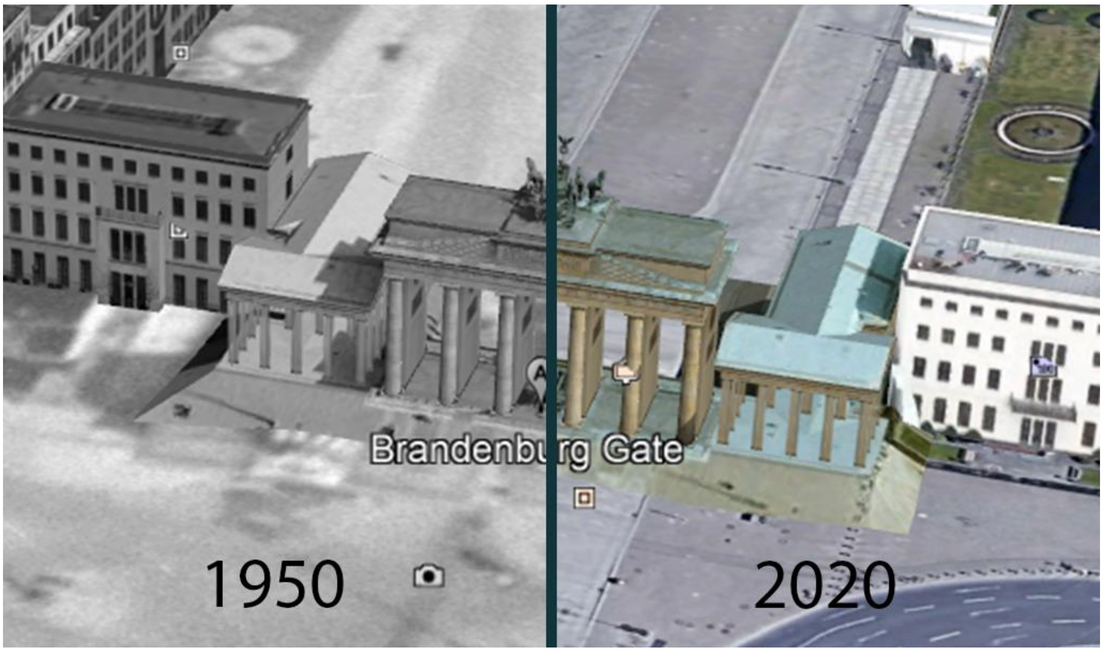

Figure 5.17 "Time" feature

5.4.3.1 Value Proposition

With a new focus on the next iteration (Lean Startup methodology), the value proposition of VRfor.us was changed. The new focus was shifted from a universal simulation of the solar system to a solar system simulation with Earth as the centre of development. More importantly, the on-Earth experience is going to play the most important role in this iteration. In comparison with the prior value proposition, this value proposition of the "Odyssey" differs in terms of the "Gains" mostly, and a small change in the "Pains".

Regarding the “Gains”, since the “Odyssey” now is focus much more on the environmental impacts on Earth, the users will add more to their environmental-wise awareness. And consequently, they will be more comfortable with school subjects with relation to environmental issues.

About the new “Pains” in the value proposition, we go deeper in the global awareness since the scope of the “Odyssey” is now more specific of Earth. One of the pains is no longer “some subject is hard to visualised”, this is now change to “global scale phenomenon is hard to visualised”.

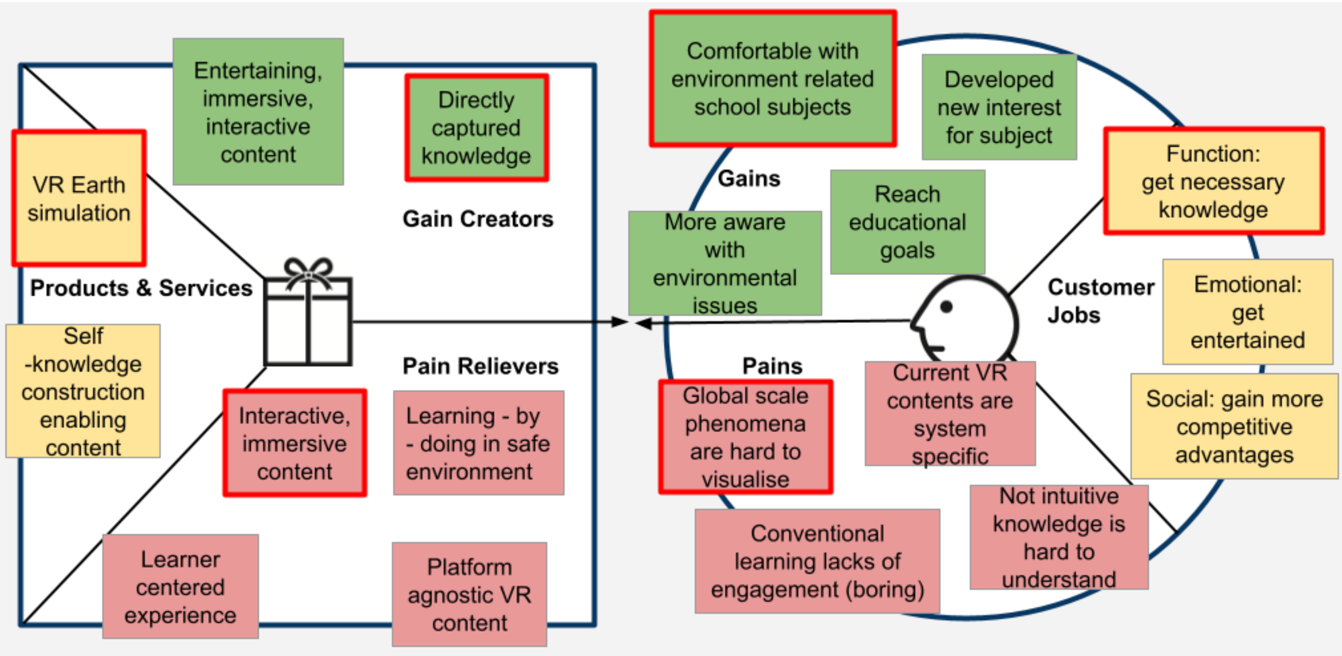

Figure 5.18 Pivoted value proposition canvas of the “Odyssey”

6 Conclusions

In this thesis the research question "How to develop an MVP of the product "Odyssey" for VRfor.us to get a competitive market foothold in the education market?" has been unfolded by answering four work questions: 1) "What is VRfor.us?", 2) "What is the market foothold for VRfor.us?", 3) "What is the competition for VRfor.us?" and 4) "How to develop an MVP of the product "Odyssey" for VRfor.us?".

The first work question regards what VR technology is, how this technology work, what benefits and challenges it provides, how this technology was developed over the years, and VR similar technologies. Basically, VR technology is an environment where a user can interact with digitally generated surroundings. Meanwhile, a virtual reality system is a combination of HMD with or without interactive modalities such as various body sensors, controllers, and sound. The technology itself is based on stereoscopic images when each eye exposed to a slightly different object. Also, since 1965, when VR technology firstly was mentioned, many applications have been developed (e.g., The Sword of Damocles, Oculus etc.). Regarding VR similar technologies, all extended reality technologies might be alternatives to VR because they share some functionalities such as digital construct in real-world scenarios.

The first question was developed further explaining what is "VRfor.us" as an organization, what processes used for creating the product "Odyssey", the company's target group, value proposition, and business model. "VRfor.us" company is planning to have a flat structure because it is best for motivating company members as they share responsibilities. Subsequently, Design Thinking, Lean Startup, and Agile methodologies are used as a process basis of the "Odyssey" product. Design thinking is good to use when prototypes are based on users' feedback and the market, the Lean Startup – when creating MVP based business hypothesis, and the Agile – when developing the product itself. Moreover, a target group of students between 13-20 years is chosen because at this age pupils learn natural science and due to publisher policy can use VR technologies. Moreover, the initial value proposition and business model was proposed before creating and testing our MVP with users.

The second work question "What is the market foothold for VRfor.us?" was unfolded by analysing literature regarding the questions: what is disruptive innovation, why VR technology is disruptive, and what is the market size for the company "VRfor.us"? Disruptive innovation, in general, is a process when an entrant disrupts market dominants by introducing new technology to a niche market which later is adopted by mainstream users. Furthermore, VR technology can be considered disruptive because the technical aspects such as convenience and affordability increasing over time while the cost reduces. Meanwhile, the market size of the serviceable obtainable market for "VRfor.us" is approximately $500M which is shared with its competitors.

In the 3rd work question "What is the competition for VRfor.us?" case, the literature was used to understand what competitor types are, how competing firms can identify their rivals, and how blue ocean strategy can be used to get a competitive advantage. As the used literature suggests there can be three types of competitors: indirect, direct, and potential. Indirect competitors share the same market but provide substitutes, the potential rivals use the same or similar resource but addresses a different market, and direct ones have the same/similar product and target the same market. Moreover, each competitor can have a perspective approach to each rival (e.g., one company sees another company as a rival, but another one does not consider the other company as a competitor). Also, the blue ocean strategy can be used in companies to identify their value criteria, which later can be used to address different market, create new niches, and determine competitive advantage.

The 3rd work question was also unfolded by identifying competition for the "Odyssey" product by analysing the environment and identifying competitors. The environment analysis was done in the use of Porter's five forces and PESTEL tools which help us to identify that the "Odyssey" should address problems regarding climate change because the European Union motivates it by various initiatives including funds. After environment analysis, products in various platforms were searched which run in virtual reality, has universe and/or on-Earth experience, and/or educated people about environmental issues. Also, technical details such as interactivity, entertainment ability to run on many platforms were checked. From the research, it has been seen that "Odyssey" is a potential competitor for at least twelve products. As the blue ocean strategy was done, the "Odyssey" can target to be a leader in educating about environmental issues in Earth, able to run on a browser and be a system-agnostic product.

The last work question "How to develop an MVP of the product "Odyssey" for VRfor.us?" was unfolded by understanding what a minimum viable product is, its types, what is a prototype and what kind of prototype strategies and techniques there are, and what technologies should be used to create MVP of the "Odyssey". The MVP can be seen as products that have just enough features to gather from potential customers with the least effort. There can be at least four prototype strategies, such as horizontal, vertical, task-oriented, scenario-based. In the "Odyssey" case mainly vertical prototypes are used as this product targets to deliver an MVP which not necessarily has to have all the functionality. Furthermore, there can be at least nine types of MVP such as "Explainer video", "Wizard of Oz", "Single feature MVP" etc. "VRfor.us" uses the "Single feature MVP" prototype technique because it represents a real representation of the final product but with selected features. Moreover, VR technologies were researched with prototyping. "Unity" engine, "WebXR" and "ArcGIS Maps" are used or are planned to use in the product.

For fully unfolding the last work question, the "Odyssey" prototype was created leveraging Design Thinking, Lean Startup, and Agile mythologies for reaching the desired result. The project has limitations such as time and resources which resulted in having one Lean Startup iteration and two development rounds in use of the Agile. During the whole project Design Thinking was used for emphasizing, defining, and ideating. Lean Startup is an iterative process used for identifying business hypothesis, which also includes the Agile iterative process for developing the product. Each development round had planning, development, and testing with users' phases. The "Odyssey" was managed to be a universe simulator where the focus was: can "VRfor.us" deliver a VR application?

The project was finalized by proposing features and a value proposition for further product development. The proposal was based on pivoting when the "Odyssey" was decided to be environmental issues-oriented rather than being a universe simulator. Feedback from and considering competitors' analysis was considered. The three main features for the product should be investigated in the future such as "Temperature", "CO2 changes", and "Time" feature. Also, the new value proposition indicated that "VRfor.us" future iterations should focus on the "global scale phenomena are hard to visualise" pain and the "comfortable with environment related school subjects" gain.

6.1 Next Steps

Now, VRfor.us has finished performing 1st Lean Startup iteration which followed up by pivoting the startup idea. The next step would involve testing a new hypothesis that is more related to SDGs and learning about environmental impact.

We, VRfor.us, are planning not to stop just with this thesis, that is why we are planning to establish a company in the upcoming months when the product will get the shape of looking like a product rather than just an MVP. Moreover, the next steps also include finding funds, partners, understanding deeper how VR and games ecosystem work.

With the soon-to-have MVP which aims at teaching knowledge about the environment and Earth in general, we seek to educate young people about the environment and let people be aware of climate change.

Our vision

To raise climate change awareness in society.

Our Mission

To educate people about the causes and effects of climate change using VR technology.

What we will provide is not just a VR application or a game but a canvas in which Earth's complex net of causes and effects will be shown. Through the "Odyssey" we hope that the conscience in people's hearts will be stimulated, and a new generation of climate-aware humans will be nurtured.

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8 Appendix

A User's Questionnaire After 1st Development Iteration

Questionnaire after the first development iteration:

Prior the test
Question P1: How do you image VR can help you to learn about planets and universe? How should it look like?
Question P2: How do you like to learn? How you imagine such learning experience? Should it be narrator or first-hand experience based?
Question P3: In this simulation, our intention is to make it fully interactive, which mean you can do anything you want to the planets, no matter what comes to your mind. What would you do with the planets if you were almighty god?
Question P4: We are about to show you a simulation of our solar system. Our intention is to make it easier for people to understand hard-to-grasp subjects such as geology, geography, astrophysics, etc. by letting people play with planets. What do you expect to see in this solar system simulation?
After the test
Question A1: How do you feel when you are in the simulation?
Question A2: What do you think of planet grabbing?
Question A3: What will you change to make it more convenience?
Question A4: What have you learned after playing with the planets?
Question A5: What is the thing that you like the most?
Question A6: What is the most annoying thing of this simulator?
Question A7: What do you think about moving around like that? Do you want teleporting?
Question A8: From 1 to 5 (1 no dizzy at all and 5 is very dizzy), how dizzy do you feel?
Question A9: Will you introduce it to your friends?
Question A10: What were you missing in the game?
Features Questionnaire
1. On planet selection: A border outside a planet would indicate that the planet is selected/on hover.
2. Ray-casting: Lines going outside the controller.
3. Eclipse: Eclipse watching feature. It can be in two ways: (1st way) watching the eclipse from the planet (e.g., Earth) and (2nd way) from in the space seeing how the moon covers the sun. It would be handy to have a time control feature to go further or back.
4. Flood when moon is being moved: Moving the moon back and forth to see how the moon influences the water in Earth.
5. Time control: Tim control would allow going back and forth in time. In this case, time could indicate the simulation time.
6. Narrator: A voice or text providing specific information about certain planets/actions.
Q1: Prioritize the list
Q2: Which is the best feature? Why?
Q3: Which is the worst feature? Why?
Q4: What is missing?

Questionnaire after the first iteration

Ramunė, age 27

Prior the test
P1: Learning about the universe is difficult to imagine, so VR would give, from the point of view of practice, to take, to touch, how to interact: what material is used, what density, what rain (acid) (what chemistry testifies is the narrator, and how it interacts is the person himself)
P2: Some introduction would help to get started, after that, a person should explore by him/herself.
P3: Firstly, I would everything destroy, then everything to build. I imagine the universe working in the zoom in / zoom out principle. The most important thing would be the choice in this simulation, our intention is to make it fully interactive, which mean you can do anything you want to the planets, no matter what comes to your mind. What would you do with the planets if you were almighty god?

P4: Space, planets, flying comets, where you can control the time at which angle light falls on the earth, how physics works, how chemistry works
Comments during testing
Is it possible to compress a planet? It's hard to grab the planets. Missing controller guidance It would be nice to have space dust. There is a lack of planetary interaction, such as sun is melting planets on interaction.
After the test
A1: It was interesting to touch the planets, and also how they interact.
A2: Lack of instruction, Z axis button keeps pressed (annoying)
A3: Faster / slower movement space, higher and lower, lack of zoom in zoom out
A4: This app more reminded planets and their arrangement
A5: Space, environment, I liked cubed menu sad that I couldn't grab them, liked that the planets are different
A6: That grabbing worked bad (I could not grab them properly), or I start moving to Z axis when I want to grab the planet. After playing with planets, there are no available planets, so reset button would be nice to have.
A7: It would be nice to have teleporting button when you are away from sun (something like in Half Life Alyx)
A8: Universe scene 1/5, menu scene 4/5 (very dizzy)
A9: Yes, if it would be easy to setup and would be free
A10: Variations, more choices, more things to do, it would be fun if you could play a game when you are teleported to a planet, a person should guess which planet it is
Features Questionnaire
Q1: Prioritize the list
1: 1
2: 3
3: 5
4: 6
5: 4
6: 1
Q2: Because not everything is taught through intuition, you need facts
Q3: Flood, because it is as clear as the menu influences, but children might want to get to know each other
Q4: Zoom in zoom out, more interaction, sun is melting planets

Jaunė, age 20

Prior the test
P1: Can help the student more easily understand what is going on, what is happening in space in coma, explore planets, how it rotates, trajectory, properties
P2: Mix, like big bang theory, it should be and narrator depending on the situation
P3: The game should give hints so as not to distort the learning itself. A star of destruction as a black hole appears
P4: Entering space, there will be planets, you can get closer to the planets, various tools for creating planets
Comments during testing
The portal is not very clear, it needs to be redesigned. Wanting to take a menu, sometimes hard to pick up, Saturn flowers should be dusty, maybe some zoom, it would be good to have more stars, it would be strange not to see anything under your feet, maybe you would need some kind of carpet, it would be fun to get to the planet. A faster flight (teleport) is needed.
After the test
A1: It felt interesting, fun to enter another space.
A2: Fun to drop a planet, and then it comes back somehow, because after that it's hard to find out where it is.
A3: I would put a board under my feet, put a star, and something in space is going on, like meteorites flying, a star exploding. As you approach the planet to see the planet in more detail

A4: I would like a narrator to have someone say what would happen here.
A5: That you can fly where you want, that you can take the planets, that you can see them up close (you want to be bigger)
A6: Get used to gliding, not finding planets, after throwing
A7: This fit, but teleportation would be between planets
A8: 1/5 menu scene, 4/5 simulation at the beginning
A9: Yes, but I wanted sound, I wanted pre-resistors
A10: Sound, no legs, stars, narrator
Features Questionnaire
Q1: Prioritize the list
1: 3
2: 6
3: 1
4: 4
5: 5
6: 2
Q2: Because it is quite difficult to imagine solar eclipses
Q3: Others were just more interesting
Q4: Teleportation, sighting of planetary surfaces, stars, comets, satellites, sound

Emilija, age 19

Prior the test
P1: To be able to view planets live, understand the differences in planet sizes
P2: When learning, and somebody explains something, it can be not understandable but when you do with hands, it can help to understand it
P3: Existing facts used, tasks like planets. One could show how they can be destroyed
P4: Get inside the planet
Comments during testing
It's hard to figure out where to go, nice colors, you need a faster flight, it would be fun to throw planets at each other and watch them explode. Or, as you would fly out of a planet to see what it was made up of. Also, it would be fun to return to their place on the planet, it would be so easy to get lost, to see information about the planets when the flew to the planet.
After the test
A1: Very interesting, completely different environment, it is fun that can be seen through VR goggles
A2: It is fun that can be taken but shaking too much seem to get stuck
A3: Faster movement / teleportation, dropping the planet and its fall, once you fly to the planet, you could read about it, the music would also be nice to have
A4: The arrangement of the planets, their speed. The apartment is a fan narrator, videos when the planets collide
A5: Most liked the variety of colours that the stars were, plus the beautiful planets
A6: That you slowly chase, that you don't go back to the planet
A7: Yes
A8: 2/5 menu scene, it seems the legs are not, and unsafe, so 4/5 in space, then getting used to
A9: Yes, that you are in space
A10: Everything was said before
Features Questionnaire
Q1: Prioritize the list
1: 5
2: 6
3: 1

4: 2
5: 4
6: 3
Q2: From the ground it is difficult to see who is insisting, and in space it would be interesting to see what it looks like
Q3: Because they are more interesting, not very necessary
Q4: Music (calm), speed, and information about the planet

B 2nd Development Iteration Planning

Questionnaire Features						
Indicator	**Title**	**Description**	**Rank (1 is the most need, 6 is the least needed)**	**Difficulty**	**Decision**	**Status**
1	On planet selection	A border outside a planet would indicate that the planet is selected/on hover.	3	medium	yes	**done**
2	Ray-casting	Lines going outside the controller.	6	easy	yes	**done**
3	Eclipse	Eclipse watching feature. It can be in two ways: (1st way) watching the eclipse from the planet (e.g., Earth) and (2nd way) from in the space seeing how the moon covers the sun. It would be handy to have a time control feature to go further or back.	2	hard		
4	Flood when moon is being moved	Moving the moon back and forth to see how the moon influences the water in Earth.	4	medium/hard		
5	Time control	Tim control would allow going back and forth in time. In this case, time could indicate the simulation time.	5	medium/hard		
6	Narrator	A voice or text providing specific information about certain planets/actions.	1	medium		
Proposed Features						
Indicator	**Title**	**Description**	**Rank (3 is the most need, 1 is the least needed)**	**Difficulty**	**Decision**	**Status**
7	Music	Play background music.	2	easy/medium	yes	**done**
8	Visit planet	Visit planet from inside	2	medium/hard		
9	Teleporting / faster pace	Make either faster walking or teleporting	3	easy/medium	yes	**done**
10	Zoom in / out	Zoom in and zoom out the solar system	2	medium/hard	yes	**todo**
11	Sun melts planets	When a planet touches the sun, it starts melting	1	medium/hard		
12	Ground under the feet	Some people felt strange not to see ground	1	easy	yes	**done**
13	Planets reset position after they have been moved	After planets are being moved from their spaces, bring them back.	2	easy/medium	yes	**done**
14	More stars	Add more starts, e.g., milky way	2	easy/medium		
15	Add comets	Add comets	2	easy/medium		
16	Add satellites	Add satellites	1	easy/medium		
17	Sighting of planetary surfaces	Whan planets are being watched from nearby, allow user to see some details of that planet.	2	hard		
18	See what kind of chemical elements planets contains	See information about planets' chemical structure.	2	medium/hard		

19	Hints giving	The app should give hints to not distort learning.	1	medium/hard		
20	Planet's creation tool	Planet's creation tool for a user	1	medium		
21	Information about planets	Provide information about the planets.	2	medium	yes	**done**
22	Guess the planet game	When a person is teleported into a random planet, she/he has to guess which planet it is.	1	hard		
Additional Features						
Indicator	**Title**	**Description**			**Decision**	**Status**
23	*Planets explosion*	*Planets explode on collision.*		medium/hard		
24	*Planets spinning*	*Plannets spinning*		easy	yes	**Done**
Bugs						
Indicator	**Title**	**Description**	**Rank**	**Difficulty**	**Decision**	**Status**
1b	Planets grabbing	Hard to grab planets.	2	medium	yes	**done**
2b	Z-axis control	Many people had problems with controlling Z-axis.	1	medium	yes	**done**
3b	Doors	Many people failed to find entrance to the simulation	3	easy	yes	**done**
4b	Easy to get lost in space	It is easy to get lost when exploring space.	1	medium/hard		
5b	Missing instructions	Missing instructions how to use the app.	1	medium		

C User's Questionnaire After 2nd Development Iteration

Questionnaire after the second development iteration:

If the first-time testing the app
Question P1: How do you image VR can help you to learn about planets and universe? How should it look like?
Question P2: How do you like to learn? How you imagine such learning experience? Should it be narrator or first-hand experience based?
Question P3: In this simulation, our intention is to make it fully interactive, which mean you can do anything you want to the planets, no matter what comes to your mind. What would you do with the planets if you were almighty god?
Question P4: We are about to show you a simulation of our solar system. Our intention is to make it easier for people to understand hard-to-grasp subjects such as geology, geography, astrophysics, etc. by letting people play with planets. What do you expect to see in this solar system simulation?
Normal sequence
Question A1: How do you feel when you are in the simulation?
Question A2: What do you think of planet grabbing?
Question A3: What will you change to make it more convenience?
Question A4: What have you learned after playing with the planets?
Question A5: What is the thing that you like the most?
Question A6: What is the most annoying thing of this simulator?
Question A7: What do you think about moving around like that? Do you want teleporting?
Question A8: From 1 to 5 (1 no dizzy at all and 5 is very dizzy), how dizzy do you feel?
Question A9: Will you introduce it to your friends?
Question A10: What were you missing in the game?
Features Questionnaire
F1: On Earth view: Temperature changes, what happens in Earth

F2: On Earth view: CO2 changes, what happens in Earth
F3: On Earth view: Time feature - seeing how cities changed over the time
F4: On Earth view: Eclipse - how does eclipse appear?
F5: On Earth view: How does tsunami appear?
F6: On Earth view: How does flood appear?
F7: On Earth view: How does tornado appear?
F8: On Earth view: What happens when a lake/see/ocean is being polluted with oil?
F9: On Earth view: How sands are being created?
F10: On Earth view: What happens when forests are being cut?
Q1: Prioritize the list
Q2: Which is the best feature? Why?
Q3: Which is the worst feature? Why?
Q4: What is missing?

Ramunė, age 27

Comments during testing
It was very dizzy in the intro scene for some reason. We need to have introduction how to control. I struggle with the control. It would be nice that some planets would have gas (atmosphere). It would be nice, if a person approached the planet, the planet stops moving. I am really missing instructions. Music it very nice, it would be better to have more funky music. I would like to have trajectories for planets. This time is better because it has better control and more features. Music should be more explorative. Also, Saturn rings overlays on the info and sometime the rings disappear
Normal sequence
A1: It feel immersive, you want to test thing out. Also, there felt I was at night
A2: For me I struggled, some guidance would be nice
A3: Don't know
A4: Some information about planets, such as the length of day
A5: Cosmos background, and that you can explore/go around
A6: Controlling because it took time to understand
A7: Fast moving is enough
A8: In the intro 4/5, universe 1/5
A9: Yes
A10: More interaction between planets
Features Questionnaire
F1: 2
F2: 5
F3: 1
F4: 10
F5: 9
F6: 8
F7: 6
F8: 3
F9: 7
F10: 4

Jaunė, age 20

Comments during testing
It is nice that there is a music. Sometimes it is hard to read information (e.g., Sun). It is very nice that I can move faster. Saturn info text is on Saturn rings. When moving Earth, moon stays for some reason.
Normal sequence
A1: I felt good, in the begging it was a bit dizzy in the universe. I like the music
A2: It was quite hard to use. It has to be with some goal, grabbing alone is not necessary. It feels that is not necessary without any interaction. I liked that it was a very nice feeling in the simulation. I was missing stars.
A3: Grabbing (it might be not necessary), may ray-casting would be better than grabbing. Planets spinning should be more realistic and adjusted. I could not see text near Sun
A4: I learned some info about the planets (e.g., length of day)
A5: I liked that I feel that is in the space, quite realistic
A6: Hard to grab, and sometimes I would like to find where the planets went
A7: Fast pace enough. But maybe it would be better if I select Earth, I want to teleport near Earth
A8: Intro 1/5, Universe 3/5
A9: Yes
A10: Action, object (stars, satellites)
Features Questionnaire
F1: 1
F2: 2
F3: 6
F4: 4
F5: 3
F6: 10
F7: 5
F8: 7
F9: 8
F10: 9

Estepa, age 29

If the first-time testing the app
P1: It can help to knowing the actual position of the planets and their relative location between each other. The software should let you navigate through the universe deciding a priori the velocity of that trip.
P2: I am better learning graphically than using different ways. First-hand experience
P3: Destroy the planets and check the effects on the rest of them. Also, having the possibility of accelerating the time and the behaviour of the planets in a long term.
P4: I expect not seeing only the planets but also the rest of the components of the solar system. Also, the movements of the planets.
Comments during testing
Nice to have a body. It would be nice to have a gun to shoot planets. I need faster moving function.
Normal sequence
A1: Actually, I felt that I was totally immersed on the game, just thinking about what I could do during the game and not about the time that I was spending on it.
A2: It is a funny idea but when you throw it to crash with another planet the interaction is a little bit boring It was quite hard to use. It has to be with some goal, grabbing alone is not necessary. It feels that is not necessary without any interaction. I liked that it was a very nice feeling in the simulation. I was missing stars.
A3: Make more complex the interaction between them when they are crashing. The mass is already implemented and some of them they are heavier, but I think that this thing about making more difficult to throw one because is more heavier does not help, for instance, you need someone to explain to you why you cannot grab easily the sun because the size between it and the rest is more less the same.

A4: Some interesting data about gravity of some planets.
A5: I think that the idea of grabbing the planets is quite fun.
A6: When you throw the planet and you cannot take it again, especially when you throw it downward.
A7:
A8:
A9: Yes, I will
A10: Maybe some small tab or radar for checking where are the planet once they have been moved from their original position. Like in FIFA when you have a small navigation panel on the bottom of the screen with the position of all the players
Features Questionnaire
F1: 1
F2: 3
F3: 6
F4: 9
F5: 4
F6: 5
F7: 7
F8: 10
F9: 8
F10: 2
Q2: It is quite interesting to see the consequences of temperature change especially link to climate change.
Q3: As I said, the pollution is something more local whose consequences are more evident in live organisms.

Simon, age 25

If the first-time testing the app
P1: The perspective can help to understand the dimensions. Also, the travel between objects can be fun, like flying with a rocket.
P2: It should be mostly an experience of exploration, but a lot of things to discover everywhere for a longer motivation.
P3: Push them around, change their orbit and speed, shoot them in heavy elliptical orbits, crash them into each other and watch the debris find its orbit, push them into the sun
P4: Planets, maybe alien
Comments during testing
Nice if can see from inside the planet. Relative position of between the solar system and the milky way is wrong. you should see a diagonal line of stars representing the milky way. Get me a spaceship already. Could be a bad ass flight simulator. If you make the Cockpit of the spaceship the user may not feel that motion sick when flying freely. To travel, give me a jetpack to fly freely. Good landing animations when going on the planet really would make it a fluent experience. Maybe give the used some moments, where a person can feel when the floor is missing. Not many as some may not enjoy it, but it can give a little rollercoaster kick. Also, it has to be in a VR space simulation to be remembered.
Normal sequence
A1: Feels good, naturally, responsive, and easy to adapt.
A2: Gets boring quire fast. Also, they start vibrating while running. What can you do with them except throwing them into nothing? It should be fun to push them to other orbits and explore what will happen
A3: *convenient. Change it from a 2d experience to flying around freely.
A4: Mars has a lot less gravity than Earth, even though they have the same size
A5: Fisting planets into nowhere
A6: When you dropped one planet out of the level, you can't get it back and you will have to reset
A7: Movement is a bit slow. Nah, faster would be fine. Maybe just add a button to sprint
A8: 1
A9:

A10: Longer motivation. Something to explore that keeps the attention.
Features Questionnaire
F1: 2
F2: 3
F3: 4
F4: 5
F5: 6
F6: 1
F7: 10
F8: 7
F9: 8
F10: 9
Q2: I would say the space related ones, I don't really see the reason for the environment aspects yet.
Q3: Tornados? Why? Just show me that the weather gets more extreme when the temperature increases.
Q4: The reason why these should be in a space simulation.

Anne, age 25

If the first-time testing the app
P1: I am a visual learner, so I think for people whose learning type is more visual this would be a very valuable tool for learning and teaching. Furthermore, when it comes to learning about the planet and universe these things can become quiet abstract, therefor visualising it for the students will help make it more tangible and thereby more understandable.
P2: As mentioned in the question before, I am a visual learner. But I also learn really well with hands-on methods. So, a combination of narration, hands on and visual I think would be a good combination.
P3: I would make them thrive. I would do my best to make the world as healthy as possible. But for the sake of learning I think VR is a great way to illustrate the bad outcomes as well. To make it more tangible for people to see the effect of their actions.
P4: I expect to see out planets, possible to be able to interact with them and go closer to understand how it looks up closely. It would be cool if it were possible to on Earth to dive into different cultures and maybe see different scenes from cultures or people’s lives.
Comments during testing
Anne tried to turn herself upside down to look at the solar system in reverse view. The frequent comment she has is how big and scary it is to be in the universe. When the music is turn off that feeling is stronger. She notices Jupiter’s moon is missing and the unusual scale of Earth.
Normal sequence
A1: I felt comfortable, but also in awe. It was super impressive, but also a bit intimidating being in the black abyss of space. But it was intrigue, and it was very immersive.
A2: I liked that feature! It was fun to throw them around. But it would have been cool if when grabbing them something happened. Like being able to enter the planet and see the surface or something similar.
A3: I think it was super convenient and immersive. So, I would not change much - just build more cool features in.
A4: I have a better understanding of the "location" of the planets, where they are in relation to the sun. It was very visual and made an intangible subject more understandable because I was able to see it for "real".
A5: I generally loved it! It was such an interesting experience. I loved the visuality of it. It was both beautiful and a good learning experience.
A6: Not much really - maybe that the info sign on Saturn was hard to see because its rings were on top of the sign. Or that the sun was very bright to look at. Okay maybe one thing actually - I didn’t like how the controller made the jump turns. Like on the right hand when trying to turn it made jumps instead of a smooth motion.
A7: I like the teleporting from the starting position through the doorway - that was pretty cool! would maybe have been good to have a sign over in case you have more places to teleport to.
A8: No, I did not feel dizzy at all - I rather enjoyed it.
A9: Oh yes! Especially if I had the VR at home
A10: More interaction with the planets - like being able to " visit" them

Features Questionnaire
F1: 1
F2: 2
F3: 3
F4: 9
F5: 6
F6: 8
F7: 7
F8: 4
F9: 10
F10: 5
Q4: I would be cool if the user were able to manipulate the environments themselves. Like cutting down the forest to see what happens, or raise the CO_2 levels.